

Study on modalities for the use of new technologies and digitalisation to facilitate the implementation and enforcement of rules on animal welfare during transport

Study on digital modalities of Animal Welfare during transport

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Directorate-General for Health & Food Safety
Directorate G — Crisis preparedness in food, animals and plants
Unit G.3 — Animal Welfare

E-mail: SANTE-CONSULT-G3@ec.europa.eu

*European Commission
B-1049 Brussels*

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Acronyms and abbreviations

	Definition
API	Application Programming Interface
AWT	Animal Welfare during Transport
AJL	Animal Journey Log
BPMN	Business Process Model & Notation
CCA	Central Competent Authority
CDN	Content Delivery Network
UN/CEFACT	United Nations Centre for Trade Facilitation and Electronic Business
DG SANTE	Directorate-General for Health and Food Safety - The European Commission department responsible for EU policy on food safety and health.
ECMRWF	European Centre for Medium Range Weather Forecast
EFSA	European Food Safety Authority
eIDAS	Electronic Identification, Authentication and Trust Services – EU Regulation (EU) No 910/2014 on electronic transactions.
GNSS	Global Navigation Satellite System - A system used for real-time geolocation tracking of animal transport vehicles.
HADEA	European Health and Digital Executive Agency.
LCA	Local Competent Authority
LAU	Local Authority Unit (synonym of LCA)
MS	Member States of the European Union.
MSCA	Member State Competent Authority
PM²	The European Commission's Project Management methodology.
RCA	Regional Competent Authority
THETIS	The Hybrid European Targeting and Inspection Information System, supporting the Port State Control Directive.
TRACES	Trade Control and Expert System – The European Commission's online platform for animal and plant health certification.
IOT Sensors	IoT Sensors are devices that collect and transmit environmental data over the Internet, working as fundamental components of the Internet of Things (IoT) ecosystem. These sensors are equipped with communication technologies to monitor several parameters such as temperature, humidity, light, and motion in real-time.
UI	User Interface
VIN	Vehicle Identification Number

Related Documents

This final report synthesises a series of deliverables that together constitute the *Study on modalities for the use of new technologies and digitalisation to facilitate the implementation and enforcement of rules on animal welfare during transport*. (short name Study on digital modalities of Animal Welfare during transport).

Reference	Definition
D02.01.01	TRACES Report
D02.01.02	Consultation Report
D02.01.02	Consultation Report - Annexes
D03.01	Market Analysis Report
D03.02	Positioning System Design Report
D04.01	TRACES Recommendations Report
D04.02	Mobile Application Outline Report

The main study deliverables and their relations are depicted below:

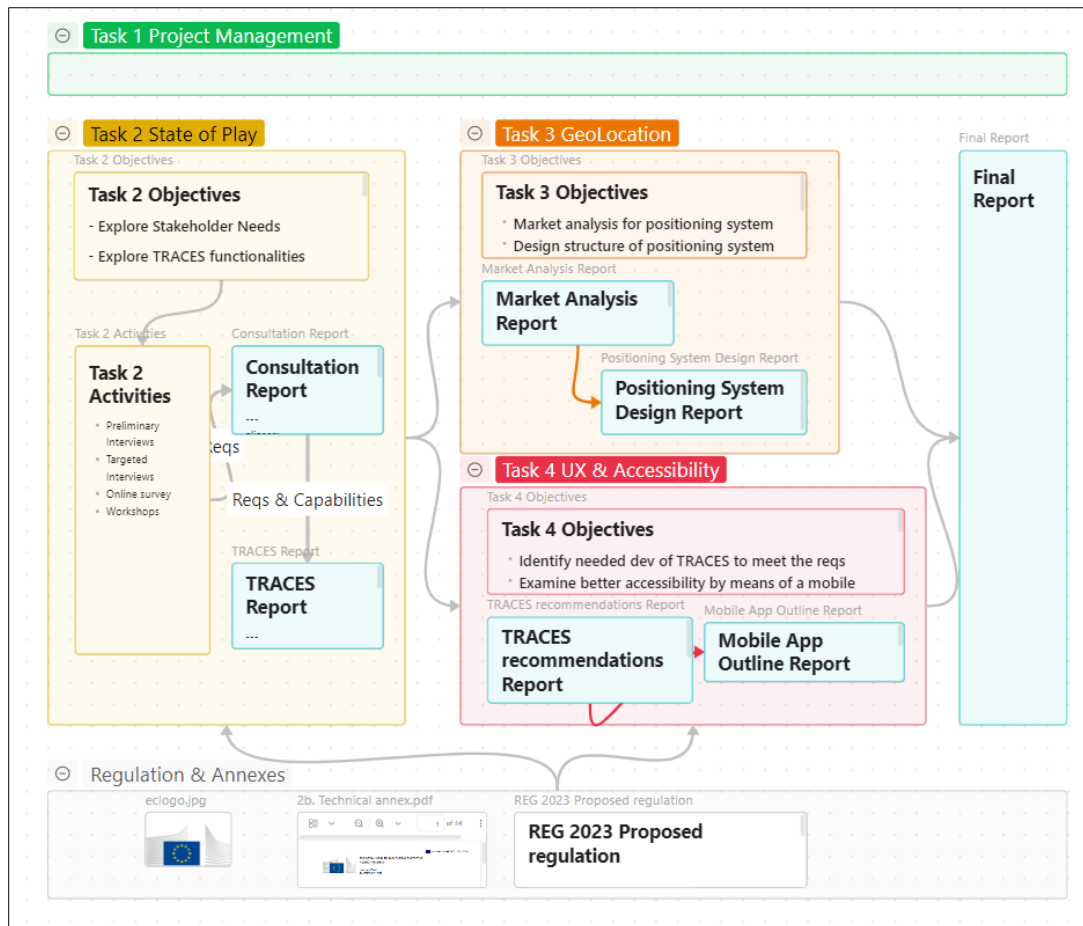


Figure 1 Overview of the study deliverables

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1 Executive Summary

Introduction and Context

The European Commission, operating through the EU4Health and Single Market Programme and under the authority of the European Health and Digital Executive Agency (HaDEA), has launched a comprehensive study to support the revision of EU legislation concerning animal welfare during transport. The current framework, rooted in Regulation (EC) No 1/2005, relies heavily on paper-based Animal Journey Logs (AJLs) and manual reporting, causing delayed compliance checks, high administrative burdens, and fragmented enforcement across the Union. To rectify these systemic inefficiencies, the European Commission's newly proposed Regulation (COM(2023)770) envisions an enhanced, fully digital ecosystem. This executive summary synthesizes the findings of six core deliverables that collectively analyse the "as-is" state of play and define a robust "to-be" architecture centred around the Trade Control and Expert System (TRACES)¹, real-time geolocation tracking, and mobile accessibility.

Consultation Insights and Stakeholder Needs

The foundation of the proposed digital improvements stems from an extensive consultation process that involved Member State Competent Authorities (MSCAs), industry stakeholders, transporters, and European institutions. Stakeholder feedback highlighted the inherent tension between elevating animal welfare standards and preserving the economic viability of the transport sector. MSCAs highlighted severe enforcement challenges related to climatic constraints, geographical variations, and species-specific regulatory differences. Both authorities and operators expressed a unified demand for an end-to-end digital ecosystem that minimizes redundant data entry. For operators, the transition to digital systems promises harmonized rules and simplified procedures. For MSCAs, a centralized digital platform would act as a single source of truth, reducing the duplication of data entry, improving data reliability, and enabling faster and more consistent official controls.

Implementation in TRACES and Process Automation

Amongst other things, TRACES serves as the EU's central IT platform for managing veterinary certificates, and storing authorisations related to live animal transport. TRACES has been accommodating the creation of journey logs (AJL) based on Regulation 01/2005 on a voluntary basis. However, to date, AJLs completed in TRACES must be printed and physically stamped to be legally valid. Under the proposed Regulation, TRACES will act as the digital backbone enforcing mandatory digital journey logs. This study outlines TRACES improvement recommendations to automate or streamline multiple processes for different stakeholder groups. Key enhancements include the centralized issuing and storage of transporter approvals, vehicle authorisations, and certificates of competence, which eliminates the repeated submission of documents for each transport. This process should be facilitated, where needed,

¹ https://food.ec.europa.eu/horizontal-topics/traces_en

by the use of interoperability solutions. TRACES could integrate new process engines to decouple document management from task management, thereby enhancing flexibility and allowing for task-based collaboration between actors. Furthermore, a dedicated configurable Business Rule Engine could help automate compliance validations, enabling authorities to apply harmonized control rules automatically. TRACES should also integrate with external platforms, such as meteorological data platforms and geo-routing APIs, to facilitate planning and documentation by accessing itinerary calculations and weather forecast features directly in the AJL.

Geolocation and Positioning System Design

A critical pillar of the proposed Regulation is the real-time positioning and geolocation tracking of consignments. The market analysis and positioning system design reports highlight the necessity of balancing tracking requirements with data minimization and system scalability. Whether the geolocation data collection is performed by the Commission or another party, standard real-time tracking at the highest frequency generates massive data volumes that are too impacting for data transmission, storage, and processing inside TRACES and are not strictly necessary for AWT compliance. Consequently, an event-based tracking architecture managed through a Geolocation Intermediary Service (GIS) is proposed. The system should collect location data at 15-minute intervals, and use virtual geographic boundaries around key locations, such as departure points, border crossings, resting posts, and final destinations. TRACES would only receive the exact times a vehicle enters and leaves these specific checkpoints, stored in the AJL. This gives inspectors the evidence they need, such as verifying if a journey took too long or if mandatory rest stops were taken, without tracking the driver/attendant's every move. To collect this data, two complementary scenarios are identified. It advises that systems propose the possibility to provide Fleet Management System (FMS) collected data, as this is the most automated and comfortable solution for operators, alongside smartphone app integration where this is not feasible. Finally, the study team suggests making the full dataset available to authorities if a vehicle deviates from its declared route.

Mobile Application for Accessibility and Enforcement

To bridge the gap between administrative systems and field operations, the draft regulation commits the Commission to delivering a mobile application for use by transport operators and competent authorities. Digital tools such as a mobile application linked to TRACES facilitate official controls, improve record-keeping, and simplify the planning and execution of transport journeys. Designed for driver/attendants, keepers, and official veterinarians, the mobile app ensures real-time access to crucial information in the AJL with offline mode and data synchronization patterns to account for varying network connectivity during transit. The application replaces manual paperwork with digital forms corresponding to the five sections of the AJL (Planning, Departure, Destination, Transporter Declaration, and Anomaly Report). Advanced built-in features include tools for the calculation of required space allowances for different species. Furthermore, additional features not included in the regulation proposal are considered, such as a real-time messaging module equipped with a built-in automatic

translation engine, and the upload of pictures and videos to assist operators who wish to document their loading and unloading.

Cost Estimates and Financial Feasibility

The proposed digital interventions present varying financial implications, which were carefully considered to ensure feasibility. The integration of geolocation data utilizes a mix of scenarios to optimize development costs. Leveraging the mobile application for GNSS data collection and syncing with established Fleet Management Systems (FMS) avoids mandating massive new hardware expenditures for Economic Operators, particularly smaller transport companies, while utilizing their existing infrastructure. Furthermore, implementing the GIS broker architecture limits server, infrastructure, and long-term storage costs for the European Commission by preventing TRACES from being overwhelmed by high-frequency data, ensuring high performance without exorbitant cloud processing fees. Financial estimates for the key components of the proposed solution are provided in section 5.3.

Conclusion

The commissioned study delivers a comprehensive blueprint for the digital transformation of animal transport administration. By shifting from a voluntary system to a mandatory digital ecosystem anchored by TRACES, introducing an event-based Geolocation Intermediary Service, and deploying a robust mobile application, the proposed framework cuts administrative overhead. It guarantees a single source of truth, enabling continuous data harmonization, automated compliance monitoring, and consistent enforcement. Ultimately, these integrated digital solutions provide practical tools that safeguard the economic interests of transporters while advancing the protection and welfare of animals during transport across the European Union.

2 Introduction & Context

The protection of live animals during transport is a complex regulatory, logistical, and ethical domain that sits at the intersection of veterinary science, internal market economics, and public administration. Over the past two decades, the European Union has maintained robust legal frameworks aimed at ensuring high standards of animal welfare. However, the administrative and operational mechanisms used to enforce these standards have increasingly lagged-behind modern technological capabilities. This section provides a comprehensive exposition of the current state of play, the structural vulnerabilities of the existing regulatory framework, the push for comprehensive legislative modernization, and how this study provides the foundational technical architecture necessary to realize the objectives of the proposed regulation.

2.1 Regulation (EC) No 1/2005 and its Structural Vulnerabilities

The current legal framework governing the transport of live animals within the European Union is established by **Council Regulation (EC) No 1/2005**² on the protection of animals during transport and related operations. Enacted over twenty years ago, this regulation was groundbreaking at the time of its inception, establishing foundational principles regarding journey times, resting periods, space allowances, and vehicle standards. However, the operational reality of enforcing this regulation is currently hindered by its reliance on paper-based administrative workflows.

At the core of the current enforcement system under Regulation 1/2005 is the **Animal Journey Log (AJL)**. For long journeys (exceeding eight hours) involving certain species (cattle, sheep, pigs, goats, and unregistered equidae), the AJL is the primary document used to plan, track, and verify compliance. Historically and predominantly, the AJL operates as a physical, paper-bound document consisting of five distinct sections:

1. **Section 1: Planning:** Completed by the organizer, detailing the intended route, estimated travel times, and scheduled resting stops at approved Control Posts.
2. **Section 2: Place of Departure:** Completed by the keeper at the place of departure and, where required, stamped by an Official Veterinarian.
3. **Section 3: Place of Destination:** Completed by the keeper at the destination or by an Official Veterinarian at a border control post, confirming the arrival and state of the animals.
4. **Section 4: Declaration by Transporter:** Completed by the driver/attendants during the journey, detailing the actual itinerary, resting times, and any deviations from the planned route.

² [COUNCIL REGULATION \(EC\) No 1/2005 of 22 December 2004 on the protection of animals during transport and related operations and amending Directives 64/432/EEC and 93/119/EC and Regulation \(EC\) No 1255/97](#)

5. **Section 5: Anomaly Report:** Used to report any irregularities or welfare issues observed during the transport.

The lifecycle of this paper document involves extensive manual filling, physical stamping, scanning, and emailing between Economic Operators (EOs) and Member State Competent Authorities (MSCAs). This heavy reliance on analogue workflows has generated several critical, systemic vulnerabilities that undermine the efficacy of the regulation.

Retrospective and Reactive Enforcement

Because the AJL is a physical document traveling with the driver/attendant, authorities at the place of departure or at centralized MSCA offices often only receive the completed, fully executed log days or even weeks after a journey has concluded. Consequently, enforcement is almost entirely retrospective. Authorities are forced to audit past events rather than monitor ongoing operations. If a transporter encounters severe delays, extreme and unforeseen weather conditions, or is forced to skip a mandatory resting stop at a Control Post, the authorities are entirely blind to these infractions as they occur. This reactive paradigm makes it impossible to intervene during a journey to alleviate animal suffering, relegating enforcement to post-facto administrative penalties.

Severe Administrative Burden and Data Fragmentation

For Economic Operators, the current system is characterized by redundant, time-consuming data entry. Transporters are frequently forced to manually input identical datasets (vehicle registration details, driver/attendants' certification numbers, animal headcounts) across disparate national IT systems or onto multiple physical forms. Furthermore, because the ultimate compliance data is often trapped in scanned PDF documents or physical paper files rather than machine-readable digital formats, it is impossible for MSCAs or the European Commission to easily aggregate statistics, perform automated risk profiling, or analyse cross-border transport trends. The fragmentation of data severely hampers evidence-based policymaking and targeted enforcement.

Vulnerability to Fraud and Document Manipulation

Paper documents are inherently susceptible to loss, degradation, and intentional falsification. The manual alteration of timestamps in Section 4 (Declaration by Transporter) to conceal excessive driving hours or insufficient resting periods is a known vulnerability within the current framework. So is the submission of forged Transporter authorisations. Verifying the authenticity of physical stamps and signatures across borders is a laborious process that further slows down official controls and undermines the integrity of the traceability chain.

2.2 Proposal COM(2023)770 and digitalization

Limitations of Regulation 1/2005 have been extensively documented by various stakeholders, including the European Court of Auditors (ECA), the European Food Safety Authority (EFSA), the European parliament Research Service (EPRS) and numerous animal welfare non-governmental

organizations. In response to these critiques the European Commission recognized that incremental adjustments to the current framework would be insufficient.

Consequently, the Commission introduced **Proposal (COM(2023)770)**³. This proposed legislation does not only update welfare parameters (such as minimum space allowances or temperature thresholds); it also reimagines the administrative and technological mechanisms of enforcement.

The central tenet of this proposed regulation is the transition from a fragmented, paper-bound regulatory environment to a **fully digitized, interconnected, and real-time ecosystem**.

2.3 Main Digital Improvements Envisioned by the Proposal

To bridge the gap between regulatory intent and operational reality, COM(2023)770 mandates several transformative digital improvements, which form the core focus of this study:

2.3.1 Mandatory Digital Journey Logs via TRACES

While the Trade Control and Expert System (TRACES) has historically accommodated the creation of digital journey logs on a strictly voluntary basis, the new proposal makes the digital AJL mandatory for all long journeys. TRACES is envisioned to become the central, authoritative data hub for all animal transport operations within the Union. By transitioning to a digital format, the proposal aims to eliminate delays, illegibility, and data fragmentation inherent to paper journey logs.

2.3.2 Centralized Digital Certification and the "Once-Only" Principle

The proposal mandates the digitization and centralized storage of all prerequisite authorizations. This includes Transporter Authorizations (Type I and Type II), Certificates of Competence for drivers/attendants, and Vehicle Approval Certificates. By maintaining a centralized, constantly updated registry of these authorizations, approvals and certificates within TRACES, the system can automatically cross-reference a proposed journey log against the validity of the operator's licenses, noticeably reducing the administrative burden of document submission and evaluation for every single trip.

2.3.3 Geolocation Tracking (Positioning System)

One of the most ambitious and technically demanding requirements of the new proposal is the mandate for recording the positioning of transport vehicles and transmitting to TRACES certain specific information. To shift from retrospective checking to proactive enforcement, authorities must possess the capability to verify journey duration, and compliance with mandatory rest stops at approved Control Posts as the journey unfolds. This requirement necessitates a secure, pan-European telematics infrastructure capable of ingesting and processing location data without compromising the commercial sensitivities or privacy of the operators.

³ [Proposal for a Regulation of the European Parliament and of the Council on the protection of animals during transport and related operations \(COM\(2023\)770\)](#)

2.3.4 Field Accessibility and Mobile Technology

Article 53 of the draft regulation explicitly commits the Commission to delivering a dedicated mobile application for use by transport operators, driver/attendants, and competent authorities. Recognizing that transport operations occur on highways, rural roads, and border crossings, far removed from administrative offices, the proposal envisions a mobile interface that allows real-time interaction with TRACES, enabling immediate reporting, dynamic itinerary updates, and on-the-spot compliance checks.

2.4 Overview of Study Deliverables

To facilitate the legislative process and ensure that the ambitious digital mandates of COM(2023)770 are technically viable, economically feasible, and operationally sound, a comprehensive, multi-disciplinary study was commissioned. Executed under the EU4Health and Single Market Programme, this study systematically mapped the "as-is" (i.e. status quo description) landscape and describes the "to-be" technical architecture. Outputs of this study are divided into six core deliverables, each addressing a specific facet of the digital transformation:

Deliverable D02.01.01: TRACES Report

This report provides a rigorous "as-is" technical and functional assessment of current TRACES capabilities in relation to the above-mentioned documents (AJL, Transporter authorizations, etc). It analyses the existing voluntary journey log module, maps the current data flows, and identifies systemic gaps between the platform's current capabilities and the requirements of the new proposed regulation. It serves as the baseline upon which all future enhancements are designed.

Deliverable D02.01.02: Consultation Report

This report provides a qualitative and quantitative synthesis of extensive stakeholder consultations. Capturing the operational pain points and user requirements from over 40 structured interviews and broad surveys with private Economic Operators, Member State Competent Authorities, and animal welfare NGOs, this deliverable ensures that the proposed technical architecture is grounded in the operational realities of the European transport sector.

Deliverable D03.01: Market Analysis Report

To address the mandate for real-time tracking, this deliverable evaluates the current state of Global Navigation Satellite System (GNSS) technologies and commercial telematics. It assesses the market availability, cost structures, and technical feasibility of various hardware and software solutions, ranging from simple smartphone applications to leveraging existing Fleet Management Systems (FMS) and considering dedicated On-Board Units (OBUs), ensuring that the geolocation mandate does not impose disproportionate financial burdens on small and medium-sized transport enterprises.

Deliverable D03.02: Positioning System Design

Building upon the market analysis, this deliverable constitutes a technical blueprint for a secure, scalable, and privacy-compliant geolocation architecture. It proposes the establishment of a "Geolocation Intermediary Service" (GIS), a sophisticated data broker system. The GIS stores high frequency GPS tracks but only transmits critical "events" (e.g., arrival at a control post, departure from a place of departure) to TRACES, balancing the need for strict enforcement with data minimization principles. High frequency tracks are only to be sent to TRACES in cases of deviation from the planned journey, facilitating controls.

Deliverable D04.01: TRACES Improvements Recommendations

This document specifies requirements for implementing the digital AJL, integrated with weather and geo-routing data. It details the centralization of authorization and certificate records in TRACES, considering interoperability with national systems. Additionally, it identifies future user experience improvements, including real-time notifications, advanced risk analysis modules and support for voluntary submission of video and image files.

Deliverable D04.02: Mobile Application Outline

This deliverable maps highly specific user journeys for driver/attendants, keepers, and competent authorities, providing a working prototype. Crucially, it defines offline data synchronization protocols to guarantee functionality in areas with poor cellular network coverage, and specifies built-in welfare tools, such as dynamic space calculators, assistants for the assessment of fitness for transport and automated, multi-lingual translation engines to facilitate cross-border inspections.

3 Methodology

The methodology of this study was strictly predicated on capturing a holistic, view of the "as-is" landscape to accurately engineer the "to-be" technical architecture.

To manage this, the study team adopted a phased requirement-gathering methodology anchored by three primary sources of data: expert knowledge, bibliography/desktop research, and extensive, structured stakeholder consultations.

3.1 Sources of Data

The foundation for translating abstract legislative goals into actionable IT requirements was built upon a triangulated approach to data collection.

Bibliography and Desktop Research

The first phase involved a rigorous preliminary analysis of existing regulatory texts and technical documentation. This included a deep-dive review of the current Regulation (EC) No 1/2005, the newly Proposed Regulation COM(2023)770, and TRACES technical annexes. Crucially, the desktop research also integrated external, authoritative perspectives to understand historical systemic failures. This involved analysing reports published by the European Court of Auditors (ECA) regarding the enforcement of animal transport laws, scientific opinions issued by the European Food Safety Authority (EFSA), and investigative reports from various pan-European animal welfare Non-Governmental Organizations (NGOs).

Expert Knowledge and Preliminary Interviews

To align the technical design with overarching policy objectives, the project team engaged heavily with institutional experts. Preliminary interviews were conducted with key directorates and agencies within the European Commission, including DG SANTE (Animal Welfare and Official Controls units), DG MOVE (Maritime Safety), and the European Maritime Safety Agency (EMSA). These expert consultations provided critical insights into the current possibilities of existing digital platforms and established the strategic boundaries for future interoperability.

Stakeholder Consultation Mechanisms

The most critical pillar of the methodology was direct engagement with end-users. The consultation process was designed to extract both strategic business requirements and granular functional needs. This was achieved through a cascading sequence of consultation techniques:

1. **Online Survey:** A comprehensive questionnaire alternating between quantitative data collection and open-ended, context-specific inquiries was published on the EU Commission survey platform, targeted exclusively at national authorities.
2. **Targeted Interviews:** One-hour, highly structured interviews were conducted with selected authorities and private operators to delve deeper into survey responses and map specific operational pain points.

3. **Validation Workshops:** Following the synthesis of the initial data, two dedicated, full-day remote workshops were held to cross-examine, validate, and consolidate the gathered requirements before translating them into technical specifications.

3.2 Stakeholder Participation and Geographical Representation

A primary challenge of the consultation phase was ensuring a proportional, representative sample that accurately reflected the diverse realities of the European internal market. Transporting unweaned calves through the alpine passes of Austria presents vastly different logistical and regulatory challenges than exporting livestock via maritime vessels from Spain or Ireland. Consequently, strict attention was paid to geographic and sectorial balance.

Member State Competent Authorities (MSCAs)

The engagement of national authorities, the primary enforcers of the regulation, consisted in:

- **Survey:** 26 different MSCAs provided detailed responses to the initial online survey, ensuring almost total coverage of the European Union's regulatory landscape.
- **Interviews:** Based on the survey data, 12 MSCAs were selected for targeted, follow-up interviews to explore specific national constraints, local IT architectures, and best practices.
- **Workshops:** Finally, 19 MSCA representatives participated in the dedicated validation workshop, actively shaping the final requirements traceability matrix.

Economic Operators and Private Stakeholders

To ensure the proposed digital tools would be commercially viable and user-friendly for the private sector, the study team engaged a broad spectrum of Economic Operators.

- **National Operators:** 18 individual national operators agreed to participate in deep-dive interviews. These operators were carefully selected to guarantee a wide geographical spread, representing Eastern, Western, Northern, and Southern European logistical realities.
- **Pan-European Associations:** To capture macro-level industry trends, 5 major pan-European operators' associations were interviewed.
- **Sectorial Representation:** Because the supply chain of live animal transport is highly fragmented, the study team ensured that all links in the chain were consulted. The sectorial breakdown of the interviewed private operators was meticulously balanced: Transporters represented the largest share (31%), followed closely by Farmers/Breeders (26%), Control Post Operators (22%), Slaughterhouse Managers (17%), and Private Veterinarians (4%).

Private operators who participated in the interview phase were subsequently invited to a dedicated Operators' Workshop to validate the proposed digital functionalities.

3.3 Main Insights: Regulatory Shortcomings and Digital Aspirations

The exhaustive consultation process yielded highly converging insights from both authorities and operators. While their motivations differed, MSCAs focusing on enforcement and animal welfare, and operators focusing on economic sustainability and efficiency, both groups unanimously agreed that the administrative mechanics of Regulation 1/2005 need reshaping, and both shared a common vision for the digital future.

3.3.1 What is Wrong with Regulation 1/2005?

Enforcement Bottlenecks (MSCA Perspective)

For national authorities, the primary concern with 1/2005 is outdated requirements for physical, signed journey logs to be completed and returned retrospectively. Authorities detailed how this creates an insurmountable bottleneck. For example, during the interviews, some MS authorities highlighted that driver/attendants typically drop off physical logs at port offices. These paper logs must then be manually relayed to regional offices, and eventually to the certifying official veterinarians. This chain of custody means that reports of a journey often take more than a month to reach the appropriate enforcing officials.

Furthermore, MSCAs pointed out that under the current regime, satellite navigation (satnav) and GPS data follow a completely different administrative route than the paper logs. Authorities are forced to manually request GPS extracts from transporters weeks after a journey, making the correlation of the two datasets (the planned paper itinerary versus the actual digital route) difficult and labour-intensive.

Administrative Burden and Unfair Competition (Operator Perspective)

From the perspective of Economic Operators, the current execution of 1/2005 is characterized by redundant, administrative burdens. Operators highlighted the constant need for "double keying" of data, being forced to manually enter identical vehicle approval numbers and driver/attendant certifications into TRACES, national databases, and physical paper forms for every single journey.

Stakeholders reported that the current paper-based system facilitates systemic non-compliance. Because manual audits are often delayed or inconsistent across Member States, rule-breakers can bypass mandatory rest periods with little risk of immediate sanction. This creates a "race to the bottom" where compliant operators face higher costs and lower volumes. This issue is particularly acute for Control Post operators, who see their business diverted to non-compliant routes, undermining both the economic stability of the sector and the integrity of EU welfare standards.

3.3.2 Stakeholder Wishes for Digitalization

MSCA Digitalization Wishes: Proactive Enforcement

Authorities demanded a shift from retrospective checks (reactive approach) to proactive enforcement (preventive approach), focused on data integration and automation:

- **End-to-End Digitalization:** MSCAs want a single, unified digital environment. They require the elimination of parallel Excel spreadsheets and postal delays, moving to a system where all journey logs are digitally signed and instantly accessible by relevant authorities in the EU.
- **Real-Time Geolocation and Geofencing:** Authorities explicitly requested automated GPS tracking to replace the manual collection of satnav data. By placing a digital perimeter around key locations along the journey, the system can automatically log the timestamp a truck enters and exits the perimeter, providing automated proof that a mandatory rest period was respected.
- **Centralized Weather Integration:** To prevent animals from being transported under extreme temperatures, MSCAs requested TRACES integrates meteorological forecast data directly within the planning section of the AJL. They want a "single source of truth" for weather forecasts to eliminate ongoing disputes with transporters over which weather app is most accurate, automatically flagging itineraries where temperatures are expected to exceed legal limits.
- **Field-Optimised Mobile Tools:** MSCAs insisted on intuitive, mobile-first applications designed for real-world conditions to improve usability and accessibility for operators involved in a journey, including in rural and low-connectivity areas.
- **Meaningful Data usage:** Authorities consistently pointed to the need for data systems that are not only capable of storing information but can also turn it into useful insight. Access to both real-time and historical data should support planning and help prevent welfare violations before they occur.

Operator Digitalization Wishes: Streamlining and Accessibility

While operators supported the push for better enforcement to ensure a level playing field, their primary digitalization wishes centred on usability, accessibility, and the reduction of friction:

- **The Mobile Application:** Just like for MSCAs, the usability dimension is a core concern of economic operators. Transporters require a tool that allows driver/attendants to easily fill out Section 4 of the journey log (the transporter declaration) directly from the road. Recognizing the realities of transport logistics, they stressed that this application must have offline capabilities to function in remote areas without cellular service, automatically syncing data once a connection is restored.
- **End-to-End Digitalization:** Operators perceive the digitalization of the journey log as an opportunity to reduce administrative burden by allowing for quick detection of possible oversights which may lead to non-compliant plannings and decision making support capabilities.
- **The "Once-Only" Principle:** Operators strongly requested that TRACES act as a central repository for their authorizations, approvals and certificates. Once a transporter authorization or a vehicle approval certificate is uploaded and validated in the system, it should be automatically available to all future journey logs without requiring manual re-entry or re-uploading.

- **Integrated Booking System:** Operators, particularly those managing complex long-distance routes, expressed a strong desire for a digital booking system for Control Posts. Being able to secure a resting reservation and automatically link that confirmed booking to their digital journey log within TRACES would vastly simplify their logistical planning.
- **Automated Rule Calculators:** Finally, to combat the issue of divergent national interpretations, operators requested that the new digital system feature built-in, automated business rules. They want TRACES and the mobile app to automatically calculate required space allowances, stocking densities, and journey duration limits based on the specific species and vehicle type, ensuring they face the exact same objective compliance standards across all Member States.

4 Digital Solutions

The objective of the proposed legislative modernization is to construct an interconnected digital ecosystem that removes the friction of manual paperwork while increasing the efficacy of official controls. Achieving this requires a holistic architectural approach. The following subsections details the core digital solutions proposed by the study team, beginning with upgrades to TRACES, continuing through the integration of advanced geolocation networks, and concluding with the deployment of field-ready mobile technologies.

4.1 Implementation in TRACES

Under the proposed regulation COM(2023)770, TRACES is designated to serve as the mandatory, central digital backbone for all administrative processes related to animal welfare during transport.

Based on the "as-is" analysis (Deliverable D02.01.01) and the functional recommendations (Deliverable D04.01), the following structural changes are required.

4.1.1 The Animal Journey Log (AJL): What is There and What Changes

What is There

Currently, TRACES includes a Journey Log module developed to support Regulation 1/2005. However, its use by Member States is entirely voluntary. Where it is used, it primarily functions as a digital typewriter, a mechanism to generate a standardized PDF that must still be printed, physically stamped, and manually circulated.

The existing module replicates the five paper sections of the paper AJL into digital text fields. While it facilitates and streamlines some data entry, primarily importing data from associated health certificates and checking against TRACES reference data, its capacity to assist with rule implementation is currently limited. Furthermore, the existing module currently does not support the display of external, dynamic data sources, meaning critical variables like upcoming weather conditions must be verified manually by operators and inspectors on third-party websites before a journey is approved.

What Changes

Under the new framework, the existing AJL module in TRACES transitions from a voluntary PDF generator into a mandatory, structured, and interactive module. To facilitate this, a redesign of the AJL workflow, transforming it from a static document into a dynamic "task-based" process, is proposed.

- **Decoupling Document and Task Management:** Currently, the entire document must be printed, stamped and passed between actors. With the digitalisation of the journey log, the system would generate specific tasks for specific users at specific times. For instance, when the "Planning" section is completed by the organizer, the system automatically generates a "Validate Departure" task specifically routed to the dashboard of the MSCA located at the departure point.

- **Integration of a Business Rule Engine (BRE):** To ensure harmonized enforcement across all Member States, TRACES could be equipped with a robust, highly configurable Business Rule Engine. This engine would validate the data entered into the digital AJL against regulatory thresholds. This would entail advantages such as allowing organisers and transporters to get an automatic estimation of the number of animals per category and species they can load, streamlining their journey planning and decreasing mistakes. Alternatively, the administrative burden of official controls would also be decreased as, instead of having an authority manually calculate if a truck has enough square meterage for 500 sheep, the authority can contrast the number of animals against the volumes estimated by the BRE..
- **External Interoperability for Predictive Welfare (Weather and Routing):** To allow the organiser and the competent authority to take account of the weather forecast at the time of planning, the new AJL module would be directly integrated via Application Programming Interfaces (APIs) with weather forecasting solutions and geo-routing services. While the proposal requires Member States to define a national source of truth for weather data (one per member state) the study team recommends using a single one (such as the European Centre for Medium-Range Weather Forecasts, OpenWeather, Google Weather or Meteo Blue). During the "Planning" phase, the system could automatically calculate the expected temperature at each stage of the journey based on the inputted route and timeframe. If the forecasted temperature creates a risk of exceeding internal vehicle temperature limits, the system can automatically flag this to the organiser. This facilitates adapting the planning when necessary. After submission, similar automatic flags can be generated for the competent authorities.
- **Integration of a control post booking module:** To facilitate planning activities, the AJL interface will allow organisers to search for control posts located on or close to the route they are planning, view availability, submit reservation requests and receive notifications from control post owners regarding the booking.

4.1.2 Certificates and Authorizations: What is There and What Changes

A critical pain point identified during the stakeholder consultations was the administrative burden associated with verifying the approvals, authorisations and certificates of transport operators. Ensuring that only qualified driver/attendants and appropriately designed vehicles handle live animals is essential to welfare.

What is There

Under the current framework, and as stipulated in article 45 of the IMSOC Regulation⁴, Member State competent authorities manually complete in TRACES reference data relating to transporter authorizations, driver/attendant certificates of competence and certificates of approval of means of transport. However, as TRACES is not the authoritative system for the management of these certificates and authorizations, this currently creates a duplication of data entry, reducing

⁴ [COMMISSION IMPLEMENTING REGULATION \(EU\) 2019/1715 of 30 September 2019 laying down rules for the functioning of the information management system for official controls and its system components \('the IMSOC Regulation'\)](#)

the timeliness and quality of the records and constituting an administrative burden for authorities. Regarding driver/attendants, their details are recorded in TRACES as a static record which limits their capacity to interact with the journey log.

Additionally, as TRACES is not connected to the national systems where certificate and authorization requests are filed and processed, there is currently no automatic way for an authority to verify whether a specific request has already been submitted and is being processed in a different member state.

What Changes

The study team recommends transitioning to a fully centralized, digitized registry of entities and certificates, approvals and authorizations within TRACES, deeply rooted in the "Once-Only Principle."

- **Structured Digital Credentials:** Certificates, approvals and authorizations could exist in TRACES as structured digital entities with clear parameters (for example, Expiry Date: YYYY-MM-DD; Approved Species: Bovine, etc). This also applies to driver/attendants, which shall possess their own individual profiles in TRACES similarly to operators, allowing them to be assigned to specific journey logs and giving them access to the features in the mobile application.
- **Automated Cross-Referencing:** When a transporter initiates a new digital AJL and selects a specific vehicle and driver/attendants from their pre-registered profile, the TRACES Business Rule Engine should instantaneously cross-reference those entities. If the transporter is only approved for pigs, but the AJL indicates cattle, the system would instantly flag this to the organiser. Similarly, if any authorization, certificate or approval expires before the journey's scheduled end date, this would be automatically flagged and could potentially block submission of the non-compliant AJL.
- **Interoperability with Member State Systems:** At present, each EU Member State operates its own independent national database for issuing and revoking certificates. Because there is no centralised system, authorities struggle to verify the validity of these documents efficiently, creating opportunities for fraud. The most effective solution would be to use TRACES to issue and centrally store these authorizations, approvals and certificates, allowing for instant verification. However, to accommodate for specific Member States which may wish to maintain their national databases, the development of robust, two-way interoperability gateways (APIs) is recommended. These gateways allow national IT systems to automatically "push" certification data (issuances, renewals, and revocations) directly into the TRACES central registry in real-time. If a Member State revokes a transporter's license in their national database due to repeated welfare violations, that revocation is instantly mirrored in TRACES, immediately preventing that operator from initiating cross-border transports in the EU. The analysis of existing TRACES NT Webservices shows that it should be possible to leverage the existing Operator Directory services to carry this out. While the study could not estimate interoperability costs for Member States, due to the diversity of national systems,

Member States that already have operational webservices linked to TRACES would logically face lower integration costs.

4.1.3 Other Features: Multimedia and In-System Collaboration

Beyond the improvements to the AJL and authorization/certification modules, the consultation phase of the study (Deliverable D02.01.02) generated several user-driven feature requests that have been incorporated into the TRACES improvement recommendations report to enhance real-world usability and evidentiary gathering.

Integration of Multimedia Evidence (Photos and Videos)

A recurring need expressed by both enforcement authorities and operators (such as slaughterhouse managers) was the inability to properly document the condition of animals upon departure and arrival. Under 01/2005, text descriptions in Section 3 (Destination) or Section 5 (Anomaly Report) often fail to capture the severity of a welfare violation, leading to prolonged disputes between transporters, keepers and authorities. The proposal foresees a revised Section 2 and Section 3 which would allow driver/attendants and keepers to sign a declaration on the fitness of animals being loaded or unloaded.

In case of disagreement or conflicting declarations, the upgraded TRACES architecture, in tandem with the Mobile Application, could support the secure uploading, storage, and contextual linking of multimedia files. Operators and authorities performing a control would then be able to upload time-stamped, geolocated photographs and short videos directly to the specific digital AJL. Whether documenting overcrowded compartments, injured animals, or poor ventilation systems, this feature could help provide objective visual evidence that remains attached to the AJL. This would provide objective evidence to authorities seeking to determine the responsibility of different actors in a case of non-compliance, reducing court cases and providing a more level-playing field for good operators.

To avoid surcharging TRACES with bandwidth and processing requirements, using “object storage technology” from European Object Storage cloud vendors⁵ is advised. This solution has been identified as being both cost-effective and compliant with data protection requirements.

Enhanced In-System Collaboration and Messaging

Currently, when an AJL contains an error, or there is an unforeseen circumstance during the journey, operators must resolve the issue outside the system, typically via fragmented email chains or phone calls, before taking action. In order to streamline this communication and overcome language barriers inherent to transnational transportation of live animals, the new proposed feature introduces an in- mobile app real time chat messaging module.

Additionally, it is proposed that a feature to allow authorities to leave localized comments directly within the draft AJL is implemented (e.g., flagging a specific rest stop as insufficient). It establishes a traceable, internal threads linked directly to the specific journey, allowing

⁵ [European Object Storage | Secure & Scalable S3 Providers](#)

operators to quickly correct minor planning errors without restarting the entire complex application process. This drastically approval turnaround times while maintaining a perfect, auditable trail of all communications and modifications. It's worth noting that similar capacities already exist in other modules of TRACES (such as the in the Establishment Amendments Lists).

4.2 Geolocation and Positioning System Design

Historically, verifying that a transporter adhered to approved routes, respected maximum journey times, and took mandatory rest stops relied entirely on retrospective, paper-based checks or the downloading of navigation data weeks after a journey concluded.

To transition from this reactive model to a proactive enforcement model, the proposed digital ecosystem must incorporate a robust positioning system. However, continuously tracking thousands of commercial vehicles across Europe presents significant technical, financial, and privacy challenges. Deliverables D03.01 (Market Analysis) and D03.02 (Positioning System Design) systematically address these challenges to propose a balanced, cost-effective, and legally compliant architecture.

4.2.1 Market Analysis: Choosing the Right Tools for Data Collection

The first critical question the study addressed was how to physically capture location data from trucks in the field. The market analysis evaluated the existing landscape of Global Navigation Satellite Systems (GNSS) and telecommunication networks. It confirmed that modern satellite constellations (such as Europe's Galileo, alongside GPS and GLONASS) and cellular networks (4G/5G) provide more than sufficient coverage and accuracy for tracking live animal transports across the EU and neighbouring regions.

The greater challenge lies in the hardware. Transport operators in the EU range from massive, multi-national logistics corporations to small, family-owned farms moving livestock occasionally. Mandating a single, expensive piece of tracking hardware for everyone would disproportionately harm small businesses. Therefore, the study analysed four potential equipment scenarios:

1. **Scenario 1: The Smartphone Application.** Using a dedicated app on a driver/attendant's smartphone (or a company-provided mobile-device) utilizes hardware that is already widely available. It is highly cost-effective and allows driver/attendants to easily capture other data. However, it relies heavily on the driver/attendants remembering to activate it and ensuring the phone remains charged. This scenario, being the one where fraud is the easiest, should thus be reserved exclusively for smaller transporters which do not already own vehicles equipped with a FMS.
2. **Scenario 2: Fleet Management Systems (FMS).** Most medium and large professional transport companies have already invested heavily in sophisticated FMS platforms built directly into their trucks to monitor fuel, engine health, and driver/attendants' hours. These systems operate automatically without driver/attendants' intervention and buffer data if the truck drives out of cellular range.

3. **Scenario 3: Integrated Manufacturer Devices.** Utilizing the native, built-in dashboard computers of modern trucks. While highly reliable, this option is currently limited to specific, newer truck models and lacks universal market compatibility.
4. **Scenario 4: Dedicated On-Board Units (OBUs).** Mandating the installation of a brand-new, dedicated tracking box specifically for animal welfare. While this guarantees a uniform standard and allows the sensor to be placed directly in the trailer with the animals, it is by far the most expensive option. Estimates suggest this could cost operators hundreds of euros per vehicle annually.

Hybrid Model To maximize coverage while minimizing economic shock to the transport sector, the study team strongly advises against forcing the entire industry to purchase dedicated OBUs. Instead, it recommends a hybrid approach combining Scenarios 1 and 2.

Smaller operators and independent farmers can fulfil their tracking obligations simply by using the free official smartphone application considered in this study. Meanwhile, larger professional fleets can seamlessly link their existing Fleet Management Systems to the European authorities via automated data bridges (APIs). This strategy leverages existing commercial investments, prevents redundant technology mandates, and ensures that the rules are enforceable across all tiers of the transport industry.

4.2.2 The Risk of Data Overload and the Need for a "Middleman"

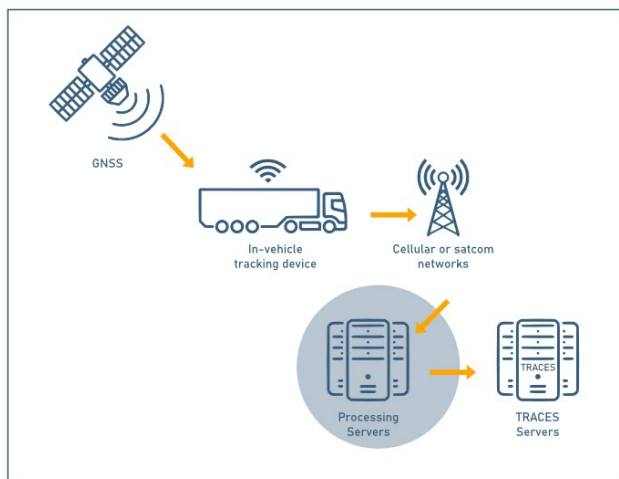


Figure 2 Geolocation Intermediary Service

While smartphone or truck FMS data must be shared with authorities, recording second-by-second GPS tracking, like a consumer navigation app, is unworkable. Tracking just 10,000 journeys at one ping per second would generate over 720 million data points annually, forcing the European Commission to invest heavily in infrastructure, driving up costs and crippling TRACES' performance for essential tasks. Beyond the technical and financial burdens, such continuous surveillance would also violate GDPR, creating privacy risks for driver/attendants.

Instead, a smarter, selective approach, such as only recording key events in TRACES, while storing and processing a data set with higher resolution in a Geolocation Intermediary Service (GIS), would balance compliance needs with practicality, cost-efficiency, and data protection.

4.2.3 Geofencing: Translating GPS Dots into Compliance Events

The core function of the GIS middleman is to translate raw GPS coordinates into meaningful regulatory information. The GIS achieves this through **Geofencing**. A geofence is a virtual,

geographic perimeter drawn around a specific physical location of interest, such as a departure farm, a port, or an approved Control Post where animals must be rested.



Figure 3 Geofencing

As the GIS receives location updates from a truck, it constantly compares the truck's coordinates against a catalogue of official geofences provided by TRACES. When a truck's digital dot crosses into one of these virtual perimeters, the GIS recognizes this spatial intersection.

To prevent false alarms, such as a truck merely driving past a Control Post on the highway without stopping, the geofencing engine employs two critical safeguards:

- **Dwell Time:** The system requires the vehicle to remain inside the virtual perimeter for a minimum duration (e.g., 30 minutes) before registering it as an official arrival.
- **Hysteresis Band:** A buffer zone around the perimeter ensures that minor inaccuracies in the GPS signal do not cause the system to falsely report that a truck is rapidly entering and exiting the location.

D03.02 Positioning system design provides specific considerations and recommendations to set these values in the Annexes. Once the GIS confirms a legitimate arrival or departure at a checkpoint, it generates a simple, lightweight "Compliance Event". This single event, essentially a timestamp, a location name, and a journey ID, is the only piece of tracking information that is forwarded to TRACES.

Handling "Blind Spots": Ferries and Tunnels The design also account for real-world logistical challenges, such as maritime transport. When a livestock truck boards a Roll-on/Roll-off (Ro-Ro) ferry, it loses cellular and GPS signals. Rather than triggering a "missing vehicle" alarm, the GIS detects the entry into the port geofence and places the journey into an "Estimated transit via ferry" status. Once the truck disembarks and reconnects to the network, tracking resumes normally, ensuring smooth multi-modal monitoring without penalizing operators for natural network blackouts.

Deviations from the declared journey: Since the number of geolocation points collected at the end of the journey should be limited to the key geofenced locations, it would not be possible to see the actual route that a transport followed between two key locations of the journey, only the key locations that were visited. If more granularity is required to analyse the deviations from the planned journey, it is possible to import the full list of geolocation events collected during the trip (at 15-minute intervals) into TRACES and display it on the map for authority review. As such, two recommendations are made: clear rules should be set to recognize what constitutes a real deviation from the journey, and MSCA users should be provided a functionality to request the full dataset for specific audit needs.

All this data can automatically populate Section 4 of the animal journey log, decreasing the burden of completing the transporter declaration in compliant journeys.

4.2.4 Privacy by Design and Data Governance

By decoupling continuous tracking from TRACES, the proposed architecture fundamentally respects the principle of data minimization and "Privacy by Design".

Pseudonymization of Vehicles Before the Geolocation Integration System (GIS) forwards a compliance event to TRACES, it passes the data through a dedicated Pseudonymization Service. Direct identifiers are cryptographically masked. TRACES only receives a pseudonymized code linked to the specific Journey Log, ensuring that clear-text identities of driver/attendants and commercial assets are not unnecessarily exposed across the wider administrative network.

Verification status of events To help inspectors quickly verify transport compliance, the GIS automatically labels each journey event with a clear status before sending it to TRACES. These labels include: *Confirmed* (when there's definitive proof of arrival/departure, e.g., GPS logs), *Estimated* (when gaps in signal, such as in tunnels or on ferries, force the system to infer timing based on nearby data and schedules), and *Needs review* (for ambiguous or suspicious cases, where inspectors can request a detailed evidence packs consisting of additional data points around the geofenced location, from the intermediary system). To reduce unnecessary workload, the GIS first filters and scores data quality, ensuring only genuinely unclear case are flagged for manual checks. In TRACES, inspectors see a simple timeline view of each journey, showing event statuses and checkpoint names at a glance.

4.3 Mobile Application for Accessibility and Enforcement

Context and Policy Objectives

In the explanatory memorandum of the Proposed Regulation 2023, digitalization is identified as an essential enabler for better implementation and enforcement of the new rules. To bridge the gap between centralized administrative IT systems and the physical reality of the road, Article 53 of the draft regulation explicitly requires the Commission to deliver a dedicated mobile application for use by transport operators and competent authorities.

This tool reflects a policy objective to modernize administrative processes and fully leverage digital technologies in support of animal welfare. The application acts as a critical, field-ready extension of TRACES, facilitating official controls, improving record-keeping, and simplifying the execution of transport journeys.

Mandated vs. Optional Capabilities

The legislative proposal sets a baseline of minimum capabilities that the application must provide. These include the creation and updating of journey log sections by registered TRACES users, the submission of journey logs for approval to competent authorities, built-in tools to support the assessment of animal fitness for transport, automated calculation of required space

allowances for different species, and the integration of weather forecasts to support decision-making on transport conditions.

However, the extensive stakeholder consultation phase identified additional capabilities that, while not explicitly mandated by the regulation, would be useful for operational success and usability. These enhancements include an in-app chat functionality equipped with automatic translation to overcome language barriers, robust offline synchronization modes, and the ability to capture and securely upload multimedia files (photos and videos) as voluntary evidence during inspections or unloading.

Customer Journey Mapping: A User-Centric Design

To ensure the mobile application is not merely functional but highly usable in the high-pressure environment of live animal transport, a system architecture was designed using a "Customer Journey" methodology. This approach maps the distinct end-to-end experiences of four primary personas:

1. **The Organiser:** The entity responsible for planning, scheduling, and managing the trip from a logistical perspective.
2. **The Driver/Attendant:** The personnel responsible for actively attending to the animals during transport.
3. **The Keeper:** The persons responsible for the animals at the place of departure, at control posts, and at the final place of destination.
4. **The Official Veterinarian:** The authority responsible for conducting welfare checks, verifying documentation linked to journey logs, and reviewing anomaly reports.

By visualizing these journeys, the application is designed to streamline overlaps. For instance, it identifies when information must seamlessly pass from the Organiser's planning dashboard to the driver/attendants' mobile device, ensuring an intuitive transition of responsibility at every stage of the transport.

Prototype testing with real representatives of transporter companies confirmed the usability of the designed mobile application.

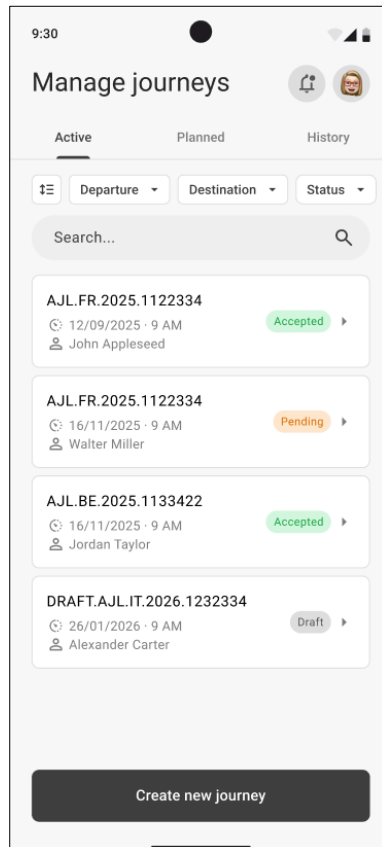


Figure 4 Mobile application

4.3.1 Core Functionalities and Features

Journey Management and the Digital Animal Journey Log (AJL)

At the heart of the mobile application is the complete digitalization of the five sections of the Animal Journey Log (Planning, Place of Departure, Place of Destination, Declaration by Transporter, and Anomaly Report).

Upon logging into the application, users are presented with a centralized home screen displaying active (ongoing), planned, and past journeys. For the Organiser, the app provides visibility, allowing them to track a truck's completed events on a map (e.g. left place of departure, reached control post, etc.), view driver/attendants details, and manage control post bookings.

For the driver/attendant, the application serves as a dynamic operational workspace. During the journey, the driver/attendants no longer rely on a physical clipboard. Instead, the app prompts the user with a specific "To Do List." Sections II and III of the AJL are automatically pre-filled with data defined by the Organiser during the planning phase. When departing from

the place of departure or reaching the place of destination, both the driver/attendants and the keeper must digitally countersign dedicated declaration forms.

Crucially, the system accounts for real-world discrepancies through multi-user updates. If a driver/attendant and a keeper disagree on the state of the animals upon arrival, the application captures these diverging interpretations as separate inputs. This ensures the integrity of the signed document is maintained while automatically triggering a formal Anomaly Report for competent authorities to review.

Built-In Welfare Tools: Space and Fitness Calculators

To reduce ambiguity and subjectivity during transport operations, the application integrates specialized technical tools directly available to the users:

- Required Space Calculator:** This feature primarily allows users to objectively calculate the number of animals which can be loaded into a means of transport per species and category. The opposite would also be possible, where the user selects the species, inputs the number of animals and their estimated weight, and the system immediately calculates the legally required space area. This proactive tool prevents overloading and ensures compliance before the animals are boarded.

- **Fitness Check Tool:** Evaluating whether an animal is fit for a long journey is a critical welfare checkpoint. While it requires human assessment, the app can provide useful support to such evaluation. The mobile app design features a dedicated widget to guide driver/attendants and keepers through this assessment. By selecting specific categories (e.g., heavily pregnant, unweaned calves, injured, lactating), the tool provides guidance on whether the transport of that specific animal is aligned with Regulation requirements, standardizing welfare assessments where feasible.

Multimedia Integration for Evidentiary Support

A major limitation of the current paper-based system is the inability to objectively document the state of animals or transport conditions. The mobile application introduces the capability for users, especially at the end of a journey during unloading, to take photos and record short videos. These multimedia files are securely uploaded to a central object storage server and linked to the specific digital Journey Log. This feature, heavily requested by both authorities and operators during consultations, provides irrefutable visual evidence that supports the swift resolution of compliance disputes and anomaly investigations.

In-App Messaging and Automatic Translation

Language barriers represent a significant operational friction point in cross-border European transport, frequently complicating interactions between international driver/attendants, local control post keepers, and national inspectors. To address this, the application design outlines an integrated, secure chat module linking the specific actors assigned to a journey.

To facilitate seamless communication, the system could incorporate an automatic translation engine. If a Polish driver/attendant needs to notify a Spanish Control Post manager of a delay, the driver/attendant could then type the message in Polish. The system would translate and display the message in Spanish for the keeper, ensuring critical welfare and logistical information is transmitted rapidly and accurately.

4.3.2 Technical Architecture: Offline Functionality and Security

Operating a mobile application in the context of international road transport presents unique technical challenges, primarily regarding intermittent network connectivity and the protection of sensitive data.

Offline Mode and Data Synchronization

Animal transports frequently traverse rural areas, mountain passes, and cross maritime borders via ferries, resulting in limited periods without cellular data coverage. A mobile application that strictly requires a continuous internet connection to function would be operationally unviable.

Therefore, the application design is architected with robust "offline-first" capabilities. Using advanced data synchronization patterns, the application could securely download (cache) all necessary journey data, control post details, and pre-approved authorizations, certificates and approvals to the local device storage while a connection is active.

Driver/attendants could continue to access their documents, utilize the Space and Fitness Calculators, and fill out required journey log sections even while completely offline. Once the device reconnects to a stable cellular network, a background synchronization engine can automatically upload stored actions to the central TRACES server. To manage conflicting data updates, the system would rely on defined data conflict resolution protocols, ensuring that the central database remains the single source of truth without corrupting the journey log.

Security and Personal Data Protection

Because the mobile application would process commercially sensitive operational data and personally identifiable information (PII), stringent security measures are a core requirement.

- **User Authentication:** Access to the TRACES backend would rely on the secure, standardized EU Login framework, ensuring that only authorized and registered entities can interact with the system.
- **Local Device Security:** Recognizing that mobile devices can be lost, stolen, or shared, the technical design mandates local user authentication mechanisms. The application could leverage the native biometric security of the host platform (e.g., fingerprint scanning or facial recognition on Android and iOS devices), backed up by a secure PIN code. This local authentication would then be triggered when opening the app or performing legally binding actions, such as electronically signing a journey log section, ensuring the user is indeed the authorized actor.
- **Data Encryption:** All data cached on the device to support the offline mode would be securely sandboxed and encrypted at rest, preventing unauthorized extraction by third-party applications or malicious actors.

The mobile application outlined in this study is a critical, transformative element designed to improve overall TRACES field accessibility for all stakeholders involved in the animal transport process. It effectively bridges the gap between central regulatory databases and the operational reality of the road.

By providing an intuitive, field-ready channel for economic actors and competent authorities to interact, the application ensures that live animal journeys are conducted in strict compliance with the Proposed Regulation. The transition from manual, error-prone paperwork to an interactive digital interface, supported by intelligent tools like space calculators, multimedia evidence gathering, and multi-lingual communication, could significantly reduce the administrative burden currently placed on users.

Furthermore, the proposed technical architecture would ensure that the application is highly resilient. By incorporating comprehensive offline synchronization protocols and security measures, the tool would guarantee that data is protected and available regardless of geographic constraints.

5 Feasibility, Market Readiness, and Synthesis

The transition from a highly fragmented, paper-based administrative regime to a fully digitized, real-time ecosystem for animal transport represents an important regulatory shift. The success of the European Commission's Proposed Regulation (COM(2023)770) hinges on whether its digital mandates, mandatory electronic journey logs, real-time geolocation tracking, and mobile field accessibility, are practically achievable.

This final section synthesizes the findings of the comprehensive study to assess the overarching feasibility of the proposed digital solutions. Feasibility in this context is multidimensional: it encompasses technical viability (can the systems be built?), market readiness (does the required technology already exist?), financial sustainability (can the authorities and operators afford it?), and legal/operational compliance (can it be governed safely?). The ensuing analysis demonstrates that by adopting a flexible, multi-option architecture, the complete digitalization of animal transport administration is not only feasible but represents a highly pragmatic evolution of existing market capabilities.

5.1 Technical and Operational Feasibility

The main digital provisions under study include the centralization administrative workflows within an upgraded TRACES platform, supported by a Geolocation Intermediary Service (GIS), weather forecast capabilities and a dedicated mobile application. From a pure software engineering and operational standpoint, this architecture is highly feasible because it relies on established technical patterns and deliberately avoids "reinventing the wheel."

Feasibility of TRACES Enhancements

Transforming TRACES' AJL and welfare certification/authorization modules from a voluntary document repository into a mandatory, automated enforcement hub is technically viable through existing means and could be enhance via the integration of a Business Rule Engine (BRE) and robust Application Programming Interfaces (APIs). The study confirms that decoupling the static Animal Journey Log (AJL) into a dynamic, task-based workflow can be achieved via backend restructuring utilizing standard enterprise software architecture. Furthermore, integrating external data sets, such as connecting TRACES via APIs to the GIS and weather forecast data source, relies on standard data-sharing protocols that are already widely utilized across the global logistics sectors. For the booking of control posts, the study compared different integration scenarios: the recommendation is for TRACES to be integrated with an existing, off-the-shelf online booking solution. Managing the control post calendar and dealing with incoming booking requests from organisers would be done by the control post operators directly in the online booking system, which would greatly simplify integration into TRACES as only the user interface relevant for organisers (searching, viewing availability, requesting, being notified) would need to be built into TRACES.

Feasibility of the Mobile Application

A critical operational risk identified during the project was the requirement for digital accessibility in the field. Transport operations frequently occur in remote rural areas, alpine passes, or on roll-on/roll-off (Ro-Ro) maritime ferries where cellular network coverage is virtually non-existent. An application that requires continuous internet connectivity to function would be operationally unfeasible.

However, the proposed solution mitigates this risk by designing the mobile application around an "offline-first" architecture. It is highly feasible to implement local data caching and background synchronization protocols. This ensures that driver/attendants and official veterinarians can seamlessly access journey logs, utilize built-in space and fitness calculators, and digitally sign documents while completely offline. The system would automatically reconcile and upload the encrypted data the moment the device reconnects to a cellular network. Prototype testing with private operators confirmed that this offline capability is one of the primary operational enablers for the digital transition.

5.2 Market Readiness and Technology Availability

Global Navigation Satellite Systems (GNSS) and Connectivity

The positioning system design relies on the availability of accurate spatial data. Crucially, TRACES already stores the addresses of most of the required locations to be geofenced. Translating such addresses into GPS coordinates is straightforward with the use of geocoding web services⁶.

Today, multi-GNSS receivers are standard global commodities. Modern tracking devices and smartphones simultaneously access the American GPS, the European Galileo, and the Russian GLONASS constellations. This overlapping coverage guarantees highly accurate positioning (often down to a few meters) across all European and neighbouring territories.

Similarly, the transmission of this data relies on commercial cellular networks. Standard 4G and 5G networks provide more than sufficient bandwidth for transmitting lightweight geolocation data and mobile application payloads. While telecommunication companies are actively decommissioning older 2G and 3G networks, which may impact legacy tracking devices installed in older trucks over a decade ago, the market has already transitioned to 4G/LTE standards, ensuring long-term technological viability.

Fleet Management Systems (FMS) and Telematics

For medium and large professional transport companies, tracking vehicles is already a core business requirement. The market analysis revealed that the vast majority of commercial heavy-duty trucks on European roads are already equipped with sophisticated Fleet Management Systems (FMS) installed by Original Equipment Manufacturers (OEMs) such as Volvo, Scania, DAF, and Mercedes-Benz, or provided by third-party software vendors.

⁶ See for instance the open source Geocode | ORS API , at <https://openrouteservice.org/dev/#/api-docs/geocode>

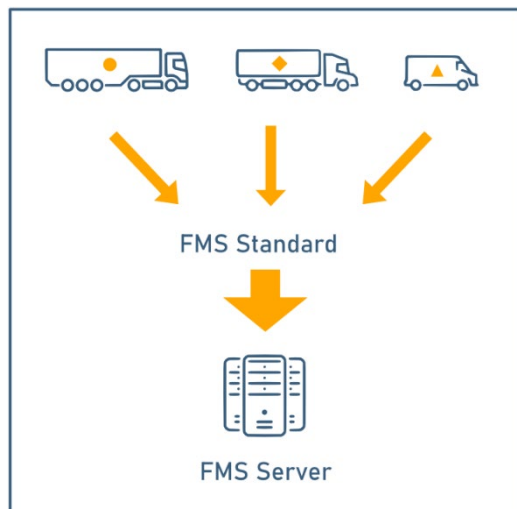


Figure 5 FMS Standard

Crucially, the market has naturally evolved toward interoperability. The major European truck manufacturers have collaborated to establish the **rFMS (Remote Fleet Management Standard)**. The latest iteration of this standard (version 5.0.0) standardizes the way vehicle data is accessed and transmitted, regardless of the truck's brand. Highly relevant to animal welfare, this modern standard also supports CAN-bus connectivity with the trailer itself, allowing the system to detect trailer identification and eventually environmental conditions where the animals are actually housed. Because the transport market has already adopted these standardized telematic ecosystems, it is highly feasible to simply tap into these existing data streams via secure APIs, rather than forcing the industry to adopt entirely new tracking hardware.

The Smartphone Ecosystem

For smaller operators, independent farmers, or occasional transporters who have not invested in expensive truck-integrated FMS platforms, the smartphone provides an immediate, universally available alternative. Modern smartphones contain all the necessary sensors (multi-GNSS chips, cameras for multimedia evidence, and cellular modems) to act as highly capable tracking and reporting devices. Whether utilizing a "Bring Your Own Device" (BYOD) strategy or company-issued tablets governed by Mobile Device Management (MDM) software, the ubiquitous availability of smart devices ensures that the barrier to entry for digital compliance is exceptionally low.

5.3 Financial Feasibility and Cost Estimates

A regulatory proposal must be financially proportionate. The study conducted a financial assessment of the various data collection and integration scenarios, demonstrating that the proposed hybrid architecture optimizes costs for all parties.

It should be noted that the study did not calculate costs of changes to the TRACES software itself as the solution is maintained by the Commission itself.

5.3.1 Geolocation features

The Cost of "Scenario 4: Dedicated On-Board Units (OBUs)"

To understand the financial pragmatism of the final recommendation, one must examine the alternative. Mandating that every livestock trailer in Europe be retrofitted with a dedicated, tamper-proof tracking box (OBU) exclusively for animal welfare monitoring was evaluated. The financial analysis concluded that this is the most cost-prohibitive approach. Operators would face an estimated upfront cost of roughly €100 per vehicle for the hardware and installation,

coupled with an ongoing subscription and data transmission fee of approximately €500 per year, per vehicle. Multiplied across tens of thousands of livestock trailers in the European Union, this mandate would impose a severe and potentially unsustainable financial burden, particularly on small and medium-sized enterprises (SMEs).

The Financially Feasible Solution: App and FMS Integration

By rejecting a blanket hardware mandate, the proposed solution ensures financial feasibility through a flexible, software-driven approach.

1. **For the Economic Operators:** The cost of compliance is drastically minimized. Small operators utilizing the official Smartphone Application (Scenario 1) face effectively zero additional hardware costs, utilizing the mobile devices they already own. Larger fleets opting to synchronize their existing FMS data with the authorities (Scenario 2) face minimal costs. If utilizing a certified data broker to route their existing telematics to the Commission, the estimated cost drops from €500/year for an OBU to a nominal subscription fee of approximately €50 per year, per vehicle. By leveraging existing commercial investments, the digital transition becomes economically painless for the industry.
2. **For the European Commission (TRACES infrastructure):** Developing the mobile application natively for iOS and Android requires an estimated one-time investment of €200,000 to €350,000, with an annual maintenance cost of approximately €50,000. To support the FMS integration via APIs or data brokers, the Commission would face an estimated integration cost of €100,000 to €250,000.
3. **The Geolocation Intermediary Service (GIS) Server:** The most significant financial investment for the European authorities lies in establishing the secure GIS middleman server to ingest, process, and geofence the tracking data. This highly scalable infrastructure is estimated to require a one-time setup cost between €900,000 and €1,600,000, with recurring annual hosting and maintenance costs of €180,000 to €300,000.

While the GIS represents a notable public investment, it is an absolute financial necessity. Attempting to ingest millions of continuous, real-time GPS pings directly into the existing TRACES infrastructure would require expensive "Big Data" server upgrades and would likely crash the system. By funding the GIS broker to filter the data and send only lightweight "events" (arrival/departure timestamps) to TRACES, the Commission avoids exorbitant long-term cloud storage fees, ensuring the system remains financially sustainable for the European taxpayer.

5.3.2 Other estimates

Mobile Application

The cost of developing the mobile application was estimated between €900,000 and €1,200,000 excluding maintenance and rollout costs (training, communication, change management...).

Booking system

The scenario that was recommended for the control post booking system foresees 1) the use of an off-the-shelf calendar/booking solution and 2) the integration in TRACES of the features needed by the organisers, while control post operators would work directly in the off-the-shelf application. The study assessed that such a set up would probably reduce implementation costs by a factor 2 or 3 compared to a full integration of booking features directly in TRACES.

Video/picture hosting service

The cost of hosting services is largely determined by the storage size that needs to be foreseen for the application. Compared to typical multimedia applications, the proposed feature entails a relatively moderate use of storage space and the cost of hosting the data is therefore not a concern. The study noted that the main cost for the feature is likely to be determined by the integration effort in TRACES.

5.4 Data Governance and Legal Feasibility

The final pillar of feasibility addresses data privacy and legal proportionality. Tracking commercial vehicles in real-time inherently invokes the General Data Protection Regulation (GDPR) and commercial confidentiality concerns.

The proposed architecture handles this with "Privacy by Design." The GIS acts as a legal and technical firewall. It only generates specific compliance events when a vehicle crosses an official geofence (e.g., a border or control post). Continuous location tracks are purged from the system once these events are calculated, except in cases of clear deviation from the planning. Furthermore, before any event is transmitted to the central TRACES database, a dedicated microservice cryptographically masks (pseudonymizes) the vehicle's identification number.

The system only retains detailed "Evidence Packs" (small snippets of raw location data immediately surrounding a geofence crossing) in a secure, long-term vault for a legally defined retention period of six years. These are not actively displayed but serve as auditable proof during formal compliance investigations. This architecture ensures that the authorities receive the precise, irrefutable data required to enforce animal welfare standards without overstepping legal boundaries or violating the privacy rights of driver/attendants.

5.5 Synthesis and Final Conclusion

The existing framework for the protection of animals during transport, anchored in Regulation (EC) No 1/2005, has reached the limits of its operational efficacy. Relying on physical paper logs, manual data entry, and delayed, retrospective checks has created an environment of administrative burdens, inconsistent cross-border enforcement, and systemic vulnerabilities to fraud. The European Commission's proposal to mandate a fully digital, interconnected ecosystem is not merely an administrative upgrade; it is a fundamental prerequisite for advancing animal welfare in the 21st century.

This comprehensive study provides the actionable blueprint to realise the digital provisions of the proposed regulation. It concludes that the complete digitalization of the sector is entirely

feasible. The necessary technologies, from multi-GNSS satellite constellations and 4G/5G cellular networks to sophisticated fleet management software and ubiquitous smartphones, are already widely deployed across the European internal market.

The success of this transition relies entirely on architectural pragmatism. By upgrading TRACES with an automated Business Rule Engine, the system guarantees harmonized, objective enforcement across all 27 Member States. By deploying a robust, offline-capable mobile application, the system ensures that operators in the most remote agricultural regions can seamlessly comply with reporting mandates.

Most importantly, the introduction of the Geolocation Intermediary Service (GIS) solves the most complex technical challenges of the mandate. The GIS allows the European Union to leverage the tracking hardware that the transport industry already owns, avoiding hundreds of millions of euros in redundant hardware costs for private businesses. Simultaneously, it acts as a privacy firewall, transforming overwhelming streams of continuous GPS data into precise, lightweight compliance events.

In closing, the digital solutions proposed across these deliverables construct an ecosystem that is **technologically mature, economically proportionate, and legally robust**. It promises to substitute the friction of paper-based bureaucracy, with a faster, clearer, and fairer operating environment. Concurrently, it equips Member State authorities with the real-time, proactive oversight required to decisively intervene and protect the welfare of millions of animals traveling across the European Union.

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6 Annexes:

6.1 D.02.01.01 TRACES report

- Introduction

This TRACES Report forms an integral part of the broader study commissioned under the EU4Health and Single Market Programme, managed by the European Health and Digital Executive Agency (HaDEA). It follows the Consultation Report, which synthesised findings from an extensive stakeholder engagement process, including a targeted survey addressed to all Member State Competent Authorities (MSCAs), over 40 structured interviews with representatives from key stakeholder groups, and two dedicated workshops—one involving competent authorities and another engaging private stakeholders—to validate findings and consolidate user needs. While the Consultation Report provided a wide-ranging overview of regulatory, operational, and digital practices, this report focuses specifically on the current operational use of TRACES in the context of live animal transport.

TRACES (Trade Control and Expert System) is the EU's central digital platform for managing, certifying, and monitoring the movement of live animals across borders. Its role is essential to the functioning of the animal transport system, supporting communication between authorities, facilitating compliance with regulatory requirements, and enabling data-driven oversight.

The primary objective of this report is to:

- **Provide a structured assessment of the current state ("as-is") of TRACES with regards to the animal journey log module**, based on the operational realities reported by users and authorities during the consultation phase;
- **Highlight how TRACES is currently supporting workflows**, enforcement activities, and coordination among stakeholders;
- **Identify requirements, stemming either from the new proposed regulation or from stakeholders that would require enhancements of current TRACES functionality and usage.**

Important note :

The present assessment report focuses solely on TRACES modules and functionalities that are relevant for the scope of the Proposed Regulation on Animal Welfare during Transport (European Commission, 2023) and identifies possible enhancements that would be useful for the AWT Stakeholders if the Proposed Regulation were to be adopted in its current form.

The authors are very much aware of the fact that the TRACES application supports processes and applications that vastly exceed the scope of animal welfare during transport. All assessments and recommendations are given strictly from the perspective of the Animal Welfare during

Transport context and cannot be extrapolated to other use cases of the TRACES application or to the application as a whole.

By focusing on the operational status of TRACES as it stands today, this report contributes to a comprehensive understanding of the system's role within the broader EU context. It explores how TRACES is currently deployed across different geographical scenarios and supports key business processes involved in the transport of live animals. The assessment covers a range of core capabilities, including user management, record management, document and journey management, compliance management, workflow management, business rules management, and system integration. It further examines areas such as entitlement management, reference data management, user onboarding, reporting, access management, and more. Each of these capabilities is analysed with regard to the solution's current features, usability, modularity, security, and performance. Finally, the report identifies interdependencies across capabilities to provide a structured view of the "as-is" in TRACES, forming a factual basis for understanding its operational landscape and informing subsequent phases of the study.

Where relevant, insights from the Consultation Report have been incorporated to contextualise findings and highlight areas already identified for potential enhancements.

- Key concepts / business objects

The objective of this section is to define a number of key concepts that are at the core of the business processes under study and will therefore be used in all subsequent sections of this document.

First a review is proposed of the key concepts used in the domain of Animal Welfare during Transport as defined in the Proposed Regulation. In a second stage, a number of scenarios are defined that can help to further define the domain under study.

- Domain model

As the main objective of the Proposed Regulation is the protection of animals during transport and related operations, the domain model can be summarised at a high level by objects such as the journey itself, the documents that define and support the correct execution of the transport and the actors involved in the transport.

- Animal Journey Log

In TRACES, an Animal Journey Log (AJL) is a container that provides a comprehensive record of a journey involving live animals. It's used for journeys within the EU, and for journeys to and from non-EU countries (see **Section 4.2**). It provides detailed information about the journey, including the animals being transported, the route, and the responsible parties.

The AJL module in TRACES was built to replicate the journey log forms in accordance with its five sections as laid down in the current Regulation 01/2005 (European Commission, 2005). Therefore, it is based on the existing legislation at the time of writing.

As such the AJL is a vital tool for monitoring and ensuring the welfare of animals during transport within and outside the EU, while also facilitating traceability and compliance with animal health regulations.

The Animal Journey Log can be seen as a high-level container for underlying business objects : the journey itself, actors involved in the journey, documents supporting the journey process and business rules and constraints applying to those objects.

- Journey

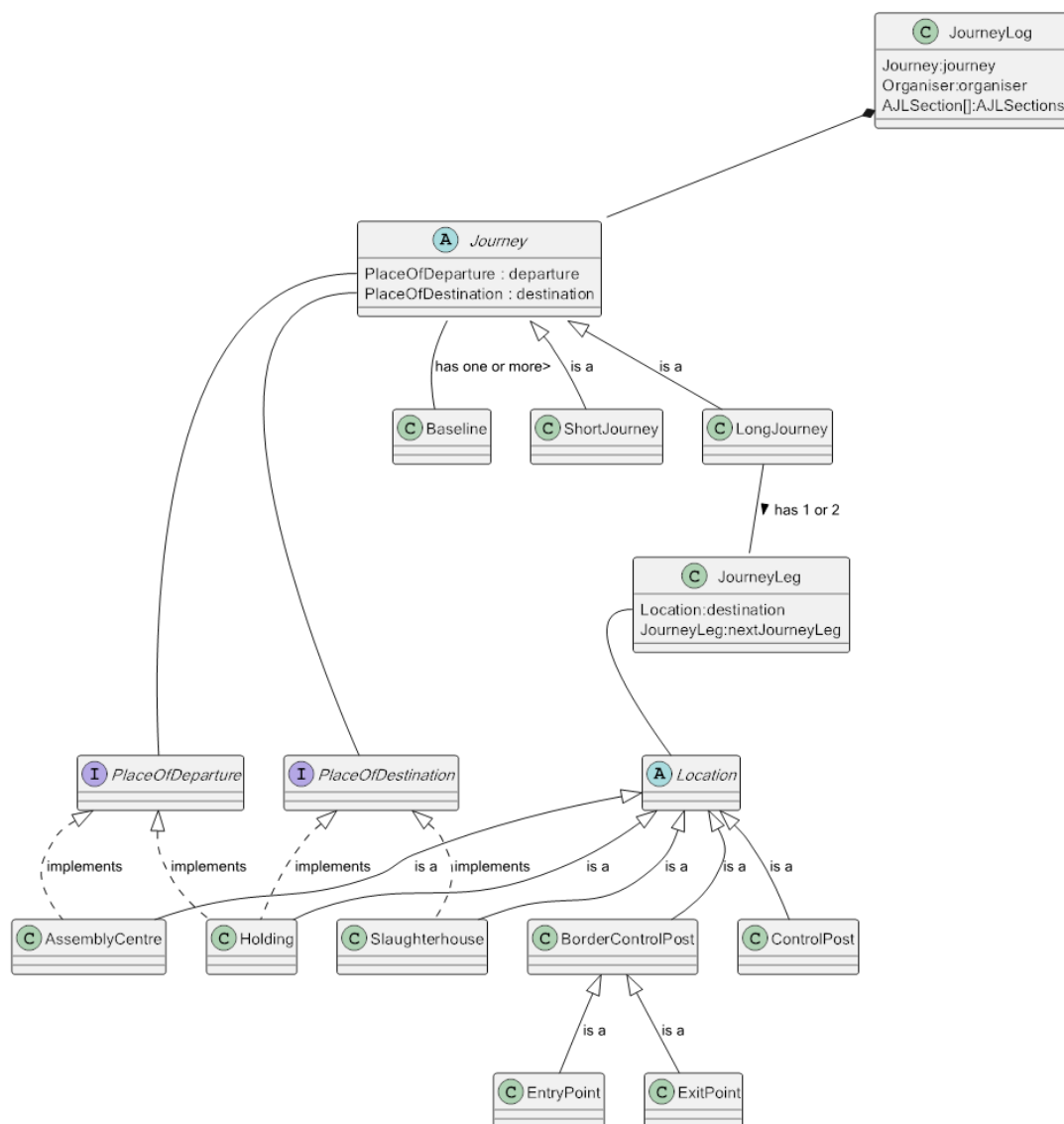


Figure 6 Domain - Journey⁷

The central concept of the domain is the notion of Journey, defined in the Proposed Regulation as “the movement of animals effected by one or more means of transport starting with the loading of the first animal onto the first means of transport at the place of departure and ending with the unloading of the last animal at the place of destination, and the related operations including rest

⁷ While in practice today most Exit Points are BCPs, Member States can technically designate other types of establishments as exit points: Article 2 Definitions, (i), of Regulation 01/2005: ‘exit point’ means a border inspection post **or any other place designated by a Member State** where animals leave the customs territory of the Community;

periods and transfer from one means of transport to another; (European Commission, 2023, p. Art 3)

Journey Duration

The duration of the intended journey is the key element that defines two sub-types of journey , namely Short Journey (= < 9 hours) and Long journey (> 9hours)

The Journey time is defined as “*the time period during which animals are moved by means of transport, including the time for loading and unloading the animals*” (European Commission, 2023, p. Art 3)

Journey Locations

A Journey is further defined by a number of specific locations that play an important role in the regulation. Typically, the Journey will be initiated at the **Place of departure**, may or may not go through an **Assembly Centre** and/or a **Control Post** to reach its **Place of destination**.

The Place of Departure is “(a)the place where an animal has been accommodated for at least a week prior to departure and where it is first loaded onto a means of transport; or (b)an assembly centre if the animal has been collected within a distance of no more than 100 km” (European Commission, 2023, p. Art 3)

The Assembly Centre means “an establishment for assembly operations registered in accordance with Article 97(1) of Regulation (EU) 2016/429 where animals of the bovine, ovine, caprine, equine or porcine species originating from more than one holding are grouped together temporarily to form a consignment” ” (European Commission, 2023, p. Art 3)

A Holding, while not explicitly defined in the Proposed Regulation, can be understood as being a general term for a place where animals are held, such as a Farm.

The Place of Destination is “a slaughterhouse or any other place where an animal is unloaded from a means of transport and accommodated for at least a week prior to the time of any subsequent departure” (European Commission, 2023, p. Art 3)

Control Posts are “staging points accommodating for at least 24 hours domestic solipeds and domestic animals of the bovine, ovine, caprine and porcine species in the Community” (European Council, 1997, p. Art 1)

Depending on the scenario (See **Section 4.2**), more locations may apply, such as **Border Control Posts** and **Entry/Exit points** :

Border Control Post is “a place, and the facilities belonging to it, designated by a Member State for the performance of the official controls provided for in Article 47(1)” ” (European Commission, 2017-625, p. Art 3(38))

Point of Entry/Exit is “a border control post or any other place designated by a Member State where animals, falling within the scope of Regulation (EC) No 1/2005, leave the customs territory of the Union” (European Commission, 2017-625, p. Art 3(39))

Journey Legs

A disposition introduced by the Proposed Regulation specifically for Long Journeys is the notion of journey part. A Long Journey may consist of maximum two parts : “the journey consists of a maximum of two parts, each of them not exceeding 21 hours, after which time the animals shall reach the place of destination;” ((European Commission, 2023, p. Art 3)

Journey baseline

An important concept introduced by the Proposed Regulation, is the need for a journey Baseline. While not explicitly defined in the Regulation, the need results from the requirement to store geolocation data from the vehicle used for the transport. Since journey logs in the current implementation represent the **planned** journey that is submitted to the Competent Authority, collecting (near)-real time geolocation data on the **actual** journey de facto implies that two versions of the journey will be stored in the log to account for the fact that the actual journey (and its collected geolocation data) may differ from the planned journey.

An essential part of the Compliance Management Capability will be the ability to compare the approved version of the AJL (Baseline) with the actual journey and analyse deviations.

The implications of this implicit distinction are further discussed in **section 7.7**

Business rules and Special cases

Several Business Rules are defined in the Proposed Regulation as applying to the Journey and/or its locations. As an example, one can cite the Business rules trying to prevent the practice of “Assembly Centre Hopping” whereby operators multiply stops at assembly centres so that the journey duration would be counted from the last assembly centre and therefore reduce the overall duration and avoid requirements applying to Long Journeys.

“Therefore, a mandatory stay of the animals at both the place of departure and destination should be imposed and assembly centres should only be allowed to be places of departure if they are situated locally, with the aim of preventing the practice of “assembly centre hopping” ” (European Commission, 2023, p. (18))

Another example is the fact that a Slaughterhouse can only be a Place Of Destination, a Holding can be both a Place of Departure and a Place of Destination, and a Control Post can be neither a Place of Departure nor a Place of Destination.

It is clear from the rules above that the objects Place of Departure and Place of Destination differ from other kinds of locations (holding, Control Post, etc) in that they are more a specification

applying to a given location object that defines the location's allowed use rather than a location itself.

Special cases involving journeys and their locations will include

- situations where the very nature of the type of Journey must be changed during the journey itself due to unforeseen circumstances; typically, a Short Journey will need to be transformed into a Long Journey en route due to delays. See **Section 7.7**
- Journeys where several transporters are involved : See **Section 7.7**

■ Documents

Definitions

The two macro processes described in **section 5** of the present document rely heavily on documents that are submitted, validated, etc... It therefore essential to clearly define the concepts that underly each type of document.

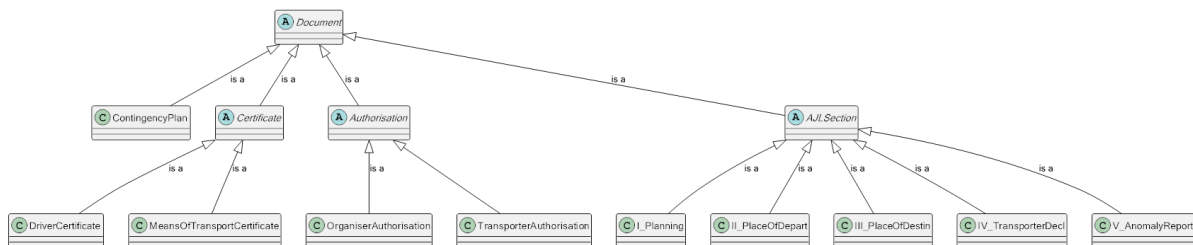


Figure 7 Domain - Documents

Certificate

“‘official certification’ means the procedure by which assurance concerning compliance with one or more requirements laid down in the rules referred to in Article 1(2) is provided by the competent authorities;” (European Commission, 2017-625, pp. Art3-(25))

“‘official certificate’ means a paper or electronic document signed by the certifying officer and providing assurance concerning compliance with one or more requirements laid down in the rules referred to in Article 1(2);” (European Commission, 2017-625, pp. Art3-(27))

In accordance with the various regulations used as reference for this document, the term Certificate will therefore be used to indicate :

- Health Certificates such as
 - EU INTRA : Health Certificates for movements between and across Member States,
 - EU IMPORT : Health Certificates for imports into the EU,

- EU EXPORT : health Certificates for exports from EU Countries to non-EU-Countries
- Certificates granted to Economic Operators, specifically:
 - Certificate of Competence for drivers & attendants (European Commission, 2023, p. Art 7)
 - Certificate of Approval of means of transport by road (European Commission, 2023, p. Art 12)
 - Certificate of Approval of livestock vessels (European Commission, 2023, p. Art 13)

Authorisation

Next to the Certificates of Competence and Approval listed above, the Proposed Regulation also defines Authorisations that can be granted by Competent Authorities to Economic Operators.

- Organiser authorisation for Long Distance Journeys (Art 5)
- Transporter authorisation for Short Distance Journeys (Art 7)
- Transporter authorisation for Long Distance Journeys (Art 8)

NB : It could be argued that there is little difference between a Certificate and an Authorisation in light of the Certificate definition laid out in (European Commission, 2017-625, pp. Art3-(25)) and cited above as both are a paper or electronic document signed by the certifying officer and providing assurance concerning compliance with one or more requirements. Both types of documents are furthermore defined in Annexes of the Proposed Regulation. However, in order to align with the text of the Regulation we will keep the distinction in the rest of the document.

AJL Sections / Forms

The AJL consists of five Forms, named Sections, that must be filled in and signed by various actors throughout the duration of the transportation process. The content of the forms is defined in the Annexes of the Proposed Regulation.

The five sections are:

- **Section 1: Planning:**

This section is typically completed by the journey organizer and includes information about the journey's overall plan, including the expected duration, departure and destination points, the species of animals being transported, and their estimated total weight.

- **Section 2: Departure:**

This section is completed by the keeper at the place of departure and includes details about the departure location, the time of departure, and any relevant information about the animals at the time of departure.

- **Section 3: Destination:**

This section is typically completed by the keeper and competent authority at the place of destination and includes information about the arrival location, the time of arrival, and any relevant information about the animals at the time of arrival.

- **Section 4: Transporter Declaration:**

This section is completed by the driver (and can be countersigned by the transporter) and includes a declaration about the welfare of the animals during the journey, along with any relevant information about the journey itself.

- **Section 5: Anomaly Report:**

This section is used to report any anomalies or deviations from the planned journey or the welfare of the animals during the journey.

Actions and States

An important element to note is that the business documents listed above are not just documents (paper or digital) , or forms with a predefined content, but also business objects in the sense that they

- 1) support predefined actions that can be applied to them (such as “approve”, “reject”, “sign” etc...),
- 2) should limit access to those actions to predefined roles and associated users and
- 3) will maintain state information representing the current state of the object (“signed”, etc...).

Those actions and states are discussed further in **section 7.9** and in **section 7.14**

Business rules and Special cases

Operators may not request a Means of Transport Certificate in a Member State if a previous request for the same Certificate has already been rejected in another Member States. Member States must have the ability to check and verify before approving a request that it does not fall under that scenario.

Document issuance versus exchange

In the preliminary interviews, DG SANTE insisted on the difference between document “issuance” and document “exchange” (Preliminary Interview DG SANTE G4).

In today’s environment, Animal Journey Log documents that are generated in the TRACES tool are always printed out to be further used in downstream processes, hence the term “**issuance**”. It should be noted that under the current legislation, TRACES is supporting the AJL on a voluntary basis, as there is no legal basis for it, and that it developed the module in its current state to facilitate the obligations under 01/2005 (but without a legal obligation do so).

In the to-be state where an AJL would be processed end-to-end in TRACES by the various actors, the term “**exchange**” would not be applicable either as it typically refers to data transfers between interconnected systems. Since the solution being considered will imply that the actors will interact directly within TRACES on a digital AJL, there is no “exchange” as such but rather a new capability allowing for **electronic signature** of a digital AJL.

- Actors

Definitions

Actors involved in the Domain model are a subset of the Stakeholders defined in the Consultation Report – Section Stakeholder Management.

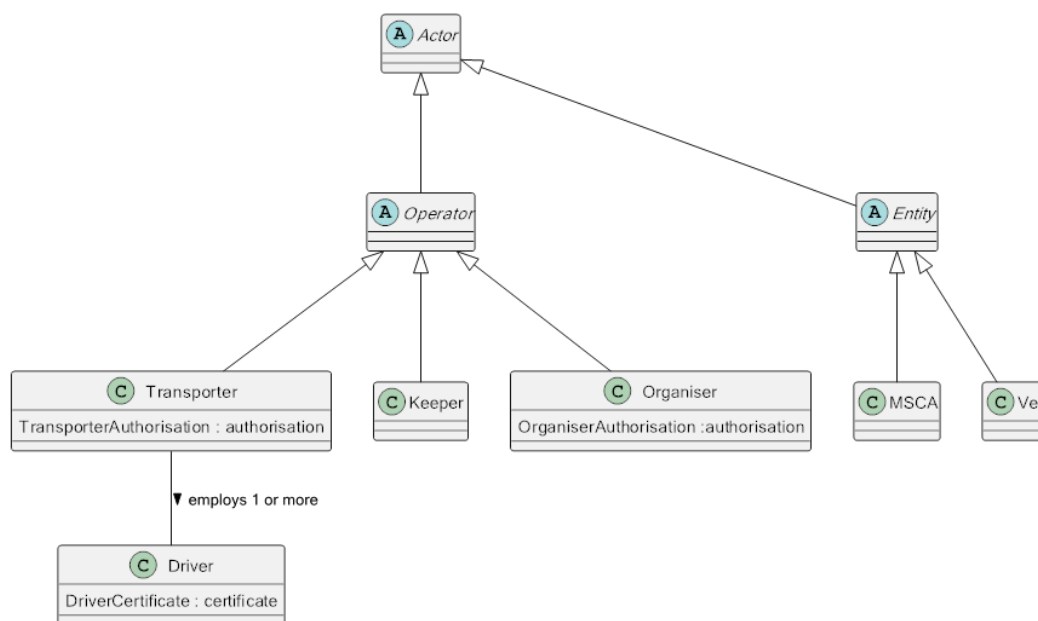


Figure 8 Domain - Actors

For the purpose of describing the role played by the various actors in the two macro processes of Animal Welfare during Transport, we will stick to the definitions used in the Proposed Regulation. It should be noted that the terminology of the Proposed Regulation is not always aligned with the denominations used in the TRACES solution, as TRACES currently implements (on a voluntary basis) what is defined under the standing legislation (which is Regulation 01/2005). We will mention differences where applicable.

Organiser means “(a)a transporter who transports or has subcontracted the transport of animals for the whole journey or a part of the journey to at least one other transporter; or (b)a natural or legal person who has contracted the transport of animals to a transporter; or (c)a person who has signed Section 1 of the journey log in TRACES as set out in Annex III.” ” (European Commission, 2023, p. Art 3)

Keeper means “any natural or legal person, except a transporter, in charge of or handling animals whether on a permanent or temporary basis;” ” (European Commission, 2023, p. Art 3) . The important point here is that the Keeper cannot be understood as the driver and/or attendant of the transporter even if they are temporarily in charge of the animals during transport. On the other hand, actors like Farmers, Control Post or Slaughterhouse operators will be defined as Keepers.

It should also be noted that “Keeper” is not defined as an activity in TRACES. See **section 7.14** for further information on roles, activities and user rights in TRACES.

Transporter means « an operator whose economic activity consists of transporting animals on its own behalf, or on behalf of a third party;” (European Commission, 2023, p. Art 3). Drivers and Attendants are individual persons working for a Transporter.

Business rules and special cases

Special cases

It should be noted that an economic actor can fulfil several roles in TRACES, such as Organiser and Transporter, or Keeper (Farmer) and Transporter and that such scenarios will need to be foreseen in the Access Management capability described in **section 7.14** . If roles around the signing of Journey Logs are clearly separated as the Proposed Regulation entails, then it will be key to allow a single operator to combine roles in his/her profile so that a farmer can sign off a Place of Departure Form both as a Keeper and as a Transporter for instance.

- Geographical scenarios

Geographical scenarios are important concepts in the Domain model as they carry a number of specific Business rules that will apply to various business objects depending on the case.

Four main geographical scenarios are applicable to the AJL Process :

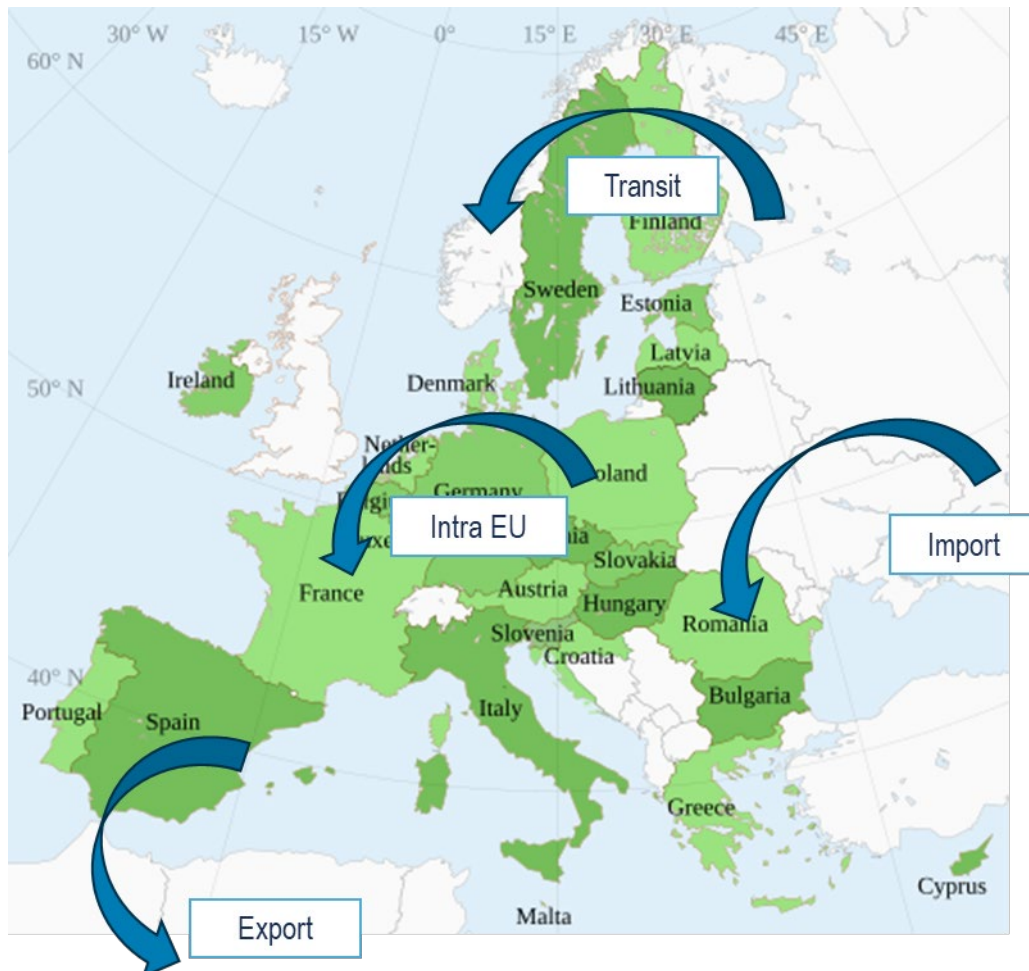


Figure 9 Geographical Scenarios

- Scenario INTRA EU

The INTRA EU scenario involves a transport between two or more EU Member States without leaving the territory of the European Union. While technically speaking, the AJL in TRACES can also accommodate the recording of transports inside a single EU member state, we will keep the “INTRA EU” term to mean journeys between member states to keep the same nomenclature as the INTRA EU health certificates (which are necessary only when crossing from one Member State to another).

- Scenario IMPORT EU

The IMPORT EU scenario involves a transport from a third country to an EU Member State, potentially crossing several other Member States.

The Proposed Regulation, article 35, foresees that the same rules will apply as for an INTRA scenario, with the Country of origin being responsible for the approval of the Journey Log, in TRACES.

- Scenario EXPORT EU

The EXPORT EU scenario involves a transport from an EU Member State to a Place of Destination outside of the European Union, potentially crossing several other Member States.

Just like for the IMPORT scenario, the Proposed Regulation foresees that the same rule should apply as for an INTRA transport, up to the Place of Destination in the third country.

It should be noted that in the current implementation of TRACES, the Animal Journey Log can only be created from an INTRA Certificate, not from an EXPORT Certificate. However, even in the case of an Export from the EU, an INTRA certificate will be needed in accordance with Animal Health Law rules for the intra-EU movement of the consignment of live animals.

Also, the AJL can be created separately and then added to the Export Certificate.

As this study focuses on the Animal Journey Log requirements and capabilities, the upstream use of Certificates per scenario will not be further analysed. The important element being the confirmation that the AJL will be required for Export scenarios.

- Scenario TRANSIT

The last geographical scenario is the TRANSIT scenario whereby a transport from a Place of Departure situated outside of the European Union is heading to a Place of Destination outside of the European Union but crosses one or more Member States en route to its destination.

The only provision in the Proposed Regulation applying specifically to the TRANSIT scenario is article 36 which specifies that “ operators shall ensure that the rules of this Regulation are complied with during the part of the journey taking place on the Union territory, except for the provisions on maximum journey times” (European Commission, 2023, p. Art 36).

- Business processes

- Macro processes

While **Section 4** provided a static view of Business Objects used in the domain under study, the following section focusses on a dynamic view, i.e. how those objects will flow through the business processes.

A number of limitations will apply to the discussion proposed below:

- *The scope of the study is limited to the impact of the Proposed Regulation on existing tools and as such, two macro processes are impacted and in-scope for the analysis: the Authorisation / Certification macro process and the Animal Journey Log macro process. It is well understood that those processes are part of a larger set of processes such as for instance the fact that some Animal Journey Logs will be issued as part of an INTRA Certificate. But those higher-level processes are out of scope of the present study.*
- *Also, processes around the management of Certificates by MSCA (Driver, Means of Transport) are out of scope as the Proposed Regulation only stipulates that those Certificates and their status (submitted, approved or rejected) must be present, not how each MSCA should go about designating Certification bodies, defining examinations, handling renewals etc...*
- *Since a detailed documentation in BPMN format of the studied processes is not required by the Technical Annex, the level of detail provided in the flows below has been aligned with the objective of the Section, namely identify the impact of the Proposed Regulation on TRACES from a process point of view.*
 - Level-2 process analysis

The processes described below are modelled based on the new requirements defined in the Proposed Regulation 2023 (European Commission, 2023)

- Authorisation process

Organiser authorisation process

The Organiser authorisation process allows an organiser to obtain an authorisation from its MSCA to be allowed to carry out long distance journeys. The process map below encompasses both a first request and a renewal.

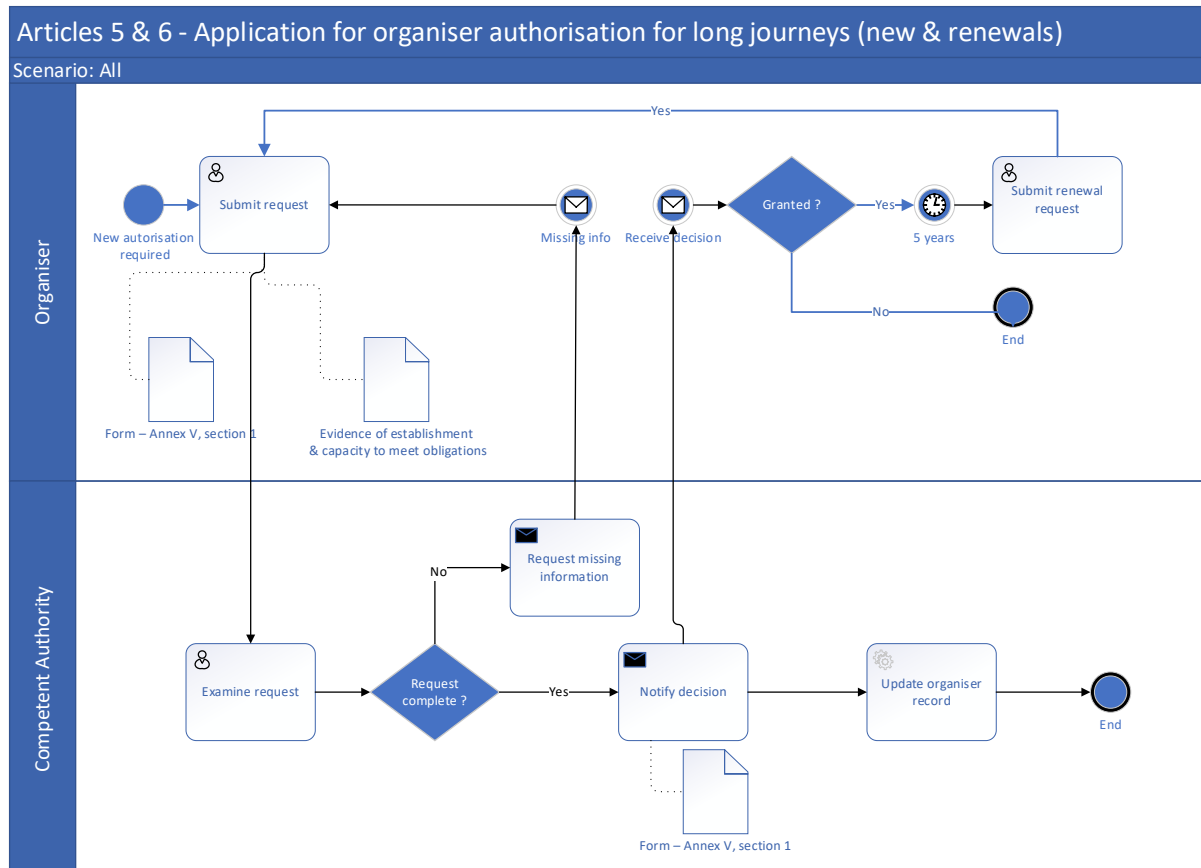


Figure 10 Organiser Authorisation Process

Title	Submit request
Description	The organiser submits its request for authorisation for long journeys by means of an Annex V Section 1 Form and supporting documents
Database	Request & docs stored in Traces DB / National System DB
Input	Business Need to organise long journeys
Output	A workflow request queued for treatment by the MSCA
Business rules	- Request must be submitted 5 days in advance - Request contains evidence of establishment or representation in country of MSCA

	- Request contains evidence Organiser's capacity to comply with Article 14 obligations. - Organisers shall apply for an authorisation to no more than one competent authority, in no more than one Member State
Capability	Workflow management
Constraints	Organiser must specify if they intend to carry out long distance transports to third countries
References	(European Commission, 2023, p. Art 5)
Points to clarify	n/a

Title	Examine request
Description	The MSCA picks up the incoming request for authorisation and examines the submitted documentation
Database	Request and associated documents stored in TRACES or national system database
Input	Incoming request for organiser authorisation
Output	Request for organiser authorisation assessed by MSCA, the request can be classified as complete or incomplete.
Business rules	
Capability	Workflow management, document management
Constraints	n/a
References	n/a
Points to clarify	n/a

Title	Request missing information
Description	The MSCA returns the request for authorisation to the organiser with a status indicating that some information is missing.
Database	Request status update stored in TRACES or national system database
Input	Request assessed as incomplete in step Examine request
Output	Request returned to Organiser asking for missing information to be provided.
Business rules	
Capability	Workflow management, document management
Constraints	n/a
References	n/a
Points to clarify	n/a

Title	Notify decision
Description	The MSCA notifies its decision to grant or refuse the requested authorisation for long journeys.
Database	MSCA decision stored in TRACES or national system database
Input	Request assessed as complete in step Examine request
Output	Decision notification sent to the organiser by means of updated Annex V Section 1 Form

Business rules	2.The authorisation shall specify the species and categories of animals, and the type(s) of transport covered and whether it covers the transport of animals to third countries or not. - The authorisation shall be valid for a period of not more than 5 years from the date of issue.
Capability	Workflow management, document management
Constraints	n/a
References	(European Commission, 2023, p. Art 6)
Points to clarify	n/a

Title	Update Organiser record
Description	The workflow system automatically updates the organiser’s record with the results of the decision communicated in step “Notify Decision”.
Database	MSCA decision stored in the TRACES or national system database
Input	Decision notified to the organiser (Form Annex I Section 5)
Output	Decision recorded in system database
Business rules	n/a
Capability	Record management
Constraints	n/a
References	(European Commission, 2023, p. Art 6)
Points to clarify	n/a

Title	Submit Renewal Request

Description	The Organiser submits a request for renewal of an existing authorisation
Database	Existing authorisation stored in TRACES or national system database
Input	Existing authorisation
Output	Request for renewal
Business rules	• Organiser authorisations have a 5-year validity period. • The request for renewal must be submitted one month before the expiry of the organiser authorisation
Capability	Workflow management, document management
Constraints	n/a
References	(European Commission, 2023, p. Art 6)
Points to clarify	n/a

Transporter authorisation process

For transporters, the Proposed Regulation foresees two different types of authorisations to be granted by the MSCA: one for short journeys and one for long journeys. The two types of requests were grouped below into a single process for the sake of brevity as the only notable difference is the type of forms used to support the approval process.

Since the type of activities involved is largely similar to the organiser authorisation process, we did not duplicate the activity breakdown but refer the reader to the section in the organiser authorisation process for more details.

Articles 7, 8 & 9 - Application for transporter authorisation for short & long journeys (new & renewals)

Scenario: All

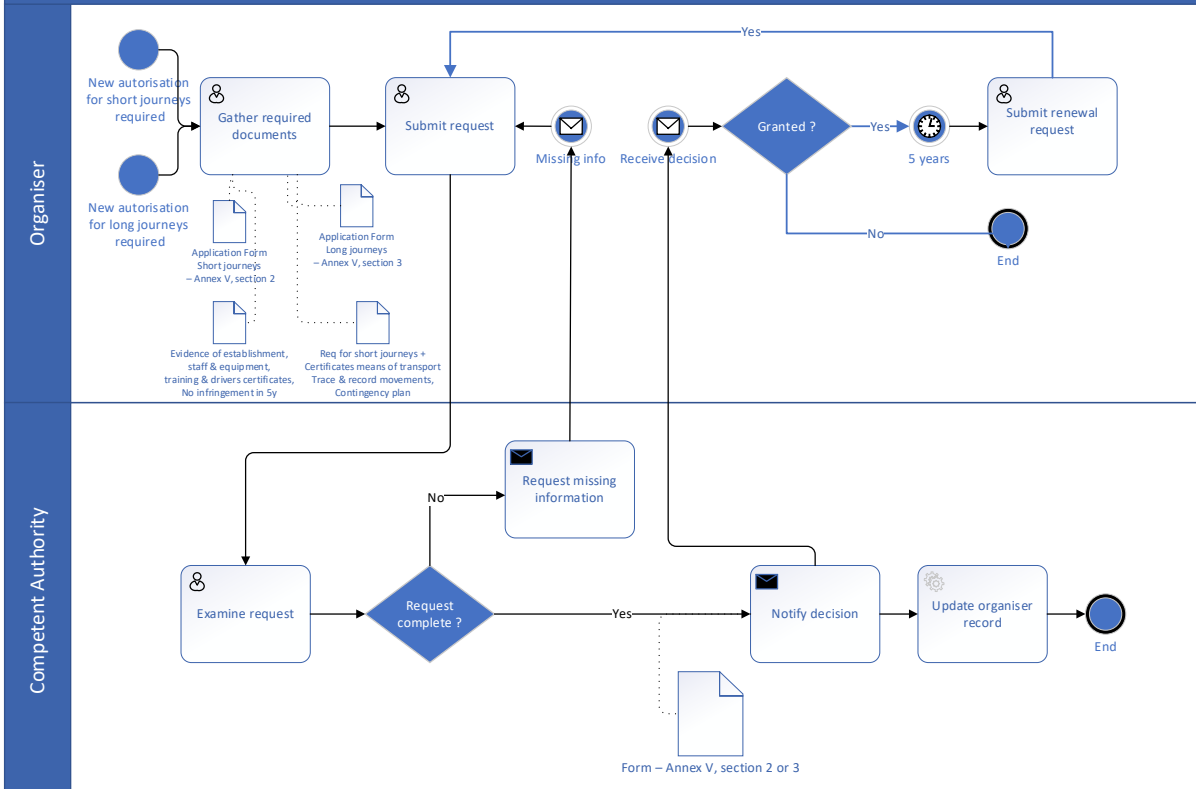


Figure 11 Transporter Authorisation Process

Suspension/Renewal

The Proposed Regulation foresees a specific process flow for suspension and withdrawal of authorisations (Renewals were covered in the previous sections). Here also there is no notable difference between the suspension/withdrawal process for an organiser authorisation versus a transporter authorisation (long or short) so all related activities were grouped into a single process flow.

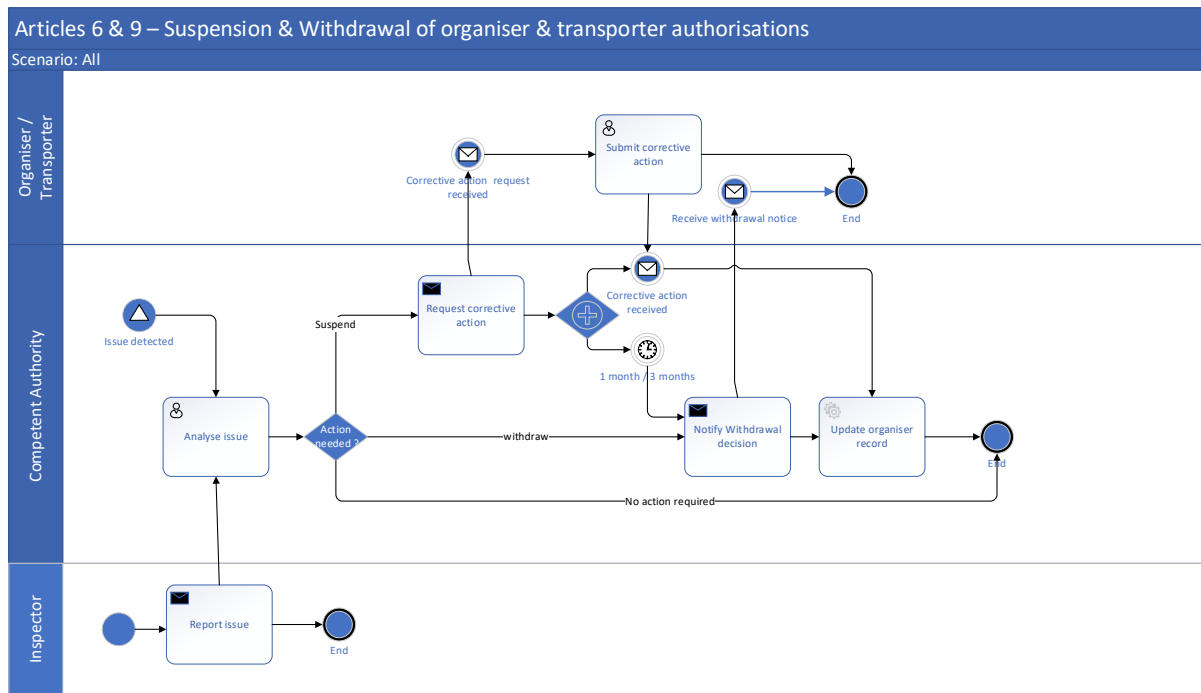


Figure 12 Organiser/Transporter Suspension Renewal Process

Title	Analyse issue
Description	The MSCA is made aware of an issue regarding a transporter or organiser and analyses whether action should be taken to suspend or withdraw the authorisation.
Database	Existing authorisation stored in TRACES or national system database
Input	The MSCA can be triggered to start the review by means of an external event or can notice that the conditions for approval are no longer met by the organiser/transporter when reviewing a request for renewal.
Output	A decision whether action is required or not
Business rules	•
Capability	Workflow management, document management

Constraints	n/a
References	(European Commission, 2023, p. Art 9)
Points to clarify	n/a

Title	Request Corrective Action
Description	The MSCA may decide to suspend the authorisation of the organiser / transporter and request corrective action based on the analysis of the issue carried out in the previous step.
Database	Existing authorisation stored in TRACES or national system database
Input	Outcome of the analys step
Output	Authorisation record is suspended in the system Request for corrective action sent to organiser/transporter
Business rules	•
Capability	Workflow management, document management
Constraints	n/a
References	(European Commission, 2023, p. Art 9)
Points to clarify	n/a

Title	Submit Corrective Action
Description	Upon receiving the request for Corrective Action from its MSCA, the organiser/transporter proceeds to correct the issue and provide evidence back to its MSCA of the measures implemented.

Database	Existing authorisation stored in TRACES or national system database
Input	Request for corrective action received from MSCA
Output	Evidence of implemented measures provided back to the MSCA
Business rules	The transporter / organizer has one month to provide evidence of the corrected deficiencies back to the MSCA
Capability	Workflow management, document management
Constraints	n/a
References	(European Commission, 2023, p. Art 8)
Points to clarify	n/a

Title	Notify Withdraw Authorisation
Description	If the organiser / transporter does not provide evidence of undertaken corrective actions within one month of the Suspension notification, the MSCA shall withdraw the authorisation and notify the organiser/transporter.
Database	Existing authorisation stored in TRACES or national system database
Input	Request for corrective action received from MSCA
Output	Notification of withdrawal sent to the operator Operator record updated
Business rules	
Capability	Workflow management, document management
Constraints	n/a

References	(European Commission, 2023, p. Art 9)
Points to clarify	n/a

- Journey Log process

The Animal Journey Log (AJL) process covers the execution of animal transport activities, from the initial planning of the journey by the organiser until the end of the journey and the completion of related administrative tasks.

The AJL process is very much structured around the five sections that constitute the log and are ordered in a chronological fashion, from “Planning”, to “Place of Departure”, “Place of destination”, “Transporter declaration” and an optional “Anomaly Report” (see 4.1.2 for details).

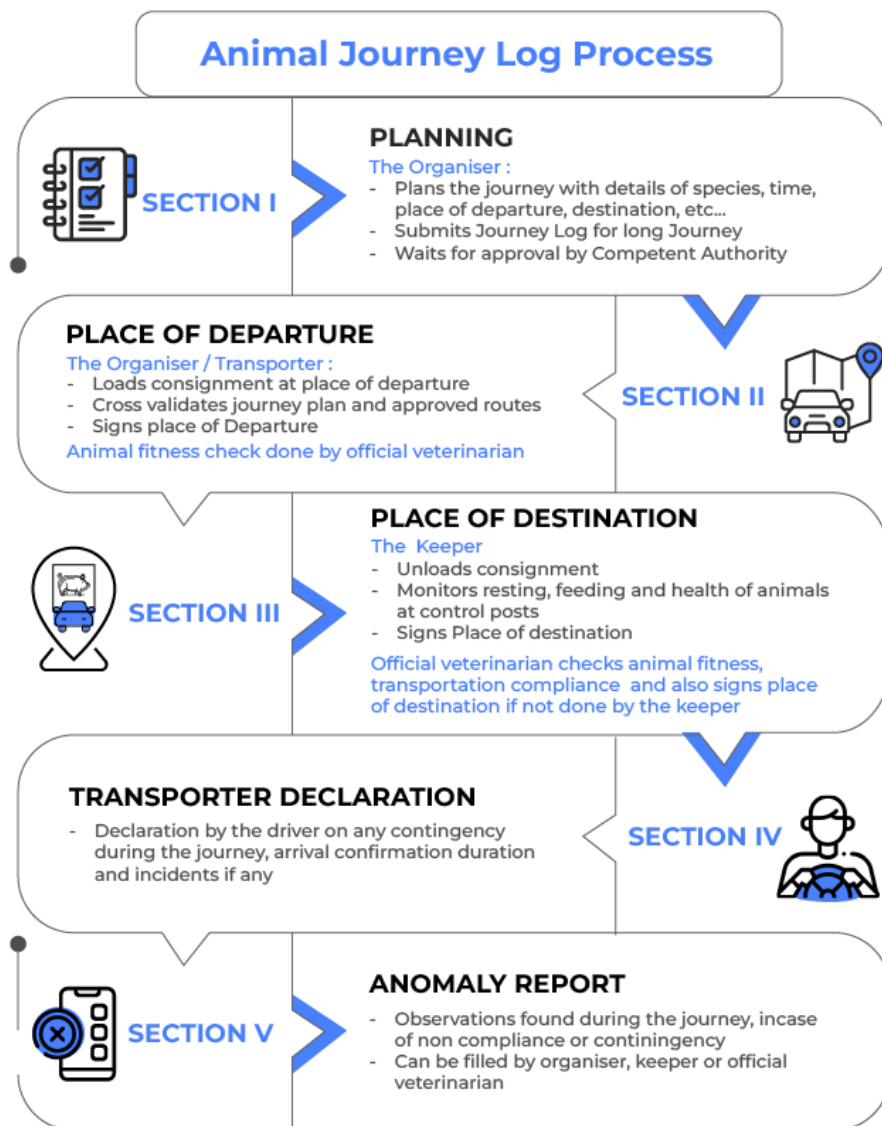


Figure 13 Animal Journey Log high level

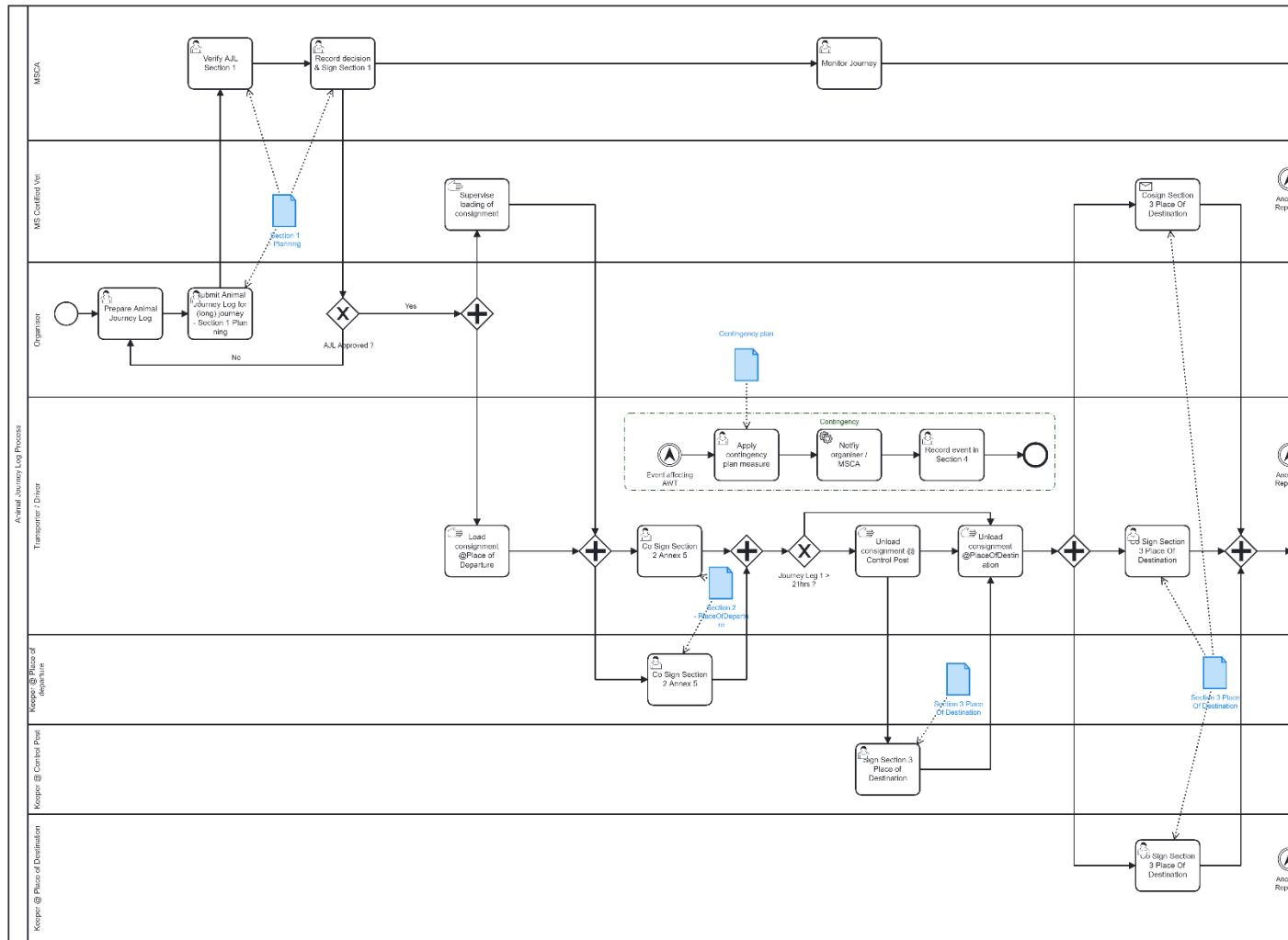


Figure 14 Animal Journey Log Process

The Animal Journey Log process modelling proposed above focuses on one specific perspective, namely the flow of information through the process by means of the issuance of the 5 AJL Sections. This is a relevant perspective as those 5 forms represent crucial moments in the flow and also centralise the interaction between the various actors of the process .

The consultation report highlighted the fact that the current AJL flow only makes use of the TRACES application to a limited extent, with only the planning form being used in a digital manner and the subsequent phases of the process being largely paper based.

○ Key insights

The analysis of requirements around the two main processes studied in this section provides a number of key insights that will be further analysed in subsequent parts of the document and can be grouped by the capabilities that are invoked by each process activity described above.

- The To-Be processes rely heavily on workflow and collaboration mechanisms to support effectively the process actors. Requests are submitted, processed and completed, records get suspended, withdrawn or re-activated, actions are queued for identified actors, timers are triggered in the flows based on predefined thresholds, etc ...
- Flows are driven by business rules and may need to be triggered by external events
- Documents get either exchanged (forms) or issued (Authorisations) (See **Document issuance versus exchange** for a discussion on the difference between exchange and issuance) , their status may vary as a result of predefined actions (grant, suspend, withdraw....) , in some cases, digital certification may be required to trigger the next step in the process , etc..
- As a result of the processes, operator records get updated to reflect the change in Authorisation states, so that they can be accessed and reviewed by other MSCAs.

Capabilities such as Workflow management, Document management, record management, business rules management will be analysed in a technology-agnostic way, allowing us to identify and analyse the required features of the to-be situation without having to rely on technological choices or dependencies. The capabilities that are starting to emerge from the requirements and the definition of the flows will need to be analysed, defined and prioritised and, most importantly, will remain relevant, regardless of ulterior technological choices made by MSCAs.

- Technical assessment
 - Interoperability assessment

Mission & Scope

This sub-chapter maps the live (“as-is”) interoperability of TRACES NT — the “TRAdE Control and Expert System, New Technology.” It describes only currently running interfaces, their associated data contracts, and the support processes in place, primarily for a DG SANTE audience. This factual overview serves as a crucial baseline for subsequent gap analysis and future strategic planning. Planned enhancements such as GPS feeds, mobile applications, or other “to-be” elements are addressed in Chapter 6. The evidence presented here is drawn from requirement IDs 1-27, steering-committee minutes, and TRACES technical annexes.

Integration Styles in Production - The SOAP / WSDL Service Layer

The primary mechanism for all business-to-business data flow within TRACES NT is SOAP (Simple Object Access Protocol) messaging conducted over HTTPS, a choice reflecting established practices for reliable and structured government-to-government or government-to-business exchanges. The system exposes approximately twenty WSDL (Web Services

Description Language) contracts to facilitate these exchanges, defining the formal contract for data exchange and enforcing required data structures. Among these, several are key to its operations, including services for UN-CEFACT import submissions, EU export certificate status retrieval, and the Metadata WebService (MDWS) for reference data. To ensure secure and efficient transmission, these services employ WS-Security (Web-Services Security) standards, typically using a username-token and timestamp, and utilize MTOM (Message Transmission Optimisation Mechanism) for managing payloads that exceed 5 MB.

Integration Styles in Production - Internal REST End-point Utilization

While SOAP dominates external communication, REST (Representational State Transfer) with JSON is utilized internally, primarily for front-end Ajax calls within the user interface and for certain background job processing. These RESTful end-points are not publicly exposed and are generally version-locked to the front-end build, ensuring internal consistency. Currently, two Member-State pilot projects, involving Greece and Estonia, consume a thin REST wrapper for specific functionalities, though no formal, public REST contract has been established for broader external use, meaning partners predominantly integrate via the more traditional SOAP calls.

Interface Version & Release Management Practices

TRACES NT operates with multiple versions of its WSDLs simultaneously, with the number of active versions varying by service; for instance, the CERT web service has as many as six. This version sprawl arose as some external consumers and partner systems, particularly Member State systems, lagged in upgrading their interfaces. While minor updates are released biannually, a formal deprecation calendar for older versions is not in place, leading to an accumulation of technical debt. Consequently, a notable portion of inbound traffic still targets older WSDLs, which increases regression-testing efforts and requires the system to maintain support for potentially obsolete security protocols.

Connections with EU-Level Systems - The CERTEX Customs Single Window Link

TRACES NT maintains a bidirectional SOAP-based link with CERTEX (Customs Single Window CERTification EXchange), operated by DG TAXUD. This integration allows for the automated sharing of sanitary and phytosanitary certificate information, such as Common Health Entry Documents (CHED), organic import certificates (COI), and forestry FLEGT licenses, with Member States' customs IT systems in real time. This connection operates under a service-level agreement stipulating a round-trip time of less than five seconds, allowing customs declarants to use the TRACES reference number to automatically verify certificates during customs procedures, thus eliminating the need for border officials to re-enter details manually.

Connections with EU-Level Systems - Integration with IMSOC Components

The system is integrated with several components under the IMSOC (Information Management System for Official Controls) legal umbrella. For instance, a rejection of a CHED (Common Health Entry Document) in TRACES can trigger alerts within iRASFF (internet Rapid Alert System for Food and Feed), facilitating rapid communication for food safety incidents. Furthermore, both AAC (Administrative Assistance & Cooperation) and ADIS (Animal Disease Information System) consume event feeds from TRACES; ADIS replaced the legacy ADNS system in 2021. To ensure a standardized communication pathway, the messages exchanged between TRACES and these active IMSOC integrations utilize a common XML data structure. In contrast, while the Europhyt Portal (formerly EUROPHYT) is part of the same regulatory framework, there is no technical API integration with TRACES, as the systems serve distinct business domains.

Connections with EU-Level Systems - The IPPC ePhyto Hub Connection

TRACES NT serves as the single EU connection point to the IPPC (International Plant Protection Convention) ePhyto Hub, enabling the global exchange of electronic phytosanitary certificates. This interface, operational since 2020, allows TRACES to both receive ePhytos from non-EU countries and send EU export ePhytos to destination countries. This connection facilitates the exchange of electronic phytosanitary certificates (ePhytos) globally, utilizing the UN/CEFACT SPS XML standard, which has significantly reduced the need for paper certificates and expedited plant health information exchange.

Connections with EU-Level Systems - THETIS

In contrast to these established integrations, there is no automated API link with THETIS (The Hybrid European Targeting & Inspection System), managed by EMSA. THETIS holds maritime-safety data, including crucial livestock-vessel approvals and is also used for monitoring waste shipments. While an interface between TRACES and THETIS has not been required in any sectorial legislation so far, it could become a potential future improvement that would allow the import of IMO (International Maritime Organization) numbers and related vessel data from THETIS into the TRACES Journey Logs. Such an integration would facilitate data entry by operators and reduce the risks of data inconsistency created by manual entry.

Member-State System Connections - Certificate Exchange Mechanisms

Several Member States connect their national systems to TRACES NT, but adoption and integration methods vary significantly. The most common interaction is pulling data, where national systems download certificates from TRACES for local processing. A smaller number of states—currently three—actively push data, for instance by submitting CHED documents via the `UN-CEFACT-IMPORT-SUBMIT` SOAP endpoint. Many national authorities still rely on manual

UI entry, a fact reflected in the numerous fields marked for manual handling in the official UN/CEFACT mapping files. The integration approaches are not uniform; for example, Greece's BOVEX system for bovine data exchange uses a mixture of SOAP, REST/JSON, and periodic sync daemons, highlighting the hybrid nature of Member-State connections.

Member-State System Connections - Reference-Data Synchronization via MDWS

Synchronization of reference and directory data is actively used by nineteen Member States to improve consistency with their national systems. This is achieved through a suite of distinct SOAP endpoints, including the Authority Directory Service (for entities like border control posts), the Operator Directory Service (for economic operators and transporters), and the Controlled Location Directory Service (for warehouses). These services, often consumed via daily delta files, aim to reduce data duplication. A push mode is also available, allowing for the submission of new regional approvals directly into the system, ensuring that shared reference data remains current.

Member-State System Connections - Challenges in Data Quality & Mastership

To manage reference data, the system uses Elasticsearch-based similarity matching to identify potential duplicates (this method replaced the Levenshtein distance algorithm previously used in the legacy TRACES Classic system). However, for establishment data, there are no universally agreed-upon mastership rules, meaning conflicts often require manual reconciliation, impacting data consistency. These challenges are compounded by the varying technical capacities and harmonization efforts across Member States.

Adherence to Standards, Code Lists & Validation Rules - The UN/CEFACT SPS Schema Foundation

The UN/CEFACT (United Nations Centre for Trade Facilitation and Electronic Business) SPS (Sanitary & Phytosanitary) schema forms the primary XML data structure for all import and export certificates within TRACES NT. This adherence to an internationally agreed format, particularly for ePhytos under ISPM 12, ensures that data exchanged is compatible worldwide. All exchanged data is validated against XSD 1.0 to ensure conformity before further business rule processing.

Adherence to Standards, Code Lists & Validation Rules - Ensuring Security & Trust

TRACES NT relies on several auxiliary code lists for standardized data representation, crucial for ensuring data consistency and interoperability in international trade. These include ISO-2 country codes for identifying nations, CN (Combined Nomenclature) commodity codes for tariff alignment and product classification, and IMO vessel identifiers for uniquely identifying maritime

vessels. Additionally, OpenStreetMap (OSM) is used as a reference data source, providing a background for displaying geo-coordinates and for a route calculator that estimates journey times. These lists are managed within the MDWS and are refreshed on a quarterly basis to maintain accuracy.

Observability & Support Processes for Integrations

Observability of integration performance is limited. While QlikSense is used for generating statistical reports on certificate volumes, it does not provide real-time monitoring of key technical metrics such as API success rates or average latency. The system currently lacks synthetic health checks that would proactively ping partner endpoints to detect issues before users report them. Consequently, authorities often learn about failures reactively. For support, an integration-specific mailbox (sante-traces@ec.europa.eu) is in place to handle partner queries.

A Snapshot of Business Impact

Effective interoperability allows TRACES NT to function as the European Union's single sanitary window, streamlining trade and control processes from a Commission-centric strategic perspective. The existing SOAP interfaces and adherence to UN/CEFACT schemas facilitate the processing of millions of certificates annually, significantly reducing border clearance times and supporting the EU's digital agenda. However, issues such as WSDL version sprawl, limited observability of interface health, and the implementing missing link with THETIS inflate maintenance costs and expose Member States to risks related to data quality and animal welfare. Addressing these gaps is a welcomed prerequisite for successfully implementing upcoming EU obligations.

- Modularity assessment

Modularity

TRACES NT follows a clear service-oriented layout: journey-log management, certificate handling, reference-data synchronisation and audit trails are packaged as separate EAR files on the WebLogic cluster. Each package owns its own SOAP contract, allowing teams to evolve a single capability—say, the CHED schema—without touching the Operator Directory or Metadata Web Service. This “one-contract, one-package” rule keeps release scope tight, shortens regression cycles and confines operational risk to the module being changed.

Inside each EAR, the codebase adopts a modular-monolith style. Domain areas—organic certificates, catch certificates, journey logs—live in distinct namespaces yet share the same

security stack, reference-data layer and audit interceptor. When another Directorate-General needs “certificate-like” functionality, developers plug their new module into these common services instead of rebuilding them, achieving functional breadth with minimal duplication. Reuse extends to taxonomy lists, operator registries and user-management screens, promoting consistency across all certificate types.

The single deployable artefact simplifies orchestration: a one-click rollout updates every domain at once and preserves in-process calls that avoid network hops. Performance profiling shows that this cohesion keeps latency low while maintaining a single point of governance for security patches and configuration changes.

Maintainability

Several engineering choices support smooth upkeep. Strict layering—presentation, business logic, integration—guides developers quickly to the source of a defect. Versioned WSDLs safeguard backward compatibility, so partner systems can remain on earlier interfaces while new features compile against the latest one. The build pipeline compiles and deploys each EAR independently, enabling targeted hot-fixes and reducing turnaround time for urgent updates. Shared utility libraries deliver consistent logging and encryption patterns across modules, lowering the cognitive load for newcomers.

Growth brings healthy opportunities for housekeeping. The unified codebase now exceeds one million lines, reflecting its rich feature set. Established AngularJS screens coexist with newer Angular views, and backend classes span JDK 8 through JDK 17 compilation targets. A phased renewal programme is already under way: teams retire AngularJS components as functional areas receive UX updates, and each JDK uplift is rehearsed in pre-production before reaching live traffic. These incremental steps refresh technologies without disrupting day-to-day operations.

Opportunities for further enhancement

The forthcoming stream of high-frequency telemetry encourages the team to extend today’s blueprint. Encapsulating the positioning interface in a lightweight, decoupled microservice—still governed by the existing integration tier—would preserve the proven EAR model while adding elastic scaling where it provides the greatest benefit. Automated dependency updates, expanded unit-test coverage and service-level health checks can build on the current pipeline to accelerate releases and monitor quality proactively. Should future scale or complexity make a domain-based split advantageous, the existing module boundaries already offer natural extraction points, ensuring TRACES NT remains adaptable and maintainable over the long term.

- Security assessment

Mission & Scope

This sub-chapter summarises the live (“as-is”) security posture of TRACES NT. We focus on how the platform currently protects data confidentiality, integrity and availability, drawing on DIGIT

hosting guidelines, operational run-books and service-desk interviews. Planned enhancements—mobile apps, GPS feeds, zero-trust measures—are reserved for Chapter 6.

Identity & Access Management

EU Login supplies single sign-on and multi-factor options; TRACES maps the asserted identity to role-based access profiles that govern screens, actions and API calls. Delegated access (“act on behalf of”) is available for economic operators; audit events capture the real and delegated identity. Member-State coordinators periodically review user lists and close dormant accounts.

Opportunity: automate those reviews through attestation workflows and explore attribute-based controls for finer policy granularity.

Transport Security & Encryption

External traffic terminates on a reverse-proxy shield that enforces modern TLS cipher suites; legacy partners can temporarily fall back to older protocols in a grace period. SOAP interfaces add WS-Security headers with username tokens and timestamps; large payloads use MTOM to avoid re-transmission overhead. Server certificates are issued and rotated by DIGIT without affecting business users.

Opportunity: align every partner on the current TLS baseline and introduce certificate pinning for forthcoming mobile clients.

Application & Infrastructure Hardening

The core Java EE stack runs on Oracle WebLogic hosted in DIGIT’s data centre, with operating-system hardening scripts applied at build time. Disks in the database tier are encrypted at the storage layer; table-space encryption is kept in reserve for future legal mandates. A web application firewall filters common OWASP attacks before traffic reaches WebLogic.

Opportunity: pilot container-based isolation to simplify blue-green deployments and shorten patch lead times.

Auditability & Logging

Every business event—certificate creation, journey-log approval, reference-data change—is written to an immutable audit table with user ID, timestamp and before/after values. System logs stream to a central Elastic Stack where support staff run ad-hoc queries and receive daily anomaly digests.

Opportunity: feed the same telemetry into the corporate SIEM for real-time correlation across Commission systems.

Vulnerability Management & Patch Governance

DIGIT applies security fixes on a regular rhythm; the TRACES team validates each bundle in pre-production before rollout. Static code scanning runs on every commit and dependency-check

reports shape sprint priorities. Independent penetration tests are scheduled under the IMSOC programme and findings enter a tracked remediation backlog.

Opportunity: extend dynamic application security testing to the SOAP layer and automate third-party library updates.

Digital Signatures & Document Integrity

TRACES integrates the DSS-EU toolkit to attach XAdES signatures, ensuring non-repudiation of official documents. Signatures are validated whenever a user opens a document; any validation issue blocks further processing and raises a support notice.

Opportunity: introduce an early-warning pipeline that tests upcoming DSS releases against a regression pack.

Interoperability Security Touch-Points

Partner systems authenticate to SOAP endpoints with WS-Security certificates stored in WebLogic trust-stores. Internal REST calls for the modern UI use secure session cookies; migrating legacy pages to the same framework would allow uniform CSRF protection. A global request-rate guard is present, and per-partner quotas are ready to be enabled as traffic grows.

Opportunity: automate certificate rotation and activate fine-grained throttling to strengthen resilience.

Security Operations & Incident Response

DIGIT's operations centre monitors infrastructure around the clock, while application-specific alerts route to the TRACES hotline during business hours. Run-books define triage steps, escalation contacts and lessons-learned templates. A recent search-cluster slowdown highlighted the benefit of JVM-heap alerts, now standard in the dashboard.

Opportunity: add business-metric triggers—such as sudden drops in certificate submissions—to turn functional anomalies into actionable signals.

Security Observability & Metrics

Key indicators—failed logins, invalid-token calls, audit-log growth—appear in weekly management briefings that guide capacity planning and highlight unusual patterns.

Opportunity: adopt a rolling year-over-year window to visualise seasonal peaks and tune defensive measures in advance.

Snapshot of Business Impact

Today's control set allows TRACES NT to move high-value sanitary and phytosanitary data across borders while respecting GDPR and eIDAS obligations. Centralised authentication accelerates onboarding, encryption shields data in transit and at rest, and layered logging underpins legal traceability. Advancing the improvement areas outlined above—automated alerting, uniform TLS

enforcement, proactive code scanning—will further strengthen resilience without disrupting the platform’s proven operational model.

- Performance assessment

Mission & Scope

This section captures the performance characteristics that TRACES NT demonstrates in production today. Findings rely on DIGIT run-books, quarterly incident logs and the most recent pre-release stress-test dossiers. Topics such as mobile apps, live GPS feeds or rule-based auto-scaling lie outside this snapshot and are discussed later in the roadmap.

Current Scalability Model

TRACES operates on a WebLogic cluster of eight managed servers, evenly distributed across two Commission data centres. The footprint was calculated against the highest certificate peak observed in past years and has remained stable ever since. When additional capacity is required—for example, ahead of a major regulatory launch—the team raises a formal change request and schedules the upgrade during the quarterly maintenance window. This fixed-size approach keeps response times predictable, although it also means any surge that exceeds the historical maximum must be anticipated well in advance.

Load and Stress-Testing Practices

Before each functional release, service-desk staff replay certificate search, journey-log submission and bulk import scenarios in a dedicated pre-production environment. The goal is to confirm that search pages still respond within roughly two seconds and that multi-step submissions finish inside the five-second comfort window agreed with business owners. These exercises run a few times a year and give the operations team confidence that planned code changes will not jeopardise baseline performance. Interim patches rely on shorter smoke tests rather than full saturation runs.

Monitoring and Alerting

Application metrics—CPU usage, JVM heap evolution, database connection counts and queue depths—stream continuously into the corporate Elastic Stack. Dashboards highlight threshold breaches, and hard failures trigger e-mail and chat alerts that reach the on-call engineer during office hours. Overnight, DIGIT’s infrastructure team handles platform-level incidents; functional anomalies such as slower-than-usual certificate queries are usually investigated the following morning. Trend-based insights, like a gradual rise in query latency, depend on manual review of weekly graphs.

Cloud Transition and Auto-Scaling Prospects

Non-production workloads already run in containers, and the production environment is in the process of being lifted to the same DIGIT-managed Kubernetes cluster. Each legacy server maps

one-to-one to a pod, so the effective capacity mirrors the on-premises setup. Horizontal pod auto-scaling remains disabled because governance still requires a fixed monthly resource envelope and because the application does not yet export service-level metrics suitable for automatic scaling decisions. Readiness probes and resource limits are, however, active, which means the technical groundwork for elasticity is largely in place once budget policy and monitoring breadth converge.

Database and Search Performance

Transactional data lives in Oracle, while Elasticsearch handles free-text queries and log analytics. Index reviews take place every quarter; unused indices are dropped, and composite keys are added where slow-query logs point to table scans. A recent expansion of the Elasticsearch cluster reduced shard-reallocation time after maintenance from nearly half an hour to well under ten minutes, noticeably shortening service windows. As each new business module introduces more complex searches, the search tier sometimes experiences short spikes in CPU usage, but these have so far been resolved by fine-tuning fetch sizes and query caches rather than adding hardware.

Frontend and API Responsiveness

Roughly half of the user interface now runs on a modern Angular stack that makes use of lazy loading, bundle splitting and consistent HTTP caching headers. The remaining screens still rely on AngularJS but inherit the same server-side caching policies. Internal REST calls and external SOAP services both traverse the Commission network, and their round-trip times stay within usability expectations unless a bulk upload coincides with heavy interactive use.

Resource Planning and Data Life-Cycle

CPU and memory reservations follow a quarterly planning routine. The team deliberately keeps about one-fifth of capacity unused to absorb unexpected spikes without breaching service windows. Oracle tablespaces and Elasticsearch indices grow at a single-digit percentage each quarter, a pace that remains manageable on the existing storage pool. Long-term regulations will soon require multi-year retention of high-volume positioning data, a demand that the current single-tier storage layout cannot meet economically. Architects have therefore outlined, though not yet implemented, a tiered storage model that would keep recent data on the fastest media while shifting older records to a lower-cost archive.

Quality-of-Service Metrics

Weekly management briefings present average page load times, median API latency and overall throughput broken down by module. The emphasis is on user-perceived speed rather than raw infrastructure counters, a focus that helps business owners relate system health to daily operations. Tail-latency metrics such as the ninety-fifth percentile are not routinely plotted, leaving occasional outlier delays less visible.

Snapshot of Business Impact

The current design provides thousands of daily users with steady certificate processing and consistent query times. Fixed sizing, targeted pre-release stress tests and disciplined index maintenance keep the platform reliable. At the same time, the absence of continuous load monitoring, automatic scaling and automated storage tiering means that future high-volume features will require careful groundwork to maintain today's service levels without introducing cost or risk surprises.

- Functional assessment

- Definition of business capabilities

The Business capability concept was introduced in the Consultation report as one of the consolidation categories for collected Stakeholders requirements.

For the purpose of this study, we use the concept of business capabilities in the TOGAF sense, namely as *“a particular ability or capacity that a business may possess or exchange to achieve a specific purpose or outcome.”* (The Open Group, 2025)

The key element is that “Business capabilities are coarse-grained concepts that enable business planning from different viewpoints. Business capabilities **are built to focus on what the business does rather than how the business uses capabilities** to deliver value. That said, in order for a capability to be defined, we need to understand how the capability is realized in the form of people, processes, information, and resources. The key distinction is that the elements of a business capability can change regularly, whereas the business capability itself can endure over longer planning horizons.” (The Open Group, 2025)

By focussing on the **What** rather than the **How**, Business capabilities differ fundamentally from features & functionalities etc. By stating that a MSCA must have a Workflow Management Capability, we are saying that in order to effectively deliver value in the Animal Journey Log or Certification processes, the MSCA must be capable of managing tasks and actions required by the lifecycle of the AJL. The capability in itself does not specify **how** the MSCA will perform those activities.

This gives a long-term stability to the concept of capability that can form the framework for product roadmaps that will define how the business wants a given capability to be realised in the future versus now: the capability will remain, but should be realised in a different/more efficient/more user friendly manner in the future.

Another essential element of Capabilities is that they can (and should) be decomposed in underlying capabilities.

- From Business Requirements to Capabilities

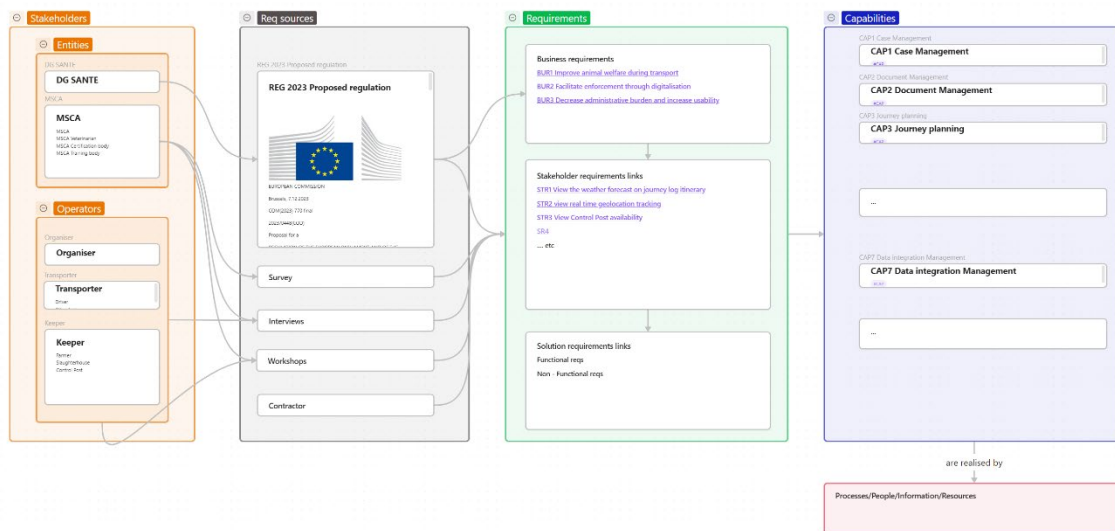


Figure 15 From Requirements to Capabilities

Just like Business Capabilities differ from Features, they also should not be equated to Stakeholder requirements. When the business context or the organisation's priorities change, stakeholders may require for a given capability to be upgraded in order for them to continue to deliver value in the new environment. A new capability can also emerge as a response to new requirements.

In the consultation report, we used Capabilities as one of several dimensions around which to consolidate requirements. The requirements were grouped under the capability(ies) that would be required for the business to support those requirements.

The following sections will review TRACES capabilities one by one, linking them on the one hand to the related requirements from the consultation report and on the other hand to capabilities on which they will depend. An assessment of TRACES will then be done for that particular capability. Given the stable nature of Capabilities as explained above, they form a natural category to assess the readiness of an application (eg TRACES) to support new requirements (2023 Regulation): the capability may exist but may / will require enhancements to better support existing and new stakeholders' requirements.

- The AWT Capability Map

The following capabilities have been retained for the purpose of the AWT Study and will be further defined in the following sections along with their respective subcategories.

Capability	Definition
Case Management	Ability to view, manage, store all documents and related business rules and attributes in order to support process decisions and actions.
Record management Entities	Ability to create and maintain record information (transporter, ...) , across cases see compliance management capability
Document management Document CRUD Document signature Document exchange Document retrieval Document disposal File upload Template management Meta data tagging	Ability to create, receive , validate , exchange, store documents or other type of information required for the execution of the process Ability to create, update , delete documents in the application using standard templates Ability to electronically sign a document in a way that unequivocally establishes the identity of the signer and the authenticity of the signed document Ability to send or receive documents electronically and link them to the corresponding case Ability to retrieve stored documents from within a case container, either through the case interface or through a keyword or metadata search Ability to dispose of documents either manually or automatically when specific business rules apply (retention period exceeded etc) Ability to upload documents, videos, photos ... to a specific case so that they can be stored and later retrieved Ability to add , update or remove document templates Ability to store & display meta-data such as author, date, ... to documents saved against the case
Journey Management Journey planning Journey stop CP Booking Journey validation Duration validation Weather validation	Ability to plan and execute animal transport according to business rules and regulatory requirements Ability to create and store a planned journey log for animal transport Ability to select / create an additional journey point and add to the AJL Ability to check availability of and book a control post and provide evidence Ability to detect inconsistencies and non-compliances during journey planning process Ability to visualise planned durations and possible non compliances Ability to visualise weather forecast information on planned journey on possible non compliances
Compliance management Timers and alerts mgt Record management Entitlement checking Record checking Compliance monitoring RT tracking Plan-to-Actual checking Historical tracking	Ability to detect in real time or a posteriori non compliant data or behaviour and enforce remediation actions Ability to generate real time notifications or alerts to system users if a predefined event occurs so that the user can take preventive or corrective actions Ability to retrieve and visualise historical information relating to a case or an actor to support decision making [note : The ISO 15489-1:2016 defines records as "information created, received, and maintained as evidence and as an asset by an organization or person, in pursuit of legal obligations or in the transaction of business".] Ability to verify that an actor has the required authorisations and or certifications to perform a given activity Ability to verify previous entitlement requests submitted by an operator, possibly in different countries Ability to verify compliance in real-time during the journey Ability to compare submitted and actual journey logs and identify plan-to-actual deviations
Workflow management Task assignment Queue management Messaging Task lifecycle	Ability to assign work items to actor roles and apply actions to those items based on predefined workflows Ability to assign work items in a given case to specific actor roles as defined in the related process Ability to queue incoming tasks for operators to select and process Ability to communicate with other stakeholders on a given workflow Ability to apply predefined actions to activity instances (approve, reject;...etc)
Business rules management Categorise Validate Advise	Ability to manage business rules to support automated decision making Ability to determine regulatory categories that apply to a given business object Ability to determine if a given business object complies with the regulatory requirements Ability to highlight regulatory deviations and suggest alternatives
Data integration Means of Transport info Weather information Geolocation information	Ability to use information from external systems Ability to use information on the Means of Transport to be used by a transporter for a given leg of the planned journey. Ability to use weather forecast information for the key locations defined in the journey log (departure, control post, exit post, destination) Ability to use geolocation and time information pertaining to the arrival to, or departure from, a location defined in the Journey Log
Entitlement management Manage authorisations Manage certificates	Ability for stakeholders to ensure the various entitlements required by the Proposed regulation to conduct Ability to manage organiser and transporter authorisations Ability to manage organiser , transporter , means of transport certificates
Reporting	Ability to extract data collected during the execution of processes for reporting, publication, compliance or predictive analysis purposes
Access management	Ability to grant or revoke access to information in the system to authenticated individuals, based on their role or attributes

Figure 16 AWT Capability map

- Capability Case Management

- Definition

Case Management is a core capability within a software application that enables users to efficiently handle and monitor complex, dynamic processes and tasks that revolve around individual "cases." A case typically represents a unique instance of a subject or issue requiring investigation, resolution, or service delivery—such as a customer complaint, regulatory investigation, permit request, or incident report. The Case Management capability provides the structure, tools, and workflows needed to manage each case throughout its entire lifecycle, from creation to closure.

At its core, Case Management involves the organization and coordination of data, documents, communications, and activities associated with a particular case. It supports the capture and storage of key information in a structured and auditable way, while also allowing flexibility to adapt to the evolving nature of each case. This capability is especially critical in domains where decisions are made over time, with input from multiple stakeholders, and where compliance with policy or legal frameworks is essential.

Key features of a Case Management capability typically include:

- **Case Creation and Intake:** Ability to initiate a case based on incoming information from various sources (e.g., forms, emails, external systems).
- **Workflow and Task Management:** Assignment and tracking of tasks and steps that must be completed, often configurable to suit different case types or business rules.
- **Document and Data Management:** Secure storage of case-related documents, images, and structured data, with version control and metadata tagging.
- **Collaboration Tools:** Facilities for internal and external stakeholders to communicate and share information within the context of a case.
- **Audit Trail and Reporting:** Automatic logging of actions taken within a case, ensuring accountability and enabling performance analysis.
- **Rules and Decision Support:** Integration of business rules engines or automated decision-making tools to guide users and enforce policy.



Figure 17 Case Management

- Review of related requirements

As a more foundational capability, Case Management did not generate specific requirements from stakeholders, rather it should be seen as the underlying framework that brings together the rest of the capabilities listed in this document, and their associated requirements.

- Assessment of TRACES

The term “case” is not used as such in TRACES documentation but much of the required case functionality for the Animal Journey Log process is already being used at the level of either the Certificate (EU INTRA, IMPORT, EXPORT) or the Animal Journey Log itself.

It remains to be determined if

- A new type of case needs to be defined to support the authorisation process: this is quite likely as the authorisation process involves a more limited set of actors than the Animal Journey log process, the sequence of activities and associated process states differs widely and the business rules that apply to it are also very specific.
- The way the current functionality is implemented can fulfil the various requirements of a case, more specifically around access management (see **section 7.14**)

- Capability Record Management

- Definition

Record management is essentially about handling finalised documents that serve as definitive proof of a completed action or decision. Once a document reaches this "record" status, it

becomes immutable, meaning it cannot be altered, ensuring its integrity, “Valid or Cancelled” in case of INTRA and “Deleted, Planning Signed, Place of departure signed, or Place of departure countersigned” for an AJL. These records are crucial for long-term preservation, demonstrating adherence to compliance, audits. This capability also involves the secure storage and consistent updating of accurate information from all relevant actors, especially the organisers and transporters. Ultimately, robust record management helps ensure traceability, supports regulatory compliance, and allows for the efficient reuse of data within the TRACES system.

- Review of related requirements

Regulatory

requirements

Record keeping and management specifies that some records will be kept for a maximum of 6 years. This aligns with broader legal requirements for data retention and auditing in the context of food and feed law, animal health and welfare, and plant health (Regulation (EU) 2017/625).

Member State Competent Authority requirements

Member State Competent Authorities (MSCAs) have specific responsibilities regarding record management within TRACES:

- **Access and Review of Records:** Access and check updated organiser and transporter records. These records are automatically updated through authorisation processes, helping authorities stay informed for proper monitoring and enforcement.
- **Validation of Records:** TRACES functions as a repository where MSCAs can validate certificates and authorisations.
- **Rejection:** A certificate/validation can be rejected, cancelled or suspended by the Competent Authority if they find the information provided by the organiser incorrect or noncompliant.

Operator Requirements

Operators (such as transporters and organisers of animal journeys) also have specific requirements and capabilities related to record management:

- **Enter Accurate Info:** Provide correct details for transporters, drivers, and vehicles.
- **Keep Records Updated:** Make sure all records reflect the latest authorisations and changes to ensure compliance.
- **Create/Update an AJL & INTRA:** Records are created or changed when completing Animal Journey Logs and INTRA certificates.

- **Use Only Approved/Valid Actors:** Select only authorised transporters, drivers, and vehicles for journeys.
- **Support Checks:** Must ensure that all records in TRACES are accurate and accessible to authorities, along with any necessary supporting documents required during live animal transport for inspections or audits.
- **Use Digital Records:** If a certificate is rejected by the Competent Authority, the operator can duplicate it as a new request, correct the errors, and resubmit it using the existing records stored in TRACES.

- Relation to other capabilities

Record management is not an isolated function but is deeply intertwined with several other business capabilities within the TRACES system to ensure a seamless and compliant operational flow.

Document Management:

Record management inherently incorporates document management. The system functions as a repository for certificates and authorizations, which are key documents. The processes of creating, modifying, and storing these documents are integral to record management, ensuring their proper handling and accessibility.

For example, when an operator completes a new application for a transporter authorisation. Upon approval by the Competent Authority, the system automatically generates and stores a digital authorisation certificate as a definitive record, making it accessible for future validation by other MSCAs.

Journey Management:

Record management is critical for Journey Management, particularly through the Animal Journey Log (AJL). The AJL is a comprehensive record of an animal's transport, covering planning, departure, destination, transporter declarations, and anomaly reports. Record management provides the functionality to create, update, and maintain these essential journey-related documents, supporting the traceability and oversight of animal movements.

Compliance Management:

Records provide an immutable audit trail of all user actions, decisions, and communications within the system. This comprehensive record-keeping is crucial for supporting internal reviews and external regulatory audits, allowing the system to monitor data and identify potential compliance breaches.

Workflow Management:

Record management is highly correlated with Workflow Management. Process steps within TRACES frequently generate new documents (e.g., certificates, authorizations), update or delete existing records (e.g., suspending an authorisation), or require the verification of existing documents or records (e.g., verifying a driver certificate). This direct link ensures that records are created and maintained in sync with operational procedures and processes.

Entitlement management

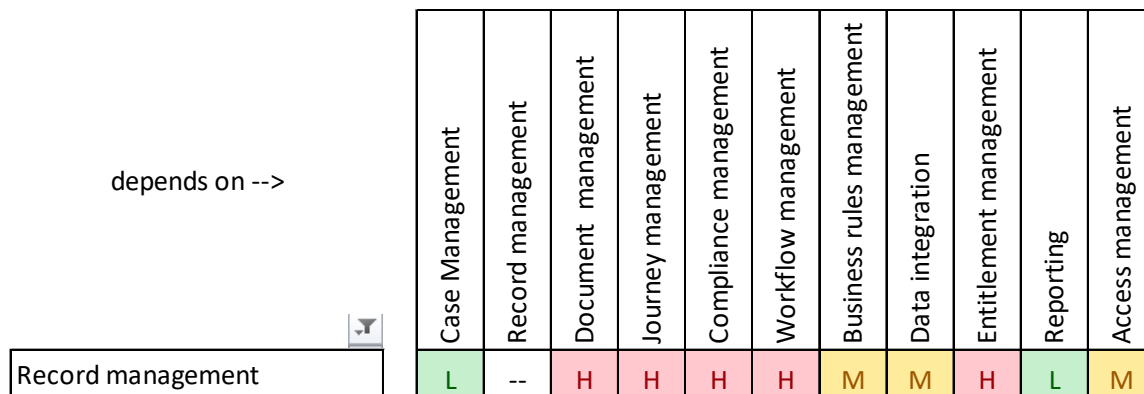


Figure 18 Record Management dependency on other CAPs

Assessment of TRACES

Competent Authorities

Competent Authorities have controlled access to records in TRACES based on their assigned roles and responsibilities. They can view, manage, and update data related to transporters, drivers, vehicles, and certificates when required for checks, approvals, or compliance monitoring. Access is regulated to ensure data protection while enabling effective enforcement.

Local authorities in countries of departure, transit, or destination can access EU Intra records if the consignee is within their jurisdiction.

Authorities do not have default access to operator records outside their area. However, if they are carrying out a consignment check and access the document using the reference number and certification date, they may view the certificate.

Once accessed, authorities can add new controls, particularly in Part 3 of the Intra certificate, as part of their inspection process.

Operators

In TRACES, operators such as transporters, organisers, and assembly centres can manage their own records to prepare and submit documents like Animal Journey Logs (AJLs) and INTRA certificates. Access is restricted to ensure data security, while transporter validity is shown to

help users check compliance. However, only authorities can update transporter status, and updates are managed nationally.

- Operators can access and manage only their own records and cannot access records from other entities unless officially shared.
- Records are used to create and submit transport documents such as AJLs and INTRA certificates.
- Previously approved records can be reused to improve efficiency and consistency.
- Supporting documents (e.g. certificates and approvals) can be attached and viewed.
- Transporter profiles in TRACES include a mandatory validity period, which is displayed through a visible banner to alert users. However, the system does not block the selection of expired transporters, so manual verification of their current authorisation status is required. Only competent authorities can update transporter profiles.

- Summary of insights

Record management in TRACES ensures accurate creation, maintenance, and use of actor records—such as transporters, organisers, and drivers—to support compliance, traceability, and efficiency in live animal transport.

- Regulations require data retention for audit and compliance
- Authorities review and validate records and can suspend or reject them if noncompliant.
- Operators manage only their own records, must use authorised actors, and ensure data is current and accessible for inspections.
- Records support document submission (AJLs, INTRAs), compliance checks, and are integrated with workflows

- Capability Document Management

- Definition

Document management is about the active creation, organization, control, and distribution of documents throughout their operational lifecycle, often before they reach a final, immutable state. Unlike records, documents in this phase are typically dynamic and can be revised, edited or updated – for instance, an INTRA certificate might be in a "Draft or New" status as an economic operator and "Pending Validation" status for an MSCA, and in the process of creating an AJL in a document can adapt a status "Draft or New". This capability is crucial for ensuring efficiency, facilitating collaboration, and maintaining version control during ongoing processes. It involves the methodical preparation, review, and editing of information by all relevant actors. Ultimately,

robust document management helps streamline workflows, reduce errors, and ensure that all necessary information is accurately captured and processed before documents transition into finalised, auditable records within the TRACES system.

- Review of related requirements

Before diving into specific roles, it's important to remember that TRACES aims for a fully digitised and paperless workflow. This inherently means that most document management steps happen electronically within the system.

- **Electronic Submission:** Documents are created and submitted directly in the TRACES system.
- **Structured Data Entry:** Information is entered into predefined fields, often with dropdowns and validations, reducing errors.
- **Notification System:** TRACES sends automated notifications to relevant parties about document status changes (e.g., submission, validation, rejection).
- **Role-Based Access:** Users have specific permissions based on their role (Operator, Authority) and the type of document they are interacting with.
- **Audit Trails:** While records are immutable, the document management phase also tracks changes and user actions, creating an audit trail leading up to finalisation.

Member State Competent Authority requirements

MSCA's are central to validating, controlling, and overseeing the official movement of animals and products. Their document management role involves scrutinizing, approving, and recording official information within TRACES.

A. For Animal Journey Logs (AJL)

- **Approve Journey Plan:** Authorities at the departure point review and countersign Section 2 of the AJL within TRACES. This officially approves the planned journey details to ensure animal welfare standards are met.
- **Record Inspections:** They record any official controls or checks performed on the animals or transport during transit (Section 3) or at the destination (Section 5), documenting compliance or non-compliance.

B. For Intra-Union (INTRA) Certificates

- **Issue Official Certificates:** Authorities at the dispatch point review the submitted details (Part I) and complete Part II of the certificate, formally attesting to the health

requirements of the consignment. They then either validate (issue) or reject the certificate.

- **Record Destination Controls:** Authorities at the destination or transit points use Part III of the certificate to record any controls performed upon the consignment's arrival or during its journey, verifying its status.
- **Manage Certificate Status:** They can cancel a certificate if it's no longer valid or issue a replacement if changes are needed, maintaining an accurate digital trail.

Operator Requirements

Operators are the direct users of TRACES for initiating, preparing, and submitting documentation related to their consignments, and for updating these documents where necessary.

A. For Animal Journey Logs (AJL)

- **Prepare Journey Plan:** Organizers or transporters fill out Sections 1 and 2 of the AJL, providing all details about the animals and the planned itinerary, including resting points and care provisions.
- **Submit for Authority Approval:** They electronically submit the completed initial sections to the departure authority for their official countersignature.
- **Update During Transport:** The transporter must fill in Section 4 of the AJL during the actual journey, recording real-time information such as actual timings, stops, and any unforeseen events or changes. A transporter declaration can also be made.

B. For Intra-Union (INTRA) Certificates

- **Create Description of the consignment:** Economic operators initiate the INTRA certificate by accurately completing Part I, providing all necessary details about the animals or products, their origin, and destination.
- **Submit for Official Validation:** They electronically submit this completed Part I to the competent authority of the country of dispatch to be officially validated and issued.
- **Respond to Feedback:** If the authority identifies issues, operators must correct the information and resubmit the certificate until it meets all regulatory requirements and is validated.

Additional requirements

End to End digitalisation and document processing in TRACES

There is strong support from both the MSCAs and Economic Operators to reduce the reliance of the current process on paper-based documents and use TRACES as the end-to-end platform for digitalisation of documents. (Interviews Sweden , Spain, etc...)

Document access

MSCAs expressed the need for easy access to documents for road side inspections, using QR Codes so that Police officers or other enforcement authorities can have access to a document without having necessarily an access to TRACES. (Interview The Netherlands)

Document signature

One MSCA expressed concern about the fact that signing off a document in TRACES by an economic operator would not mean legal requirements in the Netherlands as there is a need for a Qualified electronic signature. (Interview The Netherlands)

While TRACES supports an electronic seal functionality for MSCAs (DG SANTE, s.d.), the Netherlands believe that the EU-Login based access for Operators will not meet legal requirements in terms of signing off a section of the AJL.

Document retention

The Proposed Regulation introduces specific requirements in terms of data retention, more specifically for data concerning the length of the journey and rest periods on the one hand and positioning data on the other hand. Those data points should be retained for 6 years. (European Commission, 2023, p. (34)). This raises two additional topics which will need to be considered :

- How should the system ensure that the data points are removed after the expiration of the retention period
- Should the entire document that contains the data point be removed along side the data themselves ?
 - Relation to other capabilities

Document management is the core process of handling all system documents. These documents are the information backbone that directly power and connect to almost every other function, like making sure rules are followed, managing tasks, tracking data, and controlling who sees what. It's the central piece that makes everything else work.

Record Management

Effective document management is foundational to record management. It governs the active stages of a document's lifecycle—creation, editing, version control, and collaboration—until a

document reaches its final, immutable form. At that point, it transitions into a record that must be preserved for long-term retention, legal accountability, and auditability. Without proper document management, reliable recordkeeping cannot exist, as both are sequential phases in the broader information lifecycle.

Workflow Management

Workflow management relies directly on document management. Documents are the items that move through set steps in a process. For example, in TRACES, this means documents go from being drafted to being sent, approved, signed, and having checks added. Workflow management automates and tracks these steps, ensuring documents are handled efficiently and correctly. Without documents, there's nothing for the workflow to manage.

Compliance Management

Many documents, like INTRA certificates or journey logs, prove that rules and laws are being followed. Document management helps make sure these documents are filled out correctly, approved by the right authorities, and saved properly. This makes it easier to show compliance when needed.

Access Management

Access management controls who can see, change, or approve documents. This protects sensitive information and makes sure only the right people can make changes. It's an important part of keeping documents safe and accurate.

Data Integration

Documents often contain useful information that can be used in other systems. For example, data from an AJL used when filling in an Intra certificate. Document management makes it possible to collect and share this data easily.

Entitlement management

Document management will be central to the management of entitlements by MSCAs.

depends on -->	Case Management	Record management	Document management	Journey management	Compliance management	Workflow management	Business rules management	Data integration	Entitlement management	Reporting	Access management
	L	H	--	L	H	H	M	H	H	M	H

Document management

Figure 19 Document Management dependency on other CAPs

- Assessment of TRACES

TRACES provides a centralised digital environment for managing documents required in the transportation of live animals within the EU. It supports the entire document lifecycle—from creation by operators, validation by competent authorities (MSCAs), to updates and finalisation after inspections. Every action is tracked, ensuring a transparent audit trail. This enables seamless cross-border coordination, regulatory compliance, and the secure handling of sensitive transport information. Both the EU-INTRA certificate and the Animal Journey Log (AJL) are integrated into this system and are vital to ensuring animal health, welfare, and transport legality.

Document CRUD (Create, Read, Update, Delete)

AJL: The AJL is generated automatically once journey details are entered. Operators complete relevant sections (e.g., journey times, stopovers, vehicle details), while MSCAs validate journey plans by approving Section 2. Once validated, it becomes part of the official transport record. Deletion is not allowed, and editing rights are restricted post-approval.

INTRA: Operators initiate EU-INTRA certificates by completing Part I. These drafts can be freely edited or deleted until submission. Once reviewed and validated by MSCAs, who complete Part II, the certificate is locked to ensure authenticity. Part III is later updated by MSCAs to reflect inspections or final delivery, making the document complete.

Document Signature

AJL: There is no traditional digital signature in the AJL, but validation by MSCAs through Section 2 serves as an official endorsement. This confirmation certifies the journey complies with EU animal welfare regulations.

INTRA: Once MSCAs verify the information in Part I, they can electronically complete and sign Part II, formally certifying the document. This digital validation ensures the certificate meets EU health standards and becomes a legally recognised record. However, there is no obligation for INTRA certificates to be signed electronically. As a result, currently, both paper and electronic certificates are being used - depending on the preference of MS national authorities.

Document Exchange

AJL: The AJL is linked to its corresponding INTRA certificate and is shared within the system. This ensures the entire journey plan accompanies the transport case and can be accessed by all relevant authorities.

INTRA: INTRA certificates are electronically accessed among the MSCA of the dispatching country, destination country, and control points. These exchanges occur automatically, streamlining communication and supporting borderless animal transport monitoring.

Document Retrieval

AJL: The AJL is retrieved when Authorities assess journey conditions and outcomes, particularly in Section 4 (driver updates) and Sections 3 and 5 (MSCA inspections).

INTRA: These certificates can be retrieved using various filters, such as certificate ID, species, date, or operator. The search functionality also makes it easy for MSCAs to locate specific records for inspections or audits.

Document Disposal

AJL: Documents such as AJLs are not manually disposed of. The system retains all records based on EU-mandated timeframes. This protects the integrity of animal welfare documentation and ensures data is available for retrospective review. The specific point introduced by the Proposed regulation around data retention mentioned above will need to be further clarified in order to determine if this will require additional functionality in TRACES.

INTRA: Similarly, EU-INTRA certificates are retained in the system according to legal retention rules. Operators and authorities cannot delete validated certificates, preserving the audit history and supporting accountability.

File Upload

AJL: There is currently no facility for uploading external files to the AJL. All required information must be entered via the system's structured forms.

INTRA: Operators can upload relevant supporting documents such as health certificates, test results, or permits. These files are stored with the INTRA certificate and can be reviewed by MSCAs during validation and inspection.

Template Management

AJL: The AJL uses a fixed format as set out in the Regulation 01/2005 that operators and authorities must complete. It is not configurable, ensuring compliance with animal welfare legislation across all member states.

INTRA: Templates for INTRA certificates vary depending on species and destination. These are managed centrally and cannot be altered by operators, maintaining consistency and regulatory alignment throughout the EU.

Metadata Tagging

AJL: Metadata includes journey duration, rest intervals, route information, and MSCA inspections. Section 4, updated by drivers, captures real-time data such as arrival times and rest stops—important for compliance audits.

INTRA: Key metadata includes certificate status, trader details, submission dates, and animal categories. This enables quick filtering and retrieval of certificates for regulatory review or enforcement purposes.

- Summary of insights

TRACES employs a robust document management system crucial for regulating the movement of animals and products within the EU. This system is designed for the active creation, organization, control, and distribution of documents like Animal Journey Logs (AJLs) and Intra-Union (INTRA) certificates.

- Documents in TRACES move through editable stages—draft, pending validation, and approved—allowing real-time updates until they become immutable records.
- Electronic submission is supported via structured data entry with built-in validations.
- Automated notifications alert users to status changes and required actions.
- Role-based access control restricts document access and editing to authorised users only.
- Comprehensive audit trails record all user actions for accountability and traceability.
- MSCAs validate journey plans, certify health status, and oversee inspections.
- Operators prepare, submit, update, and correct consignment documents as needed.
- Document management is the backbone of TRACES, integrating workflow automation, record management, compliance assurance, audit logging, security, and data interoperability.
- The platform promotes efficiency, collaboration, and adherence to regulations in cross-border animal and product movements.
- Challenges include inconsistent national validation rules, sometimes complex user interface, and absence of mobile functionality.

- Capability Journey Management

- Definition

The Journey Management capability is defined as the ability to plan and execute animal transport according to business rules and regulatory requirements.

The capability allows actors involved in the animal journey log process to plan, validate, execute and report on Journeys involving live animals.

Note: as the AJL is the central object supporting the AJL process, many features described in the other capabilities obviously impact the AJL (Approving an AJL in Workflow Management, etc etc). This capability therefore focuses primarily on the planning aspect of the AJL.

- Review of related requirements

Regulatory requirements

Many of the regulatory requirements around journey planning are expressed in the 2023 Proposed Regulation in the form of business rules and are therefore discussed under **section 7.10**.

MSCA and operators' requirements

In this section we will briefly summarise MSCA and operators' requirements around the planning of journeys in TRACES. See Consultation Report and Traceability Matrix for more details.

Integrate temperature forecast and geolocation data in planning activities:

Not surprisingly, temperature and geolocation data comes as a requirements from both the operator and MSCAs side as it would greatly simplify journey planning activities and compliance checks.

“Combine journey planning with reservation confirmation and weather forecast visibility.” (Workshop Operators - Hunland),

“Integrate heatwave forecast and route re-planning module” (Workshop Operators - Hunland)

The forecast and duration calculations should come from a central service, shared by all stakeholders to avoid disputes in case of divergent output received from different web services.

Track Itinerary hotspots

MSCA expressed the need for a geolocation-based warning system where competent authorities or users can flag custom hotspots along a route, such as regions known for extreme heat or transport risks. Then the system should be able to trigger notifications or alerts when the vehicle enters those zones (Interview Ireland).

View planned versus actual journey

The notion of “baselining” of a Journey is an implicit requirement deriving from the proposed Regulation (see **Section 4** for a discussion of the concept

“Integrate GPS data and journey log systems to enable automatic cross-verification and flagging of anomalies for follow-up.” (Interview Ireland)

Pre-approved routes

An interesting variation of the previous requirement stems from a Best Practice implemented in Austria whereby Operators must use pre-approved routes in their AJLs.

“Compare requested itinerary with pre-approved routes” (Interview Austria)

Re-classify journeys

Given the fact that Short and Long Journeys have very different sets of requirements and the fact that the duration of a journey is the key differentiator, that can change during the journey, MSCAs expressed the need to be able to convert a Short Journey into a Long Journey if conditions change en route due to delays.

“Mobile and TRACES must support dynamic journey reclassification (e.g., from short to long distance during planning).” (Interview Germany)

Multi-consignment journeys

Manage AJLs where animals are loaded into one consignment for long journeys from two or more different places of loading

“Ability to track journey duration per individual animal, even when calves are split or regrouped across assembly centres. Current TRACES logic doesn’t reflect actual travel time.” (Operators Workshop – Berghuis)

Multi-transporter journeys

MSCAs also expressed the need for a simplified way of handling journeys that involve several transporters.

Booking system

MSCAs & Operators support the need to be able book a control post from within the application, receive evidence of the booking and link it with the AJL to facilitate compliance with the new requirement in the Proposed Regulation around providing evidence of such a booking.

“The system needs to support bookings beyond control posts—such as ferry reservations—to ensure transporters properly schedule all critical journey segments.” (Interview Portugal)

“Need for an automatic booking confirmation to Control Posts” (Interview Qualivia),

“A centralized, user-friendly digital system is essential for booking management of control posts” (Interview Berghuis)

This requirement will be analysed in more details in the TRACES Recommendation Report in Task 4 as the need can be implemented in very different ways.

- Relation to other capabilities

As the central capability of the Animal Journey Log process, the Journey Planning capability relies heavily on other capabilities:

Compliance management

The compliance management capability supports the planning activity in a variety of ways:

It allows the planner to identify non-compliant elements of a journey being planned so that issues can be corrected and errors avoided. By the same token, the approver of a submitted journey log will rely on the same alert and notification mechanism to review the AJL and make an informed decision as to whether the AJL should be approved or revised.

Business rules management

The Business Rules Management capability supports the planning process by providing calculations and compliance checks to the AJL planner.

Workflow management

The Workflow Management Capability allows the planner and the approver to interact and cycle through the approval process. A flexible workflow mechanism allows for changes to the AJL after submission if conditions change between the moment the initial approval is given and the start of the journey. The workflow also supports the various stages of the journey and the interaction of the actors through the signoff mechanism of the various AJL Sections.

Access management

Since the workflow management capability determines much of the actual process around the journey management capability, it is obvious that the Journey management capability will be strongly reliant on access management to ensure that the access rights for each actor's role involved in the AJL process are strictly enforced.

Data integration

The planning, validation and execution/monitoring activities for animal journeys will, under the Proposed Regulation 2023 heavily rely on data coming from external systems such as temperature forecast and geolocation data. As such, the dependency of the Journey management capability onto the data integration capability is also going to be high.

Summary of capability dependencies:

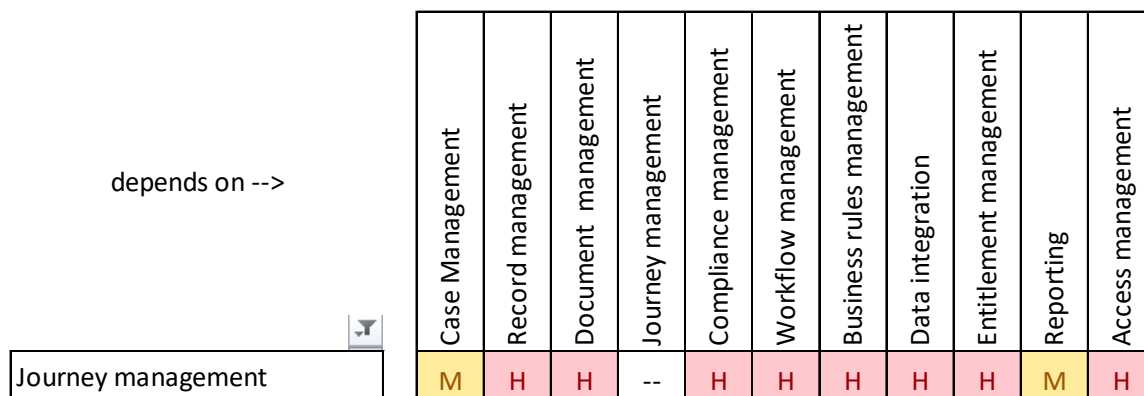


Figure 20 Journey Management dependency on other CAPs

▪ Assessment of TRACES

The AJL module in TRACES is a well-established module that has been supporting the current AWT regulation for many years. From a journey planning perspective, it supports core functions such as the following:

- It allows operators to plan their journey by defining the Place of Departure, Control Posts, Place of Destination.
- It allows operators to select pre-registered locations, or define new ones if not already recorded in the system
- It also calculates the estimated total journey duration (in the EU INTRA, see **Section 7.11, on GeoLocation data integration**)

Many other robust functionalities supporting the planning operations are described in the corresponding capabilities.

A number of areas are not covered yet by the AJL module, either because they are new features introduced in the Proposed Regulation, or because they have been suggested by operators as potential improvements.

- The AJL Module of TRACES could be enhanced to support the notion of a planned (baseline) versus actual Journey
- The AJL could be extended to support the Austrian Best Practice of selecting a predefined route for a given destination in a small set of pre-approved routes which greatly facilitates the MSCA checks around durations among other things.
- Geolocation and Temperature could be linked to locations added to the planned (forecasted temperature at the time the transport is scheduled to reach that location) and actual journey (geolocation and actual temperature when the transport reached that location)

- The ability for the MSCA to add specific hotspots to a proposed journey log, alongside the standard Place of Departure, Assembly / Control Posts, Place of Destinations locations, would enable the system to also collect temperatures and geolocation data on those specific points to help the MSCA monitor journeys crossing geographical areas known to be challenging for various reasons.
- The possibility to re-classify a journey would be a welcomed enhancement
- The possibility to book a control post directly from the TRACES interface, either as an integrated booking module in TRACES that would be fed directly by Control Posts and Transporters through the interface, or as an integration to an external booking system, through an API that would allow the user to request a booking from the TRACES interface and display the confirmation from the external booking system directly in TRACES.

- Summary of insights

TRACES includes journey planning functionalities designed to ensure the safe and compliant transport of live animals across EU and non-EU countries. These features allow operators and authorities to create, submit, and validate *Journey Logs* as part of the Animal Transport process, in accordance with the current Regulation 1/2005.

Key functionalities include:

- **Journey Log Creation:** Users can input all stages of the journey, including departure, transit, and destination locations, estimated times, and rest stops.
- **Route Validation:** The system automatically checks the journey plan against legal requirements, including travel time limits and rest periods.
- **Competent Authority Approval:** The journey plan must be submitted for approval by the relevant authorities, who can review and validate the proposed route and logistics.
- **Integration with Transporter and Vehicle Data:** TRACES links to transporter authorisations, vehicle approvals, and driver certificates, ensuring all actors involved meet regulatory standards.
- **Digital Traceability:** All journey data is stored digitally, enabling traceability and monitoring throughout the transport process.

Stakeholders highlighted needs for future enhancements to better support the Proposed Regulation (2023) such as

- journey baselining,
- implementation of Best Practices such as the selection of pre-approved routes for a given destination,
- collection and display of Geolocation and temperature data per defined location,

- booking functionality from within the AJL
- and a number of more specific enhancements around multi-transporter journeys and reclassification of journeys.

- Capability Compliance Management

- Definition

A **Compliance Management Capability** within a **Case Management System (CMS)** is a core function designed to ensure that organizational operations, particularly those involving regulated activities or sensitive processes, are conducted in accordance with internal policies, legal obligations, industry standards, and regulatory requirements. This capability integrates compliance oversight seamlessly into the lifecycle of each case, enabling proactive risk management and audit readiness.

This capability empowers organizations to manage compliance obligations proactively rather than reactively, minimizing legal risk, improving operational transparency, and fostering a culture of accountability. By embedding compliance directly into case processes, organizations can better manage complex regulatory environments while maintaining agility and efficiency.

At its foundation, the compliance management capability provides the following key features:

- **Notification and Alert management:** Ability to generate real time notifications or alerts to system users if a predefined event occurs so that the user can take preventive or corrective actions
- **Rule-Based Automation:** Configurable business rules and validation checks enforce compliance criteria throughout the case lifecycle. These rules can trigger alerts, escalations, or corrective actions when deviations from compliance thresholds occur.
- **Audit Trail and Documentation:** All user actions, decisions, and communications within the CMS are logged and timestamped. This audit trail is immutable and provides transparency for both internal reviews and external regulatory audits.
- **Risk Identification and Reporting:** The system continuously monitors case data to identify potential compliance breaches or emerging risks. Dashboards and reports highlight key compliance indicators, enabling real-time oversight and strategic decision-making.
- **Workflow Integration:** Compliance checks are embedded within case workflows—such as approvals, documentation submission, and closure steps—ensuring they are not optional or overlooked. This reduces manual oversight and ensures consistency across all cases.

- **Case-Specific Compliance Tasks:** Compliance-related tasks (e.g., risk assessments, approvals, disclosures) can be dynamically assigned based on case context, stakeholder roles, or jurisdictional requirements.
- **Escalation and Remediation Tracking:** When non-compliance is detected, the CMS facilitates automated escalation to compliance officers and tracks remediation actions until resolution, ensuring accountability and closure.

In the context of AWT, compliance activities carried out by MSCA can be seen from a temporal perspective, looking at the moment where such activities take place.

Prior to the journey, MSCAs will need to verify if an intended journey meets the criteria of the Regulation. Such checks will include

- Checks on economic operators records and the associated authorisations and certificates
- Checks on the submitted AJL to see if the journey meets the requirements in terms of duration, maximal temperature, etc ...

During the journey, inspections can occur at the predefined locations by a certified veterinarian, such as the standard checks performed at the place of departure, control posts and place of destination. Checks can also occur en route with the help of the police where vehicles are stopped and inspected.

After the journey, comparisons are made between the submitted AJL and actual journey searching for possible discrepancies (durations exceeded, etc), using among other things geolocation data submitted by the transporter. Other sources of information are used such as anomaly logs that can be submitted by economic operators themselves or inspectors.

- Review of related requirements

Note on the terminology

In this section, the term requirement can take a different meaning depending on the type of requirement discussed. From a regulatory perspective, regulatory requirements are often equivalent to compliance requirement as the regulation defines the criteria (= requirements) that a transport must meet in order to be deemed compliant. On the other hand, when talking about MSCA or operator requirements, we are referring to NEEDS expressed by those actors to be in a better position to either comply with or verify compliance with the regulatory requirements.

MSCA requirements

During the various interviews and workshops, MSCA consistently emphasised the importance of compliance checks to ensure animal welfare during transport, a point of view largely shared by European Agencies such as the EFSA that repeatedly stressed the importance of inspections in its various reports and in the interview conducted by the project team.

At the same time, the compliance checks were repeatedly labelled as extremely time-consuming due among other things to the lack of digitalisation of the processes:

“A major barrier to effective enforcement is the outdated requirement under Regulation 1/2005 for physical, signed journey logs to be returned post-transport. Drivers typically drop off these logs at port offices like Rosslare, which then relay them to regional offices and finally to the certifying veterinarians. This process is lengthy and inefficient; reports often take more than a month to reach the appropriate officials, by which point relevant details may have been forgotten. Additionally, satnav data follow a different administrative route, complicating the correlation between the two data sets. “(MSCA Interview – Ireland).

Operators requirements

As analysed in the consultation report, the compliance requirements were not surprisingly frequently reported by operators as being time-consuming and difficult to implement. At the same time, some operators mentioned that a consistent enforcement of requirements across Europe was a guarantee to ensure fair competition as some transporters were gaining unfair advantages by not respecting some constraints such as rest times at control posts. (Hunland Interview).

- Relation to other capabilities

Record and document management

Many compliance management capabilities will involve checking record and/or documents in TRACES. Authorisations and Certificates will need to be checked for their:

- Existence: an MSCA will check if the organiser, transporter, driver have the required authorisations and certificate associated to their record when validating a request for a journey.
- Uniqueness: an Operator is not allowed to submit a request in another MS following a rejection in their own MS. MSCA are expected to check for this.
- Validity: as Certificates are to be renewed after five years, documents have to be checked for their end dates.
- Status: since Certificates can be suspended, it is not sufficient to be checking validity periods, but also for an active status.

Journey Planning

A key feature of the Journey Planning capability will be required for Compliance Management checks post-journey to be fully effective, namely the ability to compare submitted / baseline AJLs with actual itineraries. This is a key feature that will involve complex integration with among other things geo-location data and temperature forecasts. See **section 7.7** for details.

Workflow management

Compliance checking entails that a MSCA can approve/reject a request for a Certificate, Authorisation or an Animal Journey Log. This is currently only partially possible, see **Section 7.9** for details.

Business Rules management

Another essential dependency is the reliance on Business Rules Management that will greatly facilitate the MSCA and the operator's ability to detect non-compliance upfront during the planning and submission stages of an AJL.

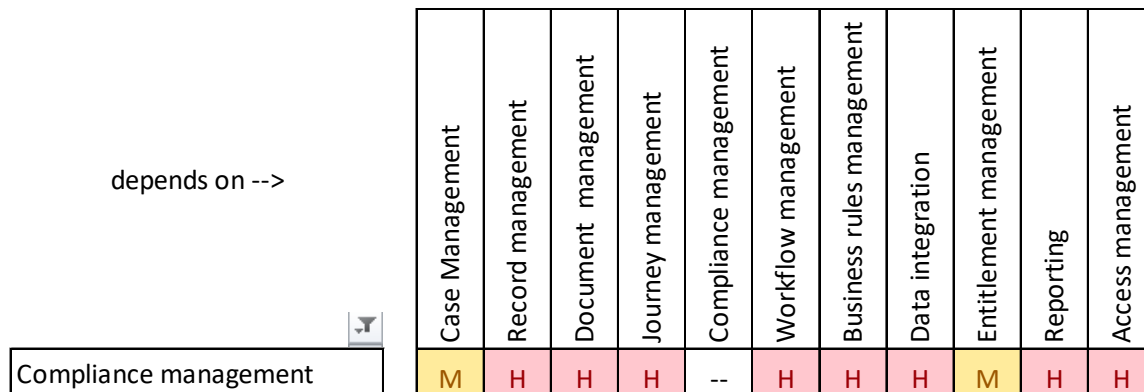


Figure 21 Compliance Mgt dependency on other CAPS

▪ Assessment of TRACES

Different kinds of notifications & alerts are currently available in TRACES, at different stages:

- Data entry / validation errors notifications are provided to the user entering incorrect data and preventing submission of the AJL until errors are fixed
- Event-based notifications;
 - Can be subscribed to by the user, either through email notification or in-app.
 - Can be tailored to a specific user role (OE vs MSCA)
 - Are generated for Events
 - around Reference data: Change to authorities, Establishment listings

- around Documents: created, rejected, validated ...

Given all the new compliance requirements introduced by the Proposed Regulation 2023, it would make sense to include in the notification mechanism events specific to an AJL that would be relevant for MSCAs checking on compliance: one can think of events like anomaly log created, etc...

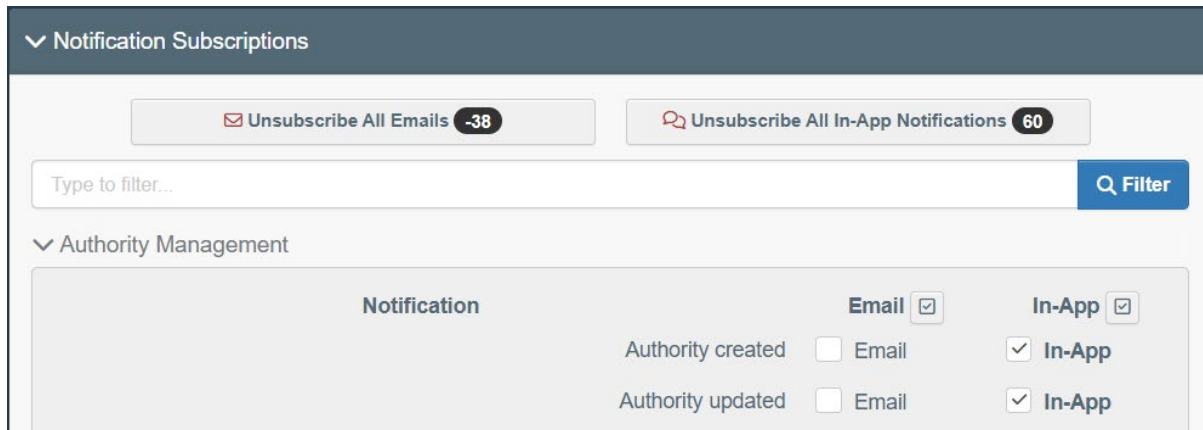


Figure 22 Subscribing to Notifications

Other useful enhancements brought to the light in previous sections are :

- A validation step by the MSCA during AJL submission
 - A baselining mechanism to compare submitted and actual journey
 - Additional business rules leading to a visual highlight in case of AJL inconsistencies or non-compliance.
- Summary of insights

The compliance management capability has been defined as a critical capability by both the EU and the MSCA stakeholders for the successful implementation of the Proposed Regulation.

The capability is very transversal and very much relies on features that will need to be supported by other capabilities and therefore will most certainly become a high-priority / high-impact area for future development of TRACES.

- Capability Workflow Management

- Definition

The capability Workflow Management can be defined as the ability to define, execute, monitor, and optimise the sequence of tasks, activities, and decisions required to process a case, in a way that is compliant with the various rules mandated by the European regulation for the transport of live animals.

The capability consists in a number of underlying abilities, such as:

- The ability to **assign work items** to actor roles following predefined routing rules and conditions
- The ability to **queue incoming work** items to a group of operators based on their roles, so that they can pick up new items for processing and monitor the flow of incoming work
- The ability to process those work items by **applying predefined actions** to those items and the associated documents, such as approval, rejection, suspension etc...
- The ability for actors **to collaborate on the resolution** of a work item with other actors in the case, by redirecting tasks as needed or by communicating out of band with actors involved in the processing of the case.
- The ability for actors **to monitor progress of tasks** and requests moving through the process in real time.

This capability plays a critical role in ensuring that a process instance gets delivered in an efficient, consistent and compliant manner. It provides transparency and predictability to process actors request execution and thereby leads to improved stakeholder satisfaction and increased regulatory compliance.

- Review of related requirements

The workflow management capability supports the execution of activities around the two core business processes involved in Live Animal Transport, as described in **section 5** of the present document , namely the Certification process and the Animal Journey log process.

Regulatory requirements

The 2023 Regulation on Animal Welfare during Transport formulates numerous requirements around the execution of the Certification and Animal Journey Log processes.

More specifically, the regulation provides strict requirements as to the sequence of activities , the order in which they must be carried out, the actions available to a given operator at a given stage of the process (for instance approve/reject/suspend/withdraw a certificate), the input and

output conditions for each step of the process, as well as the business rules , thresholds and conditions that apply to each step.

Member State Competent Authority requirements

Next to regulatory requirements, MSCAs have also expressed specific requirements that will require strong workflow capability.

In the MSCA Online survey, questions around workflow-related capabilities were frequently cited as areas where improvement was required:

Workflow-related survey questions:	Nr of MSCAs
Automation of administrative processes	14
Business workflows for the different issuance, renewal and suspension of certificates	15
Collaboration Tools - which facilitate collaboration on commenting, version control of documents	13
Enhanced communication and coordination among stakeholders	17

Those requirements were reinforced during individual MSCA interviews;

- Decrease burdensome approval processes, inconsistent document submission pathways, and a lack of integration between national systems and TRACES
- Support the ability for TRACES to receive electronic applications directly from organisers to reduce manual handling and duplication.
- Support the development of IT tools that reduce manual workload for inspectors while ensuring high standards of verification and traceability.
- The system must send email alerts and notifications to all stakeholders (transporters, keepers, CAs) for missing inputs.

Austria MSCA for instance, highlighted the efficiency and consistency gains that could be expected from a workflow for the handling of the certification process:

“Applications for authorisations and certificates are submitted via email and processed manually by competent authorities. Once approved, authorisations are uploaded into TRACES, but the process of application itself is not integrated into the system. Authorities expressed support for allowing electronic submission directly into TRACES, which would improve efficiency

and consistency, especially for journey logs and transporter applications.” (MSCA Interview – Austria).

At the same time, it should be noted that MSCAs have expressed the explicit requirement during the MSCA workshop for the workflow capability to allow for flexibility so that for instance Sections III, IV and V of the Animal Journey Log are not blocked if Section II has not been signed off yet, as is currently the case in TRACES.

Also, one MSCA expressed the need to have the MSCA country of destination co-approve the Animal Journey Log. This is currently not foreseen in the 2023 proposed regulation, but it clearly highlights the need for a flexible workflow management capability that would allow to deal with future changes such as adding an actor as an additional approver in an existing workflow.

Operators’ requirements

Last but not least, economic operators emphasised the importance of operational efficiency and transparency in the execution of the process flows to guarantee smooth approval flows for the transport authorisations.

- Relation to other capabilities

The workflow management capability relies heavily on other capabilities in order to deliver the expected value. The section below lists the most important dependencies for the workflow management capability:

- Record and document management

Both the Certification and Animal Journey Log process flows in the proposed regulation are highly correlated to record and document management capabilities; the process steps in question can:

- generate documents (certificates, authorisations...) directly as an output of the task or activity
- update or delete existing documents and records (eg suspending an authorisation) or
- require the task operator to verify the existence or the conformity of an existing document or record (verify driver certificate, etc...)

- Compliance Management / Alerts & Notifications

As one of the key benefits of the workflow management capability is improved compliance, it should not be surprising that the compliance capability and its underlying capabilities will play a significant role in supporting workflow management. More specifically, the Alerts and notification capabilities will be closely integrated to the workflow, as the regulation defines numerous thresholds and alert levels that should be triggered in the workflow, either as the result of an action / selection or because no action was taken within a given threshold.

- Business Rules management & Data integration

In the same manner, the ability to manage business rules will support the workflow capability by defining the constraints that must be applied to each step of the workflow, be it travel durations, temperatures, distances etc...

- Entitlement management

Managing the Economic Operators entitlements is a workflow-intensive activity that requires the ability to manage renewals, suspension, withdrawals etc in predefined flows.

- Access Management

The access to the various work item queues and work item actions described above is regulated by the Access Management capability, to restrict access to those features only to the users carrying the corresponding role.

Summary of capability dependencies :

depends on -->

	Case Management	Record management	Document management	Journey management	Compliance management	Workflow management	Business rules management	Data integration	Entitlement management	Reporting	Access management
Workflow management	M	H	H	L	H	--	H	H	H	L	H

Figure 23 Workflow Mgt dependency on other CAPs

▪ Assessment of TRACES

From a Certificate management perspective, TRACES is currently used as a repository system where certificates and authorisations of organisers / transporters can be stored and retrieved for validation purposes. This includes information on authorised transporters, vehicles, drivers, and attendants.

A very valuable enhancement would be the ability for authorities to manage the application and validation process in TRACES. Currently, TRACES only encodes final, approved data but does not support the initial application stage. Digitalising this process would be a valuable enhancement, allowing data to be collected automatically within the system.



Figure 24 Certificates pending action

Certificate lifecycle

When creating an **INTRA certificate** in the TRACES NT system, the operator can first save the draft, allowing time to complete or edit the request before submitting. Once the INTRA is submitted, it is locked for further editing. If a cancellation is needed at this stage, the operator can request the CA to cancel it. If the CA rejects the certificate (due to missing information, validation issues, or other reasons), the operator can use the “Copy as New” function to duplicate the rejected certificate, make the necessary corrections, and resubmit it as a new request.

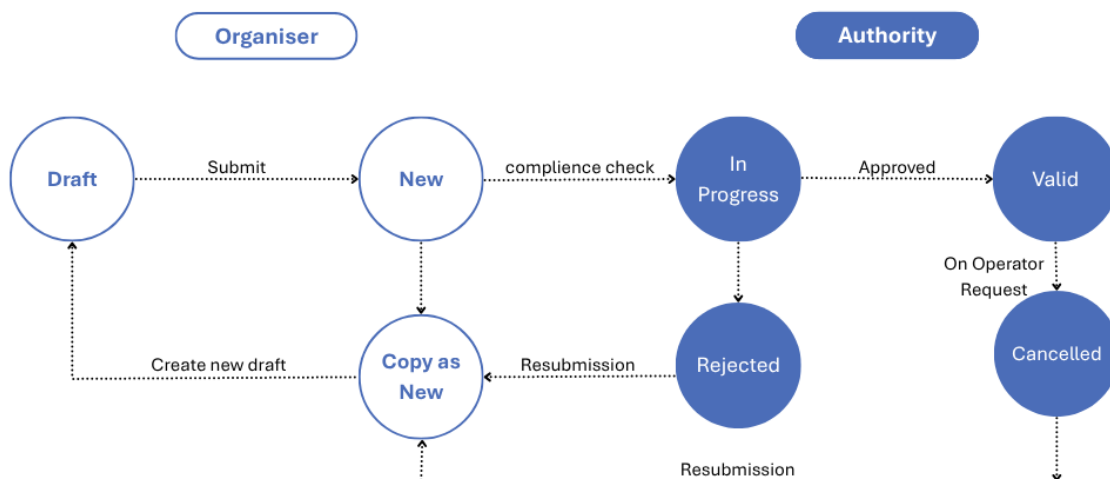


Figure 25 TRACES Intra certification process

In the **Animal Journey Log (AJL)** process within TRACES NT, operators can initially save the AJL in draft form and make unrestricted modifications during the planning phase and at the place of departure stage. During this period, they may also delete the AJL if necessary. However, once the Competent Authority verifies and countersigns the place of departure, the AJL becomes locked, meaning no further edits are allowed. In cases where the AJL is deleted but needs to be reused, the “Copy as New” function allows the operator to duplicate the deleted AJL, make corrections, and submit it again.

Similarly, operators can save transport certificates as drafts and may submit and re-submit modifications until the certificate is officially signed by the Competent Authority.

The current Regulation 2005 did not foresee any formal approval by the MSCA on the AJL itself, which means that there is currently no formal approval step foreseen in the current workflow. Since this formal approval of the AJL by the MSCA is required by the new proposed Regulation, an enhancement to the workflow will be needed.

MSCAs have also requested the ability to access and complete Sections 3, 4, and 5 of the AJL even if Section 2 has not yet been signed off, highlighting a need for greater flexibility in the AJL workflow.

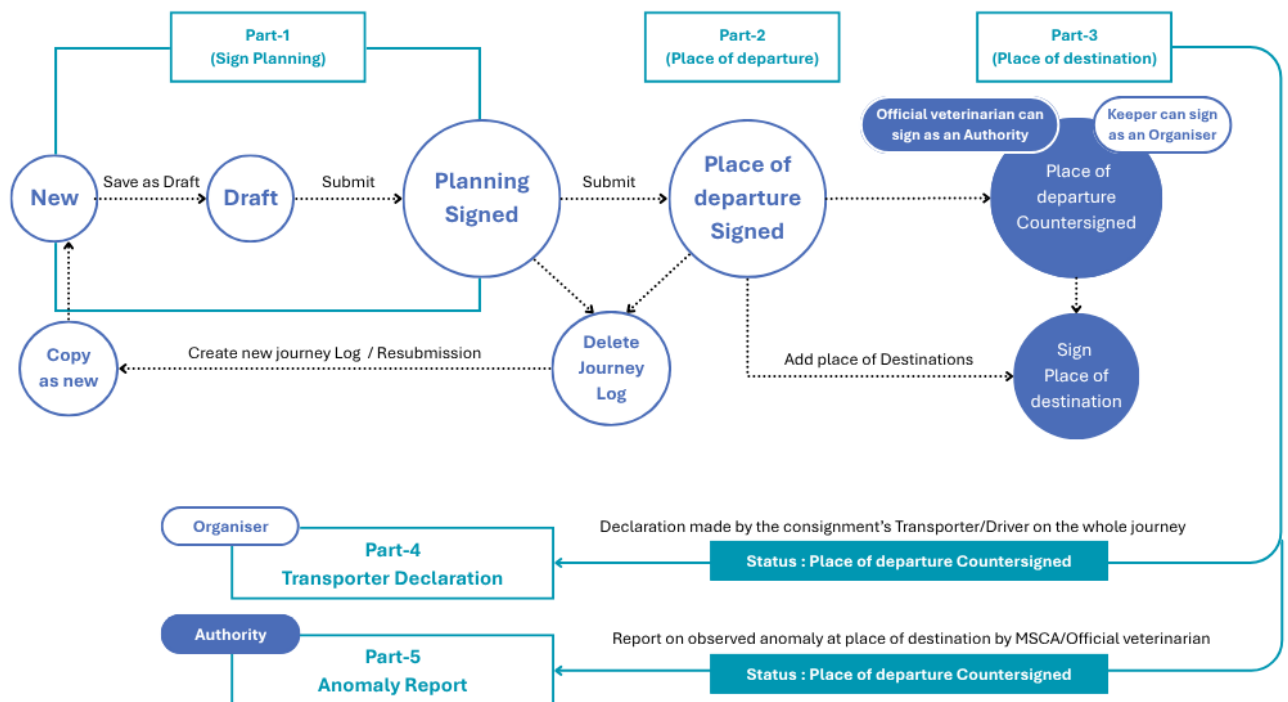


Figure 26 Animal Journey Log(AJL) Process

Summary of insights

TRACES currently provides support for process flows and also manages the lifecycle of key objects and related actions on those objects. This support however does not cover all requirements of the Proposed Regulation.

The validation process for Certificates is not currently implemented in TRACES. As this process flow is a candidate for an integration between TRACES and National Systems (see **Section 7.12**), adding support for Workflow management to the Certification process will be a very significant effort, implying that all functionalities deployed in TRACES to enable the workflow will also need to be exposed through an API for those MSCAs wishing to choose the interoperability route.

Other insights include

- the need for a new, formal approval step by the MSCA in the AJL (to be potentially extended to the MSCA of a destination country in long journeys)
- the need to support parallel flows in the AJL process
 - Capability Business rules management
 - Definition

A **business rule** in a software application is a specific directive or condition that defines or constrains how business processes should operate within the system. It represents the logic, policies, or procedures set by an organization, which the application enforces to ensure consistent behavior, compliance, and decision-making.

More specifically, business rules should be:

Declarative: States *what* must be true or done, not *how* to do it.

Contextual: Operates based on specific data, roles, or events within the application.

Actionable: Triggers decisions, validations, or workflows.

Changeable: Designed to be updated independently of core application code.

Business rules ensure that the software application aligns with organizational objectives, policies, regulatory requirements, and operational standards. They enable automation of decisions, reduce manual errors, and provide a foundation for auditable, consistent outcomes across the system.

From a capability perspective, the Business Rule Management Capability can be defined as the Ability to manage and apply such business rules to support efficient decision making and ensure regulatory compliance. This entails that the capability will support process actors with:

The **classification** of business objects into the correct category according to the regulation (Long distance Journey Log, etc...),

The **validation** of the business objects according to all business rules associated with that object's category and

The **suggestion** of alternatives or corrections in case of deviation from the associated business rules.

A large number of requirements listed in the Requirement Traceability Matrix fall under the definition of a business rule as presented above. This should come as no surprise as the proposed Regulation is a major source of requirements for the project.

To illustrate the expected benefit of a business rule management Capability, we will apply the proposed definition to the example of business rules associated with a Long Journey.

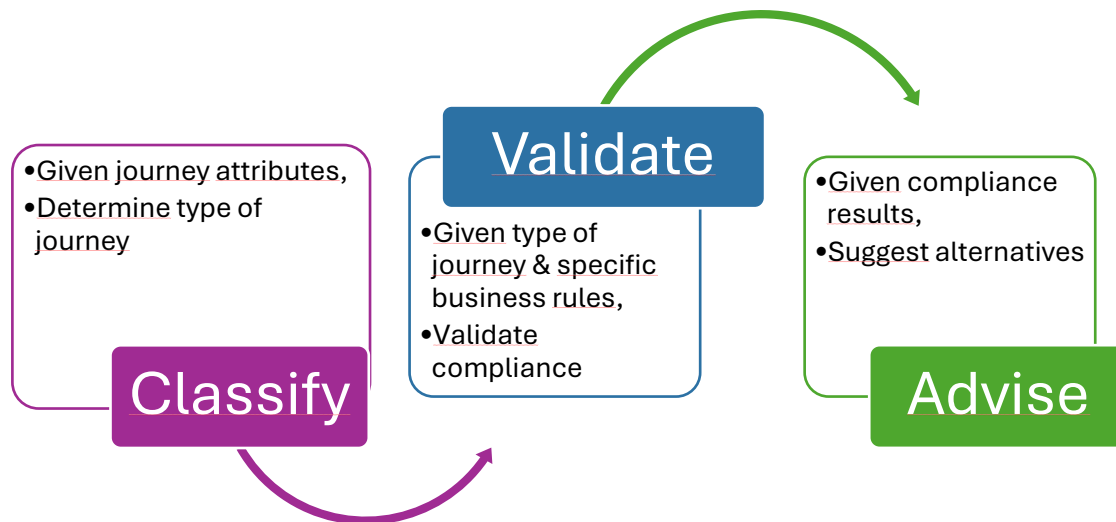


Figure 27 Business Rules Capability

Classify

To fall under the category of a Long Journey, a journey must be greater than 9 hours (European Commission, 2023, p. Art 3). A number of other business rules further qualify that high-level rule, either as specifications or exceptions. For instance, the duration of the segment of the journey that takes place at sea will not be counted under the total journey time.

Validate

Given the type of the object, a Long Journey, a list of business rules specific to that journey type can be applied to determine regulatory compliance of the journey. For instance, the business rule that specifies that a Long Journey must consist of maximum 2 parts, each of which lasting for a maximum of 21 hours, etc. As an outcome of this validation, the Journey will be deemed compliant.

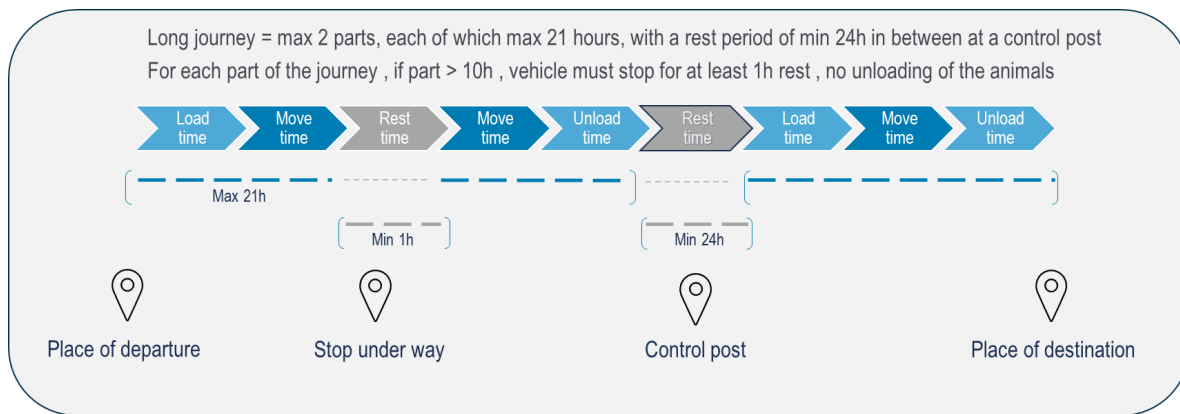


Figure 28 Validation of a Long Journey

Advise

Based on the outcome of the Validation step, recommendations or alternatives can be presented to the operator. As an example, alternative routes that do comply with the duration requirements listed above could be presented to the operator if and when a non-compliant journey is being planned.

Attribute-based rules

Building upon the Animal Journey Log example, we can see that business rules applying to the AJL affect a high number of the journey attributes (see **Section Business rules and Special cases in 4.1.2**), yielding a really complex set of rules that will apply to the classification and validation steps explained above. Specific rules apply to the type of location that may or may not be used as a Place of Departure or Place of Destination, rules vary according to the Species of animals but also to the animal type within a species (see dispositions around unweaned calves for instance), Scenarios also have specific rules such as for instance the case of the Transit Scenario where business rules around travel duration do not apply, Forecasted temperature rules, rules applying to specific means of transport etc..

A second element, is that rules are multi-attribute, functioning like decision tables:

<i>Destination</i>	<i>Species</i>	<i>Means of transport</i>	<i>ofSpecial authorisation granted</i>	<i>Etc...</i>	<i>Output: max duration</i>
<i>Slaughter</i>	<i>Rabbits</i>		<i>No</i>		<i>24hrs</i>
<i>Slaughter</i>	<i>Other</i>	<i>Road or rail</i>	<i>No</i>		<i>10hrs</i>
<i>Slaughter</i>	<i>Other</i>	<i>Road or rail</i>	<i>Yes</i>		<i>Long journey</i>
<i>Etc ...</i>					

A third aspect is the fact that the business rules listed above can be chained, meaning that the output of one set of rules will be used as the input of another set of rules. For instance, one decision table determining the actual duration of a journey as an output will be used as input for another set of rules. This would be the case where we need to calculate the Actual travel time using rules that subtract time spent at sea for instance (Art 30) and then feed it to another one that returns the type of Journey (short vs long).

- Review of related requirements

Member State Competent Authority requirements

Requirements impacting the Business rules management capability were mentioned by entities to support actors dealing with the complexity of the regulation , more specifically around possible tools and calculators that would ease rule-intensive calculations like the space allowance requirement calculation or the fitness for transport (see Sweden for instance) and the need to “provide clear rules regarding the quality, completeness, and approval procedures of journey logs” (Denmark).

Operators’ requirements

From an operator perspective, requirements around the capability revolved around clarifying difficult or complex aspects of the regulation and supporting tools like the calculators mentioned above.

- Relation to other capabilities

As a supporting capability, Business Rules management is not very much dependent on other Capabilities, it is rather the other way around: most other Capabilities dependent heavily on it. One exception would be the Data integration capability : getting information from external environmental data sources such as geolocation and temperature readings is a key point in the ability to for the capability to provide value to the other components of the solution.

depends on -->

	Case Management	Record management	Document management	Journey management	Compliance management	Workflow management	Business rules management	Data integration	Entitlement management	Reporting	Access management
Business rules management	L	L	L	L	L	L	--	H	L	L	L

Figure 29 Business Rules dependency on other CAPS

▪ Assessment of TRACES

As the main business tool supporting highly regulated environments for a large number of business processes within the EU, TRACES already supports business rules capacities very extensively.

More specifically for the AJL process, business rules are applied at all levels of the application; one can think of examples like controls on which bodies can be selectable in which sections of an AJL, rules calculating the duration of a journey, rules to determine the National/Regional/Local entity to be associated to the AJL, validation rules upon submitting the AJL etc.

On top of those functionalities, the Proposed Regulation 2023 will bring new sets of rules or calculations that could be added to the existing TRACES business rules management capability :

- Calculation support around space allowance and travel fitness checks
- Automatic attribute-based classification of journey as short or long
- Automatic attribute-based calculation of maximum journey duration
- Automatic calculation of actual journey duration (taking into account specific rules around sea transport, etc)
- Etc ...

▪ Summary of insights

Given the complexity of the AWT domain and the associated rules, the Business Rules management capability appears to be absolutely central to ensure a correct implementation of the Proposed Regulation and to facilitate its adoption by end users.

While TRACES already supports a vast array of business rules across the board, the complexity of the rules introduced by the Proposed Regulation calls for advanced business rules management capabilities such as decision tables and rule chaining. The impact on TRACES is therefore likely to be quite significant.

- Capability Data integration

- Definition

For the purpose of this study, we defined data integration as the ability to use data from external sources in a consistent manner for validation, compliance or decision-making purposes. The capability focuses more precisely on using external data points such as temperature forecast and geolocation during journey management activities.

- Review of related requirements

The requirements expressed by Stakeholders during the consultation phase around the use of temperature and geolocation data points are described in **Section 7.7**

It should be noted that such external data points in journey management activities are currently very much used by process stakeholders, albeit in an entirely manual manner. Temperatures are checked during the planning approval phase by MSCAs using external websites such as the European Centre for Medium-Range Weather Forecasts (<https://www.ecmwf.int/>) and geolocation is used by MSCAs to control compliance post-journey, by requesting transporters to provide readings from the truck's navigation system upon completing the journey.

As described above, there is strong support for a level of automation and integration in using those external datapoints as the process of obtaining and using the data points is extremely time consuming for the MSCAs.

- Forecast temperature measures are subject to discussions with transporters as various sources can be consulted by the different actors. Forecasts change by the hour so need to be re-checked by the MSCA several times.
- Obtaining geolocation extracts from drivers is an extremely lengthy process (see Targeted Interview Ireland) and the interpretation of the data is difficult as it is provided in a large variety of formats.

The integration of those external data points in the TRACES interface would therefore bring a lot of value, especially for MSCAs.

Temperature data integration

Building upon the user requirements expressed in Journey Management, we can further specify a number of solution requirements for temperature data integration:

Single source of truth:

While MSCAs insisted on the need to have a single source of truth in terms of temperature forecast in order to avoid discussions between MSCAs and transporters on divergent forecasts,

it should be noted that Austria currently complements the information received from the European Centre for Medium-Range Weather Forecast (ECMWF) with data from a national system in order to obtain a more precise forecast in alpine environments. (Targeted Interview – Austria). This could potentially significantly complexify integration efforts.

Baselining:

the baselining concept presented in **Section 7.7** should also apply to temperature forecasts. If an itinerary is approved by a MSCA, it should be baselined not only in terms of stops, order of the journey legs and leg durations but also in terms of temperature for the stops / segments selected, at the time where the journey is approved. This would allow a MSCA to see that a journey was approved at t0 because the temperature requirements at that moment were compliant even if the situation changed at t1.

Journey segments

In the Austria best practice presented in Targeted Interview – Austria, the segments of the route that are in excess of a threshold temperature are highlighted in red. This could be done by comparing temperatures at the segment start and end points.



Figure 30 Geosphere Austria weather portal

Hotspots

Countries requested the possibility to add waypoints on an itinerary that are not part of the standard Regulation locations (Control Post, etc). Temperature checks should be extended to those hotspots as it would allow MSCAs to monitor temperature in areas known to be problematic. In combination with the previous point on segments, MSCAs could define two

waypoints on the itinerary to define start and end points of a segment to monitor more specifically for temperature.

Forecast granularity and travel times:

It would be very valuable to be able to display the itinerary waypoint temperature based on the hour of arrival at that waypoint, in addition to the day's maximum temperature, since the Proposed Regulation 2023 explicitly specifies that transporters should take into consideration

“the temperature forecast at the place of departure, the place of destination and, when relevant, the place of the control post, at the time animals are expected to be at those places” (European Commission, 2023, p. Art 31).

One thing to be noted though is that while major weather Application Programming Interfaces (APIs) allow to request an hourly forecasted temperature for a given location, this forecast will typically be available for a significantly shorter period than a maximum temperature forecast; 4-5 days versus 10 days respectively.

Other views

The Geosphere Austria weather portal offers additional views of weather information:

- A map of temperatures for a given area where forecasts are analysed for four consecutive days to determine whether maximum temperatures exceed 30 degrees Celsius. The results are displayed using a traffic light-kind of colour scale where Red means that the 4 day forecast period contains more than 3 days where the maximum temperature will exceed 30°C, orange one to three days and green zero day.

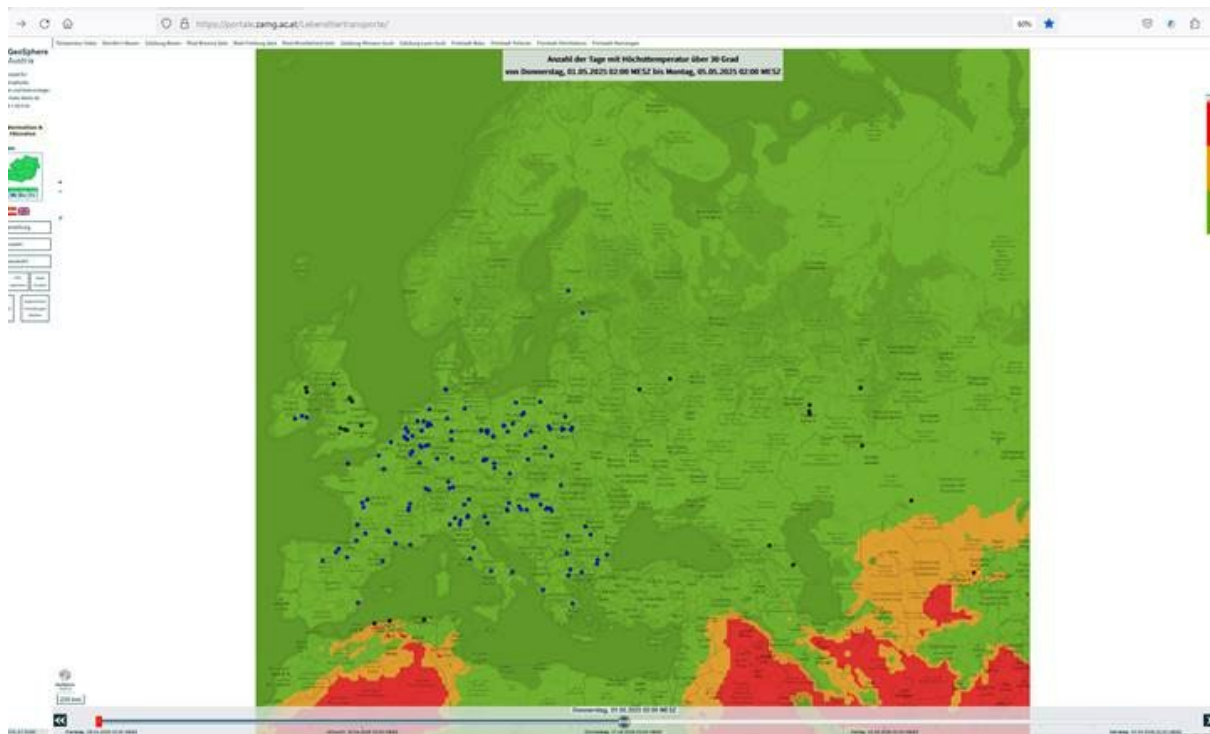


Figure 31 Geosphere Austria weather portal

A given point on the itinerary can further be queried (here a control post in Grosny) for the temperature forecast for the next 9 days.

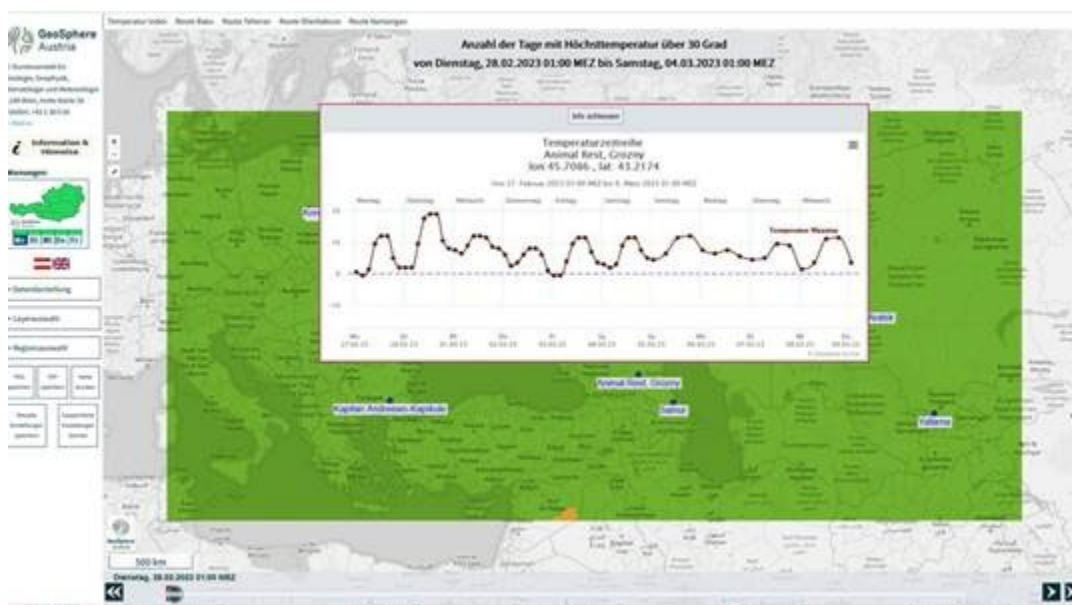


Figure 32 Geosphere Austria weather portal

All Geosphere Austria weather portal screenshots provided courtesy of M. Scottini, MSCA Austria.

GeoLocation data integration

Since geolocation will be discussed in a separate, dedicated deliverable (D03.01 - Market Analysis Report), we will only briefly summarise the geolocation requirements identified in the consultation phase.

The requirements expressed in the consultation phase by MSCAs focuss essentially around

- The need to obtain geolocation data in a near real time, automated way instead of the current manual and time-consuming process of collecting gps extracts from individual transporters after the journey has taken place (see above)
- The need to be able to display the geolocation data collected in a visually friendly way in order to easily verify that the journey followed the planned route, in terms of itinerary, planned stops and journey segments duration.

A number of secondary requirements can be derived from that main objective, that closely align with the requirements listed for temperature ;

Single Source of Truth :

Just like for temperature forecasts, stakeholders relayed the need to have a commonly agreed source of journey duration calculation, as often calculated journey times differ between the software used by economic operators and the estimated duration in TRACES, leading to discussions.

Baselining

Baselining is also a derived requirement as the MSCA will need to be able to confront a planned itinerary (baselined) with the actual geolocation readings received from the system during and after the journey. Deviations between the two can show for instance that a mandatory stop was not respected, or that a different route segment was used at some stage in the journey leading to a longer travel time.

Hotspots

The ability to define additional way points on the planned itinerary can provide more granularity for the MSCA when comparing planned with actual route in terms of duration for instance.

Geofencing

A specific use of geolocation data, geofencing, was of particular relevance for MSCAs as it would allow them to check that a transporter actually respected a stop at a Control Post. Geofencing the immediate surroundings of the Control Post would ensure that the system would collect the time at which the transporter's truck entered the geofenced area and the time at which he left it, thereby showing that a planned 24h stop at that particular location was respected.

- Relation to other capabilities

Data Integration is mainly dependent on access management as there are significant concerns from Operators around an automated collection of geolocation data from a personal data protection perspective.

depends on -->

	Case Management	Record management	Document management	Journey management	Compliance management	Workflow management	Business rules management	Data integration	Entitlement management	Reporting	Access management
Data integration	L	L	L	L	L	L	L	--	L	L	H

Figure 33 Data integration dependency on other CAPS

On the other hand, it is important to note that several key capabilities would benefit directly from an enhanced Data integration capability:

Journey Management, Business rule management & Compliance Management are very much reliant on temperature and geolocation data points. Integrating those data points in the planning phase of a journey through automated reading of external sources would greatly enhance the user experience, allowing early detection of problematic journey plans and greatly increasing the efficiency of the preventive checks and controls carried out by the MSCA.

- Assessment of TRACES

From a technical point of view, the ability of TRACES to connect to external services for data integration is very well established and analysed in **section 6** Technical assessment .

Temperature

The use of forecasted temperature is not relevant in the context of an assessment of the current TRACES version as the 2023 regulation brings new sets of requirements and constraints around temperatures that can by definition not be part of the current TRACES solution.

Geolocation

Geolocation on the other hand is widely used in TRACES today by means of an Open Street Map (OSM) integration. A geographical hierarchy is available for the country managed by a MSCA. France for instance, uses several hierarchical levels as shown in the picture below, depicting the hierarchy France > Metropolitan France > Auvergne-Rhône-Alpes>Ain > List of Cities.

Using the OSM link, each geographical area is geocoded by means of an OSM relation (in case of a boundary) or an OSM node and contains longitude and latitude references as shown in *Figure 29 Geocoding in TRACES*.

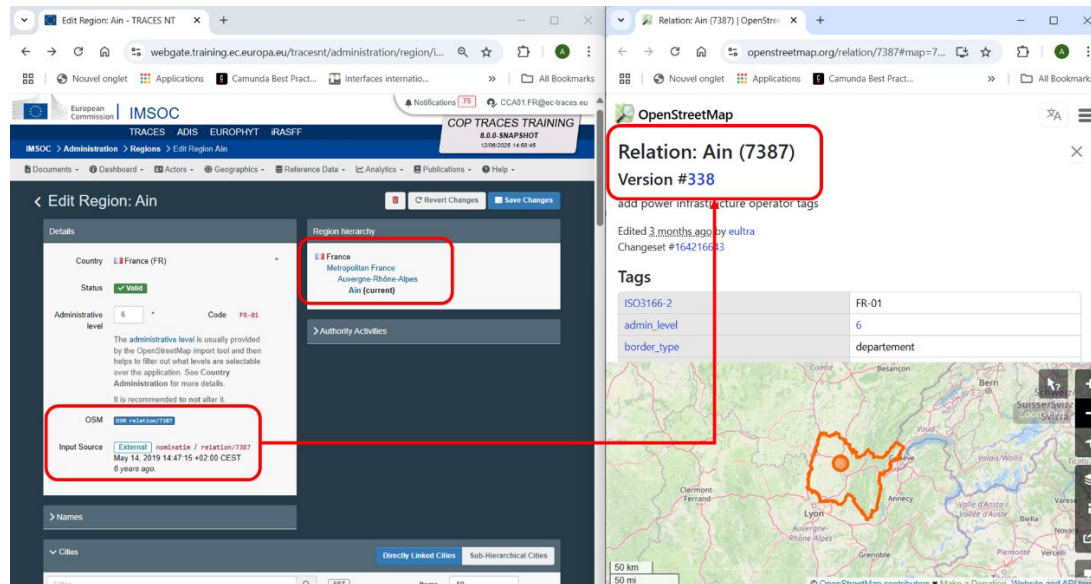


Figure 34 Geocoding in TRACES

Operators registered in TRACES are in turn created under the same geographical hierarchy. See Figure 30 Geocoding in TRACES for an Assembly Centre created under the same geographical hierarchy, in the Ain department.

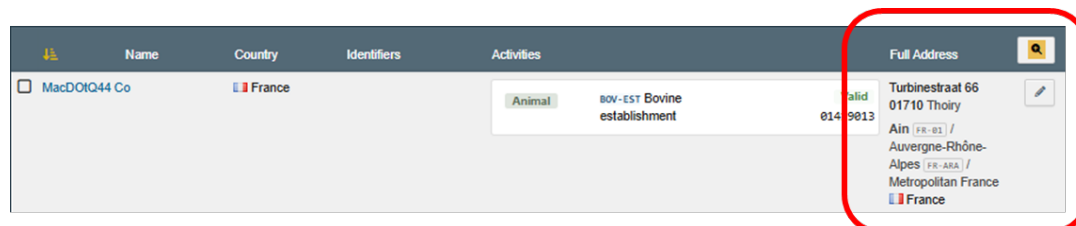


Figure 35 Geocoding in TRACES

Georouting is used in the EU INTRA to estimate the duration of a planned itinerary :

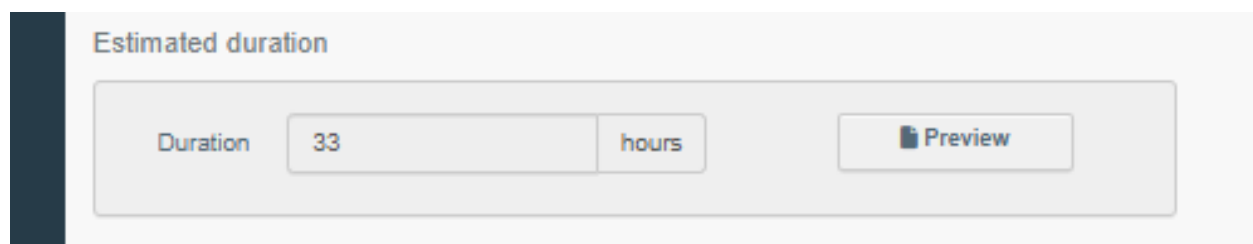


Figure 36 Estimated travel duration in EU Intra

The calculation is performed using OSRM (Open Streetmap Routing Machine). It has been adapted to fit trucks better than the standard search for a car (avoid smaller roads, lower average speed) but it does not take into account traffic or pauses. However, it should be noted that the calculated “Estimated journey time” should be seen as indicative and for information purposes. The requirement to have an AJL is based on EU Intra Box I.14, Date and time of departure and estimated date and time of unloading at arrival.

- Summary of insights

Integrating temperature and geolocation data in a journey log brings up very similar requirements as the two are essentially metadata linked to one or more journey log locations.

In both cases , the main requirement is to provide automated data points to the Journey log to remove the manual handling required today and to present the information in a graphical manner that allows the MSCA to be able to spot non compliances easily.

In terms of TRACES readiness however the situation is a bit different as an integration of external weather forecast systems is not foreseen and is a new requirement. On the other hand, TRACES already makes use of geolocation data to a large extent, laying the foundation for further use of geolocation data in the AJL.

- Capability Entitlement management

- Definition

We define Entitlement management as the ability for stakeholders to ensure the various entitlements required by the Proposed regulation to conduct live animal transport are in place and can be verified. Entitlements include economic operators’ authorisations and certificates as defined in **section Documents 4.1.3** .

Entitlement management is a central component of the Proposed Regulation 2023 to improve animal welfare during transport as it seeks to ensure that economic operators are properly trained, use means of transport that meet the regulatory requirements, etc ...

We propose the term “Entitlement” even if it not used as such in the Proposed Regulation 2023 for the following reasons:

- The focus of the capability is on the management of certificates and authorisations granted by MSCAs to economic operators that allow those operators to conduct live animal transport activities

- As such, the capability includes all the economic operators' authorisations defined in the regulation (Organiser authorisation, Transporter authorisation for long journeys, Transporter authorisation for short journeys) and operator-related certificates (Certificate of Competence for drivers, attendants and animal welfare officers, Certificate of approval of means of transport by road for long journeys, Certificate of approval of livestock vessels). It does not include certificates in the sense of Intra, Export, ... Certificates.

This section focuses on Entitlement management as an end-user requirement and the related assessment of TRACES from a functional perspective, but it is tightly linked to the technical perspective of Interoperability that is presented in **Section 6.1**.

- Review of related requirements

Interoperability TRACES with national applications

The main requirement that was brought to the light during the consultation phase is the need for MSCAs to be able to manage the entitlement process in a more efficient manner, reducing the number of paper-based exchanges, manual processing and duplication of data entry activities which is currently leading to inconsistencies between national records and the TRACES system.

However, one key finding of the MSCA online survey and accompanying MSCA interviews was that MSCAs have different expectations as to how the current entitlement process can be improved. A number of countries that have invested in a national application will be seeking an integration between their application and the TRACES system in order to manage the entitlements in their application and have the outcome replicated and synchronised in TRACES, while other countries that do not have such a specialised application would opt for the use of TRACES as the entitlement management system of choice.

This dichotomy in application landscape between the various MSCAs means that the functionalities that will be needed to implement the entitlement capability would potentially need to be realised both as an enhanced TRACES end-user interface AND as a new set of TRACES web services to be implemented by MSCAs in their national applications.

As could be expected, the various national processes leading to the issuance of a specific type of entitlement differ widely for each country. Federal countries might handle certain certificates at the federal level and delegate the issuance of another type of certificate to a regional authority who in turn could delegate the delivery of a required training or an inspection to an external accredited body etc...

This diversity of processes and outputs mean that a common interface will have to be provided by TRACES, based on the Proposed Regulation 2023 requirements and that MSCAs will have to convert the output of their national processes into that common interface.

It is possible to further define the requirements that will be applicable to the interface (graphical or web services) using the Proposed Regulation 2023 as the baseline.

Information

The format and content of the various entitlements to be submitted to TRACES by MSCAs are defined in Annex V of the regulation for the three authorisations and the three certificates under consideration. (European Commission, 2023, p. Annex V)

For each type of certificate or authorisation, the regulation defines the required attributes of the entitlement. It should be noted however, that the Annex V is not a technical document and that the entitlement structure will need to be further specified in order to serve as an implementation base (allowed values, types, maximal length ...)

Process

The process for authorisations and certificates has been defined in **section 5** of the present document based on the various requirements of the Proposed Regulation. The process presents the various states and actions that the entitlement object can go through (request, suspend, withdraw, etc...)

People

Actors are also defined in the process flows based on the Proposed Regulation. The key assumption here is that from a TRACES point of view, the main actor will always be the MSCA, either as a user of the to-be-developed TRACES graphical interface or as the national application in case of a web service integration.

- Relation to other capabilities

The ability to manage entitlements is highly dependent on the following capabilities

Record and document management

The outcome of the entitlement capability *is* a system record, with accompanying documents. The entitlement capability will rely heavily on the ability to manage economic operators' records, attach documents, check validity dates etc...

Business rules and Compliance management

The entitlement flows will use the business rules capability to ensure rules around the validity of entitlements are enforced and complied with (renewals, etc...).

Workflow management

The entitlement capability will rely extensively on the ability to manage workflows and related states and actions as it needs to support the entire lifecycle of an entitlement going through the various states that have been described above.

depends on -->

	Case Management	Record management	Document management	Journey management	Compliance management	Workflow management	Business rules management	Data integration	Entitlement management	Reporting	Access management
Entitlement management	M	H	H	L	H	H	H	L	-	L	L

Figure 37 Entitlement mgt dependency on other CAPS

- Assessment of TRACES

From a functional perspective, TRACES does not currently offer modules or integrations for the two types of interoperability presented above as these are new requirements driven by the Proposed Regulation 2023.

It should be noted however that TRACES offers very extensive integration capabilities in handling other types of certificates, including through webservice. This is very important as it would considerably limit the risks involved with enhancing the entitlement capability.

See **Section 6** for a technical assessment of TRACES interoperability capabilities.

- Summary of insights

Entitlement management is a key capability as it supports one of the two macro processes described in **section 5**.

While there are no modules specifically designed for the implementation of the capability in TRACES at the moment, both in terms of UI and of webservice, the requirements are well defined and understood and TRACES offers wide support for similar capabilities in other areas of its domain.

- Capability Reporting

- Definition

Reporting as capability is made possible by using QlikSense. QlikSense is embedded in TRACES as an analytics and data visualization tool to help authorities efficiently access, filter, and extract

critical data — particularly when navigating complex document structures like certificates or journey logs, which are otherwise time-consuming to search via the standard interface.

- Review of related requirements

Effective report management through QlikSense plays a vital role in supporting animal transport oversight across Member States. Based on user feedback, the platform is utilised for a variety of important activities aimed at improving compliance, welfare, and coordination. Below is a summary of its current usage, adoption levels, and key requirements identified to enhance its effectiveness.

Current Usage:

QlikSense is primarily used to analyse trends in animal transport, which is the most frequent application reported by users. It also helps identify risk areas for non-compliance, monitor and improve animal welfare standards, and support enforcement and regulatory decision-making processes. Additionally, although less common, it facilitates cross-border coordination—an important strategic function.

Adoption Levels:

There is considerable variability in the extent to which QlikSense is adopted among Member States. Scores range from 0 to 10, with an average rating of approximately 5.83. Notably, four Member States have rated their adoption level at the maximum score of 10, while three have indicated no adoption, with a score of 0.

Requirements Based on Feedback:

User feedback from 26 EU Member States highlights several key requirements for improving QlikSense reporting capabilities, based on their current usage patterns and challenges.

- **Reliable Data Integration:** Multiple respondents noted that “as long as journey logs are not fully functional and usable in TRACES-NT, there is limited data available for analysis in QlikSense”. It is key to note here that when MSCAs mention that AJLs are not fully functional, they refer to the fact that the AJL is not used end to end because of the constraints listed in various sections of this document (need for paper based documents, signature , etc) and not to missing functionality of the AJL itself. As a result of the lack of end to end adoption of the AJL, business data collected and available through QlikSense is inevitably partial.
- **Core Reporting Activities Supported:** QlikSense is used primarily for “analysing trends in animal transport,” with many Member States also leveraging it for “identifying risk areas for non-compliance,” “improving animal welfare monitoring,” and “supporting enforcement and regulatory decisions”. Additionally, some users highlighted the strategic value in “facilitating cross-border coordination,” although this is less frequent.

- **Variability in Usage / Limited Adoption:** Feedback reveals differences in how widely or limited QlikSense is used in TRACES. For example, one comment noted, “local authorities appear not to use QlikSense much, despite having received training. It is more frequently being used by regional authorities/the Liaison Body, e.g. for political and media enquiries concerning certified transports.” Some users also mentioned that “few inspectors are able to use it at the moment,” indicating varying levels of access and capability.
- **Customisable and Multi-Level Reporting:** Users expressed the need to generate reports at local, regional, and central levels. This is important to accommodate different user roles and ensure relevant data is accessible across organisational layers.
- **User-Friendly Dashboards and Training:** Given adoption challenges, “training-focused dashboards” and simplified user interfaces designed for inspectors and local users are essential to encourage wider use in the field.
- **Cross-Border Data Views:** Aggregated views across Member States are necessary to enhance international coordination and allow comparison of trends—functions recognised as strategically important.
 - Relation to other capabilities

This comparison evaluates QlikSense Reporting against other capabilities, highlighting where it adds the most value.

Compliance Management

QlikSense supports compliance monitoring for Intra certificates and Animal Journey Logs based on their workflow status like new, valid or rejected consignments (see **section 7.9**). Authorities can quickly identify patterns of concern—such as repeated certificate rejections or incomplete journey logs—supporting timely enforcement and risk-based inspections.

Data Integration

QlikSense integrates data from Intra and AJL modules, combining it with related datasets (e.g., transport means, species, holding locations). This enables a consolidated view of trade flows and journey conditions across member states, enhancing traceability and coordination.

depends on -->		Case Management	Record management	Document management	Journey management	Compliance management	Workflow management	Business rules management	Data integration	Entitlement management	Reporting	Access management
Reporting		L	M	L	M	H	L	L	H	L	-	M

Figure 38 Reporting mgt dependency on other CAPS

▪ Assessment of TRACES

QlikSense is integrated into TRACES as a powerful data analytics and visualisation tool designed for Member State Competent Authorities (MSCAs). It provides clear insights into regulatory workflows—such as certificates and journey logs—that are otherwise difficult to analyse using the standard interface.

Data & Tools Overview

Flexible Data Access: Nearly all fields in TRACES can be selected and analysed.

Two Data Sources:

- Legacy (DW) – Pre-2021, based on the original TRACES system
- TRACES NT (TNTDW) – Post-2021, API-driven and modernised

Documents Covered:

- Certificates: EU-Intra, CVEDs, CHEDs, etc.
- Animal Journey Logs (AJLs): Limited digital data due to continued reliance on paper-based workflows

Access & Permissions

- QlikSense can be accessed within TRACES by navigating to the Analytics submenu.
- Access is restricted to MSCAs. Operators can request data from the MSCAs if needed.
- Visibility is role-based, with access granted at the central, regional, or local level, in line with the TRACES access structure.
- Sensitive data, such as operator validity details, are not yet a part of the system.

How it works

The process of data retrieval in QlikSense for EU-Intra Certificates and AJL begins by accessing the data streams, which are separated based on their system of origin: 'DW' for data from the legacy TRACES system and 'TNTDW' for data from TRACES NT.

- **Process for EU-Intra Certificate**

Once you've selected the relevant data stream, you move into the filtering and exploration phase. This involves using dynamic filters based on criteria such as certificate status, dates, countries, species, and commodities. These filters are interactive, with "white" values indicating data represented in your current view and "grey" values representing data that is filtered out. A key best practice is to apply pre-filters before loading large datasets to significantly improve performance. For example, if your goal is to monitor cattle exports from Ireland, you would first apply specific filters for "valid certificates," the species, "Ireland" as the country, and a "defined date range" to narrow down the data efficiently.

After filtering, you can proceed to build a custom table tailored to your needs. This is where you select specific fields like certificate reference, commodity, transporter, and dispatch/destination country. You can also add metrics, such as the number of certificates. To ensure data integrity and prevent rows with identical values from being automatically merged, it is a critical best practice to always include a unique identifier, such as the IMSOC Reference or the certificate reference itself. When monitoring data, this is vital for building a reliable table that includes certificate references, transporter names, and the certificate status for auditing or reporting.

- **Process for Animal Journey Logs (AJLs)**

Once you have selected the appropriate view, you can begin the filtering and exploration phase. This involves using dynamic filters to narrow down the data. For example, if your goal is to monitor journey logs by organizer or departure country, you would apply filters based on criteria such as the departure country, the organizer of the journey, or specific journey section dates. You can also choose to view partially or fully signed logs.

It is important to note that the end-to-end digitalisation of the AJL process foreseen by the proposed Regulation 2023 would significantly increase the benefits of the AJL reporting capability. Having all five Sections of relevant AJLs consistently created and signed off in TRACES instead of on paper would allow MSCAs to analyse AJL trends in much more detail than is currently the case.

After filtering, you can proceed to build a custom table tailored to your needs. This is where you select specific fields relevant to journey logs, such as journey ID, organizer details, departure and destination points, and journey dates. You can also add metrics if applicable. To ensure data integrity and prevent rows with identical values from being automatically merged, it is a critical best practice to always include a unique identifier for each journey log.

The final step for the both the process is to export custom table to an Excel file for further analysis or reporting. It is strongly recommended to rename the exported file immediately, as the default file names are generic. This simple best practice ensures clarity and traceability, making the data easy to use for monitoring and analysis.

- Summary of insights

QlikSense is an embedded analytics and data visualization tool in TRACES for Member State Competent Authorities (MSCAs), enabling them to efficiently access and analyze complex data from certificates and journey logs. Its main applications include analyzing transport trends, identifying compliance risks, and supporting regulatory decisions, though its adoption varies significantly among Member States.

- Access is restricted to MSCAs and is role-based (central, regional, local).
- Data is sourced from both legacy (DW, pre-2021) and modern (TNTDW, post-2021) TRACES systems.
- Users can build custom reports by filtering data based on criteria like status, dates, and species, etc.,.
- It is a best practice to apply pre-filters for better performance and include unique identifiers to prevent data merging.
- Reports can be exported to Excel and should be renamed for clarity.
- Limited data for AJL reflects adoption
- Key user feedback highlights the need for reliable data integration (especially for digital journey logs), user-friendly dashboards, better training, and customizable multi-level reporting.

- Capability Access Management

- Definition

Access Management is defined as the ability to grant or revoke access to information in the system to authenticated individuals, based on their role or attributes.

Access control is a critical aspect of information security, determining who can access what resources in a system. Two widely used models for managing permissions are **Role-Based Access Control (RBAC)** and **Attribute-Based Access Control (ABAC)**. While both aim to regulate access, they differ significantly in approach, flexibility, and complexity.

Role-Based Access Control (RBAC)

RBAC is a model where access rights are assigned to users based on their **roles** within an organization. A role represents a set of permissions that reflect a job function, such as "HR Manager," "Engineer," or "System Administrator." Users are granted roles, and through those roles, they inherit access to resources.

For example, if a "Finance Analyst" role has permission to view payroll data, any user assigned to that role will have that access. RBAC simplifies administration by grouping permissions and assigning them collectively to users.

Attribute-Based Access Control (ABAC)

ABAC is a more dynamic and granular approach. Access decisions are made based on a combination of **attributes** associated with users, resources, actions, and the environment. Attributes can include user department, security clearance, time of access, location, or even device being used.

For instance, a policy might allow a user with the attribute "department = finance" and "clearance = high" to access a file labeled "confidential" during business hours. ABAC uses Boolean logic and policy rules to evaluate these attributes at the time of the access request.

- Review of related requirements

Regulatory requirements

The 2023 Proposed regulation does not provide explicit requirements around access management controls in TRACES. However, many specifications in the proposed regulation will de facto require access control in order to be implemented in the tool.

Some areas need to be highlighted where access control will be key:

- Positioning data and other GDPR-sensitive information will need to be protected through access control rules to ensure it can only be access by authorities with a clear need-to-know.
- Document certification; the regulation specifies that records and documents must be certified by legitimate process actors, such as a MSCA veterinarian, a keeper or a long-distance transporter. Such a certification will require that authenticated individuals are duly associated with the correct role and can certify documents as part of the capacity

associated with that role. (Note see **section 7.6** for a discussion around the limits identified around electronic certification for economic operators).

- Record-keeping. The Regulation specifies that some records will be kept for a maximum of 6 years but does not clearly specify if records will then need to be physically deleted from the system or be archived and have their access policies removed.

MSCA requirements

MSCAs expressed the need for finer-grained access control on the Animal Journey Log as today, any MSCA user can have access to sign off functionality of the AJL section that should only be accessible for a certified Veterinarian. (Workshop Operators).

MSCAs also relayed the fact that anomalies have been reported in the paper-based Animal Journey Log process whereby different sections were signed off by the same individual/handwriting, raising suspicions of fraud. A fully digital AJL, processed end-to-end in TRACES would allow to control the access of operators to relevant sections of the AJL and ensure they sign off only the forms they are entitled to.

Operators' requirements

Operators expressed the need for strong access control protection around sensitive data such as positioning and other personal data. Several operators were very reluctant to see a driver's geolocation data be stored in TRACES and this concern will need to be addressed to provide assurances to end users that sensitive personal data will not be compromised.

- Relation to other capabilities

As a supporting capability, Access Management is not very much dependent on other Capabilities, it is rather the other way around: most other Capabilities dependent heavily on Access Management.

depends on -->	Case Management	Record management	Document management	Journey management	Compliance management	Workflow management	Business rules management	Data integration	Entitlement management	Reporting	Access management
	L	L	L	L	L	L	L	L	L	L	--

Figure 39 Access Mgt dependency on other CAPs

▪ Assessment of TRACES

Authentication of individuals accessing TRACES is done through EU Login. Authenticated individuals are then associated with a body, either an authority or economic operator to enable access control. The mechanism and approval process by which users are associated to TRACES bodies is beyond the scope of this study; we will focus further only on the access control functionalities that are enabled by that association.

TRACES uses a form of Role-Based Access Control (RBAC) whereby authenticated individuals are associated with an entity (or “Body”) and derive a number of rights from that association. The “role” in TRACES is derived from the association between the person and the entity; in other words, there is no collection of roles available for selection for a given Body, rather, once an individual has been associated to a Body, he/she will automatically have access to all the functionalities allowed for that Body.

One notable exception concerns administrators and signers. When assigning an individual to a Body, it is possible to grant administrator or signer rights to that specific user, on top of the other rights derived from the membership of the Body.

There are two main types of Bodies in TRACES: authorities and economic operators (EO).

Authorities are defined based on a geographical hierarchy per country, from the Central Competent Authority (CCA), through Regional Competent Authority (RCA) down to Local Competent Authority (LCA). It is up to Member States to define if they want to implement a single-level hierarchy or add more levels to it.

A CCA will by default have access to all Certificates to that country. If lower levels are defined, (RCA and LCA) TRACES will automatically determine if the Body must have access to a Certificate by assessing the geographical location of key entities in the Certificate. This also applies to AJLs created by other countries that contain a stop in the relevant geographic location for a LCA/RCA/CCA.

In parallel, bodies such as Border Control Posts (BCPs) and National/Local Contact Points (NCP / LCPs) can also be defined.

- Border Control Post users will manage the CHED documents for the commodities that transit through their BCP.
- National/Local Contact Points users will manage the lists of authorised establishments defined in TRACES for their country.

Economic operators only have one level. An Economic Operator (EO) can have one or more activities in its profile. Activities define the functionality that will be available to an EO and include items like “Transporter”, “Control Post”, “Assembly Centre” etc... An Economic Operator can have multiple activities to its profile, additional activities are requested by the Economic Operator and approved by the Competent Authority.

Just like for Authorities, all individuals assigned to an Economic Operator automatically gain access to all functionalities allowed for that Operator: if an Operator has multiple activities associated with its profile, the individual will have access to all functions associated to all the corresponding activities.

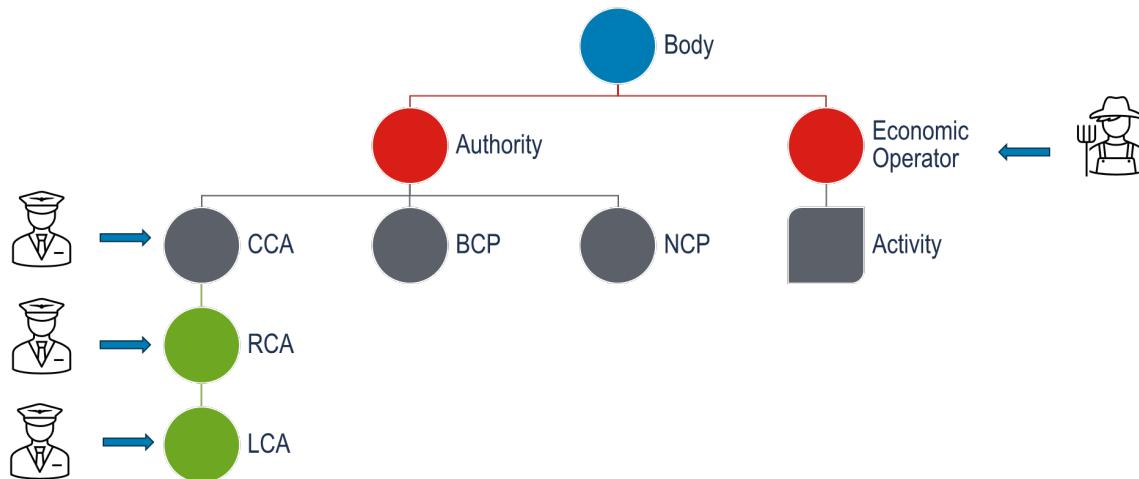


Figure 40 RBAC in TRACES

In the illustration below, an operator has been linked to two Economic Operator bodies. The first EO contains three activities: assembly centre, Bovine establishment and Registered transporter.

Your Roles			
Filter status	☒ 0 Requested	☒ 0 Suspended	☒ 2 Valid
Request new role			
Operator	LMS place of departure FR 75000 Paris France (FR)		Valid
	Assembly center ASC-UNG Valid Bovine establishment BOV-EST Valid Registered transporter REG-TRANS Valid		
Operator	Nossa Fruits 75783 Paris France (FR)		Valid
	CITES Operator EU_CITES New Organic Importer ORGANIC IMPORTER Valid Organic Operator ORGANIC OPERATOR Valid Professional operators other than those referred to in Article 45(1)(l) IMSOC EUPO New		

Figure 41 Economic Operator Activities

It should be noted that certain concepts listed in the proposed regulation such as “Keeper” are fields in TRACES, not activities. There is no specific “keeper” activity in TRACES, however several

TRACES activities fall under the definition of “Keeper” as defined in the regulation , such as “Assembly center” or “Bovine establishment” in Figure 35.

The regulation explicitly excludes transporters from the notion of Keeper : “26. ‘keeper’ means any natural or legal person, except a transporter, in charge of or handling animals whether on a permanent or temporary basis (European Commission, 2023, p. Art3 (26)). The Regulation defines obligations of keepers at the place of departure, control posts and places of destination, not during transport.

Furthermore, the regulation foresees that keepers and drivers must record in TRACES the date and time of the arrival, and the condition of animals, by completing and signing section 3 of the Journey Log. (European Commission, 2023, p. Art 25) . The regulation also foresees the possibility of Keepers and Drivers disagreeing on the condition of animals at the place of destination. This reinforces the idea that from the perspective of the Proposed regulation, keepers and drivers/transporters are distinct roles, that should be in a position to independently fill in and sign off Journey Log sections, as authorised keepers and drivers, respectively.

Role-based Access Control systems offer a limited granularity, especially in situations where the same operator may require several roles in a particular case / journey, but not necessarily in other journeys. For instance, a farmer (keeper) who would transport animals himself in one AJL (act as both keeper and transporter) but would rely on a professional transporter on another AJL.

This situation is dealt with in TRACES by limiting the operators that can be selected in Sections Place of Departure and Place of Destination to those operators defined in relevant parts of Section 1 Planning. For instance :

- the keeper that can be selected in the Section 2 Place of departure is the Operator linked to the establishment quoted in Section 1 under « Place of Departure »
- the Keeper that can be selected in the Section 3 Place of destination is either the control posts quoted in the Section 1 I.6 List of scheduled resting, transfer or exit points OR the operator quoted in Section 1 I.4.1 (Place of destination).

Since the Planning Section is validated by MSCAs, this mechanism will effectively prevent an operator from unduly signing off a section for a role he has not been assigned to in that particular AJL, a situation that has been reported by MSCAs on the current paper-based flow.

For authorities, since the only restrictions that apply are dependent on the level / hierarchy defined by the MSCA (CCA vs RCA vs LCA), it is not currently possible to apply access control at a finer granularity level, such as restricting access to sign off functionalities to a Certified Veterinarian for instance (see MSCA requirements section above).

- Summary of insights
 - TRACES uses a form of Role-Based Access Control

- There is an asymmetry between the RBAC Control implemented for Authorities and for Economic operators. A form of granularity in access roles for Authorities can be implemented through a hierarchy of competent authorities within the country. For operators, this is achieved by assigning additional activities to an Economic Operator as there is no hierarchy within Operator Bodies.
- The assignment of “Activities” to Economic Operators is complemented by restrictions in the different AJL Sections, preventing an operator that would not have been added to the planning section from being selected in the subsequent sections.

- Business Capabilities Mapping

Having identified and organized the various business capabilities that support the AWT processes, we can now start to apply the information to business analysis and planning by mapping those capabilities in a number of ways as presented below.

Business capability mapping is also a first step towards a change roadmap and prioritisation of capability enhancements that will be presented in the deliverable D04.01 - TRACES Recommendations Report.

In a first step, a matrix of interdependencies is created that identifies the dependencies between capabilities and thereby a high level view of the impacts that changes or enhancements on one capability can have on other capabilities.

In a second step, the capabilities are put in perspective with the AWT value stream map, a higher level perspective that groups capabilities in function of which section of the value stream they mostly impact, along with the associated macro processes and channels.

Lastly, a heat map is proposed that represents the capabilities in terms of the contribution each capability would bring to the business.

- Business capability interdependencies

The Capability dependency matrix categorises the dependency between two Capabilities on a scale Low/Medium/High : the mapping of dependencies between capabilities is intended to show the impact of changes or enhancements on one capability onto other capabilities.

The matrix can be read from rows to columns or vice versa :

- Reading the matrix rows to columns indicates **the level of dependency** : capability R relies on capability C in order to deliver its potential.
- Reading the matrix columns to rows indicates **the level of impact** of changes or enhancements: changes to capability C will impact very much depending on capability R.

For instance, we can see that the capability Access Management (row) is not highly dependent on other capabilities to deliver its functionality : it is actually the other way round, changes to the Access management (column) may impact greatly a number of other capabilities that are dependent on it.

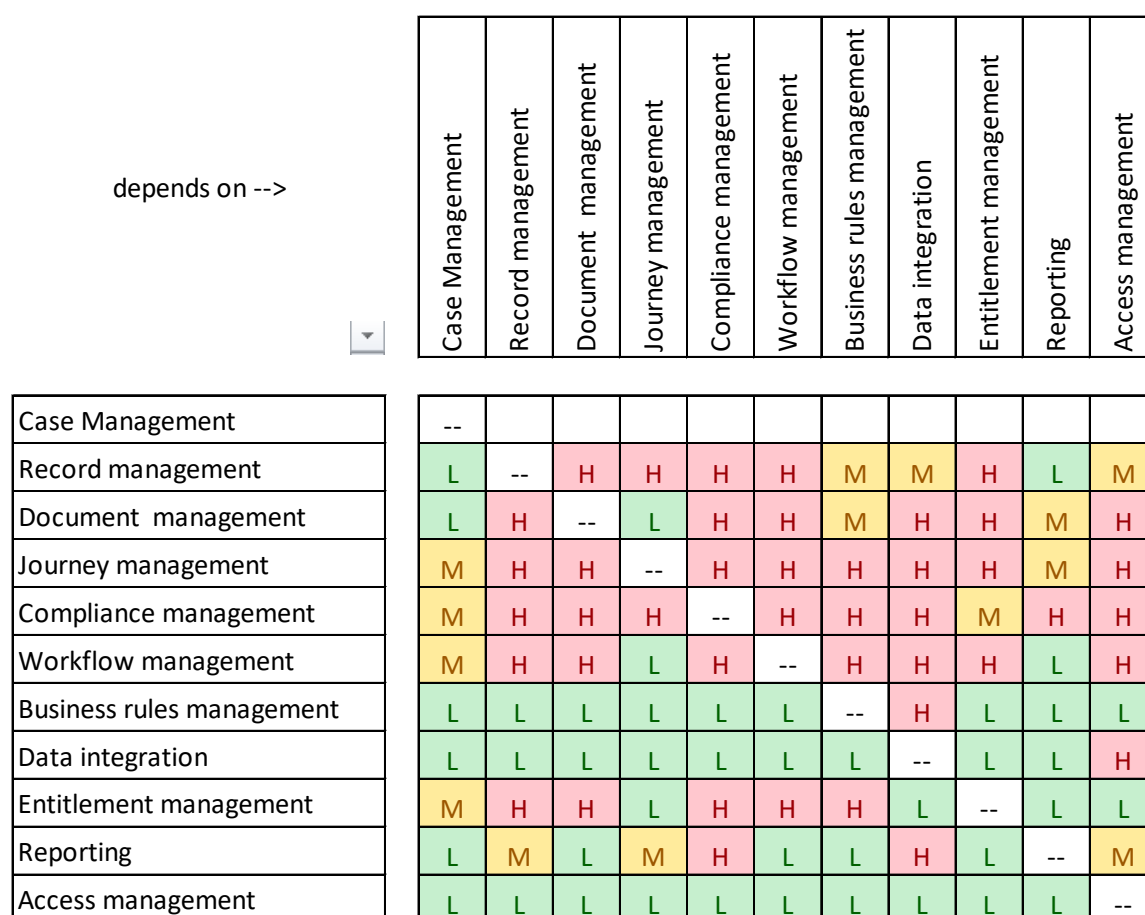


Figure 42 Capabilities interdependencies

The matrix shows that not all capabilities are created equal in terms of dependency / impact they have on other capabilities.

High Dependency / High impact

Not surprisingly, the capabilities Entitlement management, Document/Record management, Journey management, Compliance management and workflow management all fall under this category. This due to the fact that the capabilities are closely intertwined and mutually dependent.

Low dependency / High impact

Another group of capabilities show little dependence to other capabilities but would have a high impact on many capabilities. A good example is the capabilities business rules and data integration. Increasing TRACES ability to collect and consolidate geolocation or temperature data is not in itself dependent on changes or enhancements to be done on other capabilities. But if the capability was introduced, it would (positively) impact capabilities such as journey management or compliance management tremendously.

- Mapping business capabilities to the value stream

The value stream mapping offers a wider perspective of where the analysed capabilities play a role in the end-to-end value generation chain of the AWT process.

The value stream is depicted as an “end-to-end collection of value-adding activities that create an overall result for a customer, stakeholder, or end user. In modeling terms, those value-adding activities are represented by value stream stages, each of which creates and adds incremental stakeholder value from one stage to the next” (The Open Group, 2025).

As such the two processes analysed in **section 5** can be seen as parts of a single end to end value stream, where the management of entitlements is a prerequisite for following activities to deliver the expected value of a transport that meets both the economic and animal welfare objectives set out in the Regulation.

It is also useful to add the two interfaces to the mapping exercise, the current TRACES desktop application interface, and the envisaged mobile application as the coverage of the value stream by those two interfaces will be different.

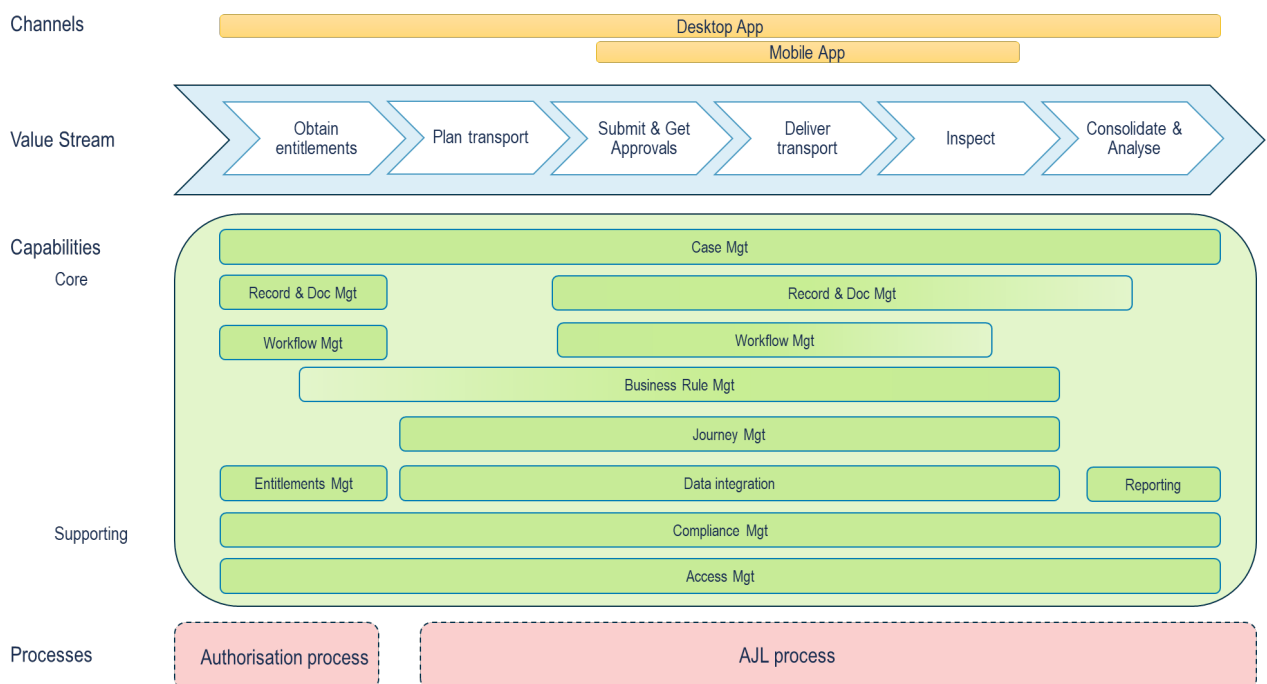


Figure 43 Value Stream to Capabilities

The Value Stream to Capabilities map will be further developed in Task 4, especially around the distribution of capabilities per channels and the definition of features to be supported by the Mobile Application.

▪ Business Capabilities heat map

A final perspective is the capability heat map which proposes a classification of the contribution that each capability could have in terms of meeting the improvement objectives of the AWT project.

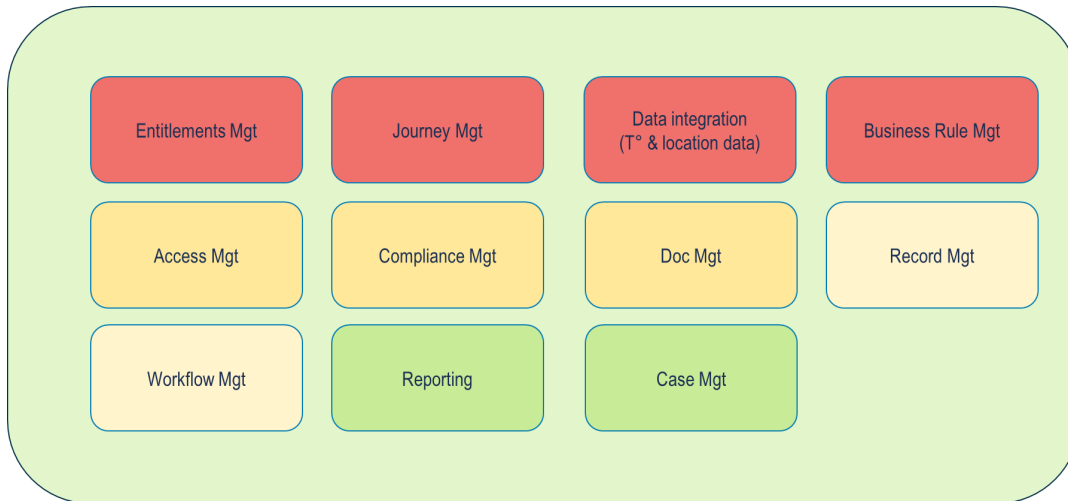


Figure 44 Capabilities heat map

The proposed heatmap is based on the analysis of the capabilities and the related stakeholder requirements as presented above, but also neatly aligns with the quantitative assessment of MSCAs requirements extracted from the online Survey;

Short description	Capability impacted	Technology impact	Total
User friendly and easy accessibility;	Journey Planning	TRACES	23
Allowing for electronic certification which replaces the use of a paper animal journey log	Document management	e-Seal	21
Interoperability with other EU IT systems;	Interoperability	TRACES	21
Complete Journey log details (authorisation, certificate of approval, etc.);	Journey Planning	TRACES	21
Improved data collection and analysis	Reporting	TRACES	20
Alerts and notification - automated alerts can notify users of significant changes or about actions required ensuring timely action and decision-making	Compliance management	TRACES	19
Support different modules and features as per the new regulation of animal transportation (certificate of approval, authorisation for organisers etc.);	Compliance management	TRACES	19
Real-time monitoring of animals (Monitoring systems, positioning systems etc.);	Data integration	GeoLocation	19
Harmonisation of documentation formats;	Document management	TRACES	19
Data protection regulations	Personal data protection	TRACES	19
Real-time monitoring and tracking of animals	Data int	GeoLocation	18
Export options – support for various export formats (e.g., PDF, Excel)	Document management	TRACES	18
Interoperability with IT systems from your organisation;	Interoperability	TRACES	18
Enhanced communication and coordination among stakeholders	Workflow management	TRACES	18
Integration with existing digital systems;	Data integration	TRACES	16
Business workflows for the different issuance, renewal and suspension of certificates	Workflow management	TRACES	16
Automation of administrative processes	Workflow management	TRACES	15
Automated verification of required documents;	Workflow management	TRACES	15
Collaboration Tools - which facilitate collaboration on commenting, version control of documents	Workflow management	TRACES	14
Performing unannounced evaluation	Journey Planning	TRACES	12
Data integration – integration with relevant data sources	Data integration	TRACES	10
User interface changes in TRACES modules (If you use some modules)	Journey Planning	TRACES	10
Should support Inspection and reporting currently done by THETIS EU	Compliance management	THETIS	6

Figure 45 Quantitative assessment of MSCAs reqs

- Conclusions

The present report took as inputs the requirements collected during an extensive stakeholder consultation phase conducted in task 2 State of Play with a large panel of institutional and economic stakeholders involved in the AWT value stream and summarised in the Consultation report.

Eleven core capabilities were defined that are required to support the AWT value stream and the stakeholder requirements were consolidated into those core capabilities. For each capability and associated stakeholders' requirements, an assessment of TRACES was conducted to survey the functionalities that are already provided by the application in its current version and areas where enhancements could be considered.

As mentioned in the introduction of this document, the capability assessment was carried out with two important assumptions : 1) the analysis was based on the Proposed Regulation 2023 in its current form (i.e. as of the first half of 2025) and 2) the assessment of TRACES was carried out from the perspective of the new Animal Welfare during Transport evolutions envisaged by the Proposed Regulation 2023, which is only a small part of the domains supported by TRACES and means that insights gathered here do not necessarily apply to other TRACES domains.

Despite those limitations, the approach proved effective in the sense that it allowed us to not only map existing features and potential enhancements but also to identify relations between the core capabilities, how the capabilities fit into the larger picture of the AWT value stream and finally propose a summarized heat map of capabilities according to the contribution they could offer to improving the AWT process.

The insights that came out of the analysis are intended to serve as input for the forthcoming Task 3 and Task 4 reports that will be delivered as part of the AWT study.

The capabilities identified in the report will provide the structure for the D04.01 TRACES Recommendation report, using the requirements, TRACES assessment insights and capabilities interdependencies identified as starting point in order to provide recommendations for future enhancements.

Reports D03.01 & D03.02 on Geolocation data and D04.02 on the mobile application outline will also start from the inputs provided by the present report to further analyse those two domains and their output will in turn enrich the D04.01 TRACES Recommendation report as we have seen that geolocation data and a new mobile access channel to TRACES are requirements that impact several of the 11 core capabilities studied in this report.

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6.2 D.02.01.02 Consultation report

1. Introduction and context

The European Commission, through the EU4Health and Single Market Programme and under the authority of the European Health and Digital Executive Agency (HaDEA), has launched **a study to support the revision of the EU legislation on animal welfare during transport**. The initiative is driven by the growing recognition that digitalisation can play a pivotal role in strengthening the enforcement of animal welfare rules, improving data quality, and reducing administrative burdens.

Currently, **TRACES** (Trade Control and Expert System) serves as the EU's central IT platform for managing veterinary certificates, journey logs, and authorisations related to live animal transport. TRACES has been accommodating for the creation of journey logs based on the Regulation 01/2005, even though this was not specifically required by the Regulation. The new proposed Regulation, by creating new rules and selecting TRACES as the main platform for journey log creation is creating a need for change. The legislative proposal envisions an enhanced digital ecosystem, which includes:

- Full digitalisation of administrative procedures
- Mandatory digital journey logs
- Real-time positioning and geolocation tracking of consignments
- A mobile application to increase accessibility for users in the field
- Greater interoperability with national and EU systems such as THETIS (maritime transport) and meteorological data platforms.

a. Objectives

In this context, the objective of **Task 02** of the study is **to assess the current state of play** of the animal welfare during transport domain along two main lines of investigation:

On the one hand, Task 02 **gathers Stakeholders requirements** and needs around the current and proposed regulatory frameworks, the digital systems currently in use (particularly TRACES), the day-to-day procedures applied in the field, and the roles and interactions of the various stakeholders involved. Particular attention is given to the gap between current practices and the expectations set by the proposed Regulation (COM(2023)770). The study also provides examples of innovation and best practices that could inform future improvements across the EU.

On the other hand, Task 02 **evaluates the existing functionalities of TRACES**, their current scope and capabilities, and their capacity to support the implementation of the new regulation. This includes examining how TRACES could be integrated with external systems to automatically detect potential non-compliance (e.g. via GPS, temperature forecasts, control post bookings) and to allow competent authorities to conduct better real-time and retrospective inspections.

Those two lines of work are complementary and will provide a comprehensive view of user requirements and current system capabilities, resulting in two separate deliverables: the present Consultation report (D02.01.02) for the requirement gathering phase, and the TRACES report (D02.01.01) for the TRACES assessment exercise.

b. Scope of the consultation report

The present report is the outcome of a consultation process that involved competent authorities in Member States (MSCA), industry stakeholders (operators, transporters, farmers), and EU institutions. The consultation process involved:

- An online **survey** addressed to all MSCAs
- Over 10 **preliminary interviews** with Institutional stakeholders of the European Commission
- Over **40 structured interviews** with representatives from key stakeholder groups
- **Two dedicated workshops**, one for competent authorities and one for operators, to validate findings with the stakeholders and consolidate user needs.

Moreover, the study also included an assessment of:

- **National legal and administrative practices** affecting the implementation of TRACES and related digital tools
- **User experiences and pain points**, especially related to usability, accessibility, and integration with national systems but also **best practices** developed by MSCAs to improve process efficiency
- The **potential for a mobile application** to bridge gaps in system access and data capture in the field
- **Options for interoperability**, particularly with systems managing vessel certification (THETIS EU), geolocation data, weather forecasting, and control post booking.

This consultation report lays the analytical groundwork for subsequent deliverables, including:

- **The TRACES report (D02.01.01)**, which will outline the current features and areas for improvement of the TRACES system, particularly considering new regulatory demands and potential system interoperability with tools like THETIS and meteorological services.
- **Task 3 deliverables** (D03.01 and D03.02), which include a market analysis and a design proposal for a geolocation-based positioning system.
- **Task 4 deliverables** (D04.01 and D04.02), which focus on TRACES improvement recommendations and a mobile application outline, using the identified stakeholder needs and regulatory constraints detailed in this document as critical design inputs.

Together, these deliverables contribute to the overall objective of the study: developing an integrated, harmonised, and digitally enabled framework that enhances the enforceability and operational effectiveness of the future EU regulation on animal welfare during transport.

2. Stakeholders

It is important to define and categorise different stakeholders to analyse the origin of the requirements. Each stakeholder group operates within distinct roles, responsibilities, and regulatory obligations. By clearly identifying and categorising stakeholders, the study ensures that the collected requirements are context-specific, accurately reflect operational realities, and address the full scope of the animal transport journey.

a. Stakeholder definition

The diagram below provides an overview of all stakeholders involved in animal welfare during transport who were interviewed as part of our study. Categories and sub-categories were defined at EU and National levels to facilitate requirement analysis and consolidation in downstream activities.

Stakeholder diagram

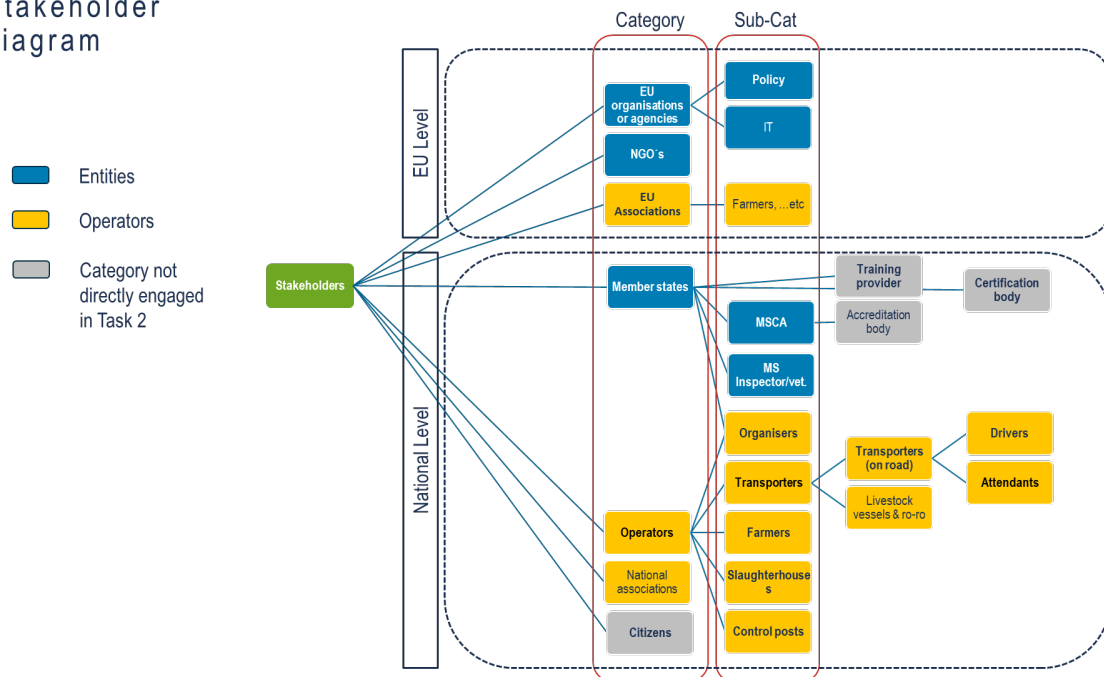


Figure 46 Stakeholders overview

The stakeholders at EU level includes EU organisations or agencies, NGO`s and EU associations.

- **EU organisation or agency-** These are the stakeholder group which includes various Directorates-General of the European Commission from the Policy department and IT department. Below are the stakeholders whom we interviewed during the preliminary interviews for our study: -
 - DG SANTE G3 (Animal Welfare)-which is the main unit responsible for drafting the regulation.
 - DG SANTE G4 (Official Controls)- which is the main unit for TRACES application.
 - DG MOVE D2 (Maritime Safety)-They involved in setting and implementing standards related to animal welfare in transport.
 - DG SANTE R4 (Information Systems)- They are the IT department for TRACES application.
 - European Maritime Safety Agency (EMSA)- EMSA works on maritime safety, security, climate and environment. They use application supporting inspection such as THETIS and THETIS EU to perform inspection for the livestock vessels.
- **EU associations-** Various EU associations representing economic operators such as farmers, veterinarians, transporters were involved in the consultation process. It is

important to note that those associations, while representing operators, are not counted under country-level statistics as they represent operators at the European level.

- **NGO`s-** We interviewed Eurogroup for Animals which is a pan-European animal advocacy organisation that brings together over 100 member organisations from across the European Union and beyond. They are dedicated in improving animal welfare through legislative influence, effective enforcement strategies, and public awareness campaigns

The stakeholders at national level are: -

- **Member states-** The member states have different roles and responsibilities as below-
 - **Member state competent authorities** - Member State Competent Authorities are the designated national agencies or departments responsible for applying and enforcing EU animal welfare legislation within their respective countries, playing a critical role in the approval, monitoring, inspection and control of live animal transport operations.
 - **Member state inspectors-** Member State inspectors are official personnel responsible for inspection of animals, vehicles and transport conditions at departure points, control post, border control post and destination points. They are responsible for conducting retrospective inspections in cases where irregularities or concerns are identified during animal transport.
 - **Member state Veterinarian-** A Member State veterinarian is a licensed veterinary professional appointed or authorised by a national competent authority within an EU Member State to carry out official controls and health-related assessments. They are responsible to provide the veterinary certificates during the start of the journey and perform a check when animals are rested and at destination points if the animals arrived are in good condition. They are also responsible to fill some parts of the journey log.
 - **Border control post** – Border Control Post (BCP) is a designated inspection point where animals and animal products entering the EU from third countries are checked. These posts are approved by the European Commission and ensure compliance with EU import conditions and animal health regulations.
- **Operators-** An operator in the context of animal welfare includes an individual or an organization involved in organizing, planning and conducting transportation of live animals

from source to destination. They include- organisers, transporters on road, farmers, slaughterhouses, livestock and ro-ro transporters and control posts.

A first group of Operators is responsible for the actual transportation of the animals. The Proposed Regulation 2023 distinguishes between Organisers and Transporters:

- **Organisers-** These operators are responsible for organising and planning long-distance journeys of live animals. They coordinate with the competent authorities of Member States to obtain the required certifications and authorizations before the transport. Additionally, they are tasked with creating the planning of the Journey and submitting it to the competent authority for approval.
- **Transporters-** These operators carry out the actual transport activities on behalf of the organisers. Specific roles within transporter organisations include the driver, the attendant and the welfare officer. They are responsible for loading and unloading activities and transport of the animals from source to destination. Specific kinds of transporters include:
 - Transporters by road.
 - Livestock vessel and ro-ro transporters- Livestock transporters and Ro-Ro (Roll-on/Roll-off) transporters are specialized operators involved in the movement of live animals, particularly over long distances and across borders which includes maritime routes.
 - Less frequently, transporters will operate live animal transports by train or air.

Another group of operators, referred to collectively as “keepers” in the Proposed Regulation 2023 are farmers, slaughterhouse operators and control post operators:

- **Farmers-** Farmers are the individuals or entities responsible for the care and management of animals, particularly those kept for agricultural purposes
- **Slaughterhouse-** A slaughterhouse is a facility where animals are received, handled, and slaughtered to produce meat and other animal-based products.
- **Control posts-** Control posts are a designated facility where animals are temporarily unloaded & held for resting, feeding, watering, and care. These posts are essential for ensuring the welfare of animals during long journeys, particularly those exceeding 21 hours, by providing breaks for rest and other needs.

Other stakeholders which are not directly involved in actual transport but play a supporting role in the animal welfare during transport process are:

- **Certification bodies-** These are bodies appointed by each MSCA to be responsible for certification activities in their country. They are responsible for evaluating and verifying compliance with established standards and legal requirement and provide the authorisations and certifications to the organisers for long journey transports.
- **Training bodies-** These are bodies appointed by each MSCA and are authorised institutions or organisations responsible for providing education, instruction, and practical training to individuals involved in the transport of live animals.

b. Stakeholder analysis

The following stakeholder matrix illustrates the relationship between the stakeholders' level of influence on the process and the level to which they will be impacted by process changes.

Influence of stakeholder	High	Ensure stakeholder remains satisfied.	Work closely with stakeholder to ensure that they agree with and support the change.
	Low	Monitor to ensure stakeholders' interest or influence do not change.	Keep informed; stakeholder is likely to be very concerned and may feel anxious about lack of control.
		Low	High
		Impact on stakeholder	

Figure 47 Stakeholder matrix

(International Institute of Business Analysis, 2015)

- **High Influence/High Impact:** These stakeholders are key players in the change effort. The list of stakeholders who has high influence and high impact are-
 - o Member state competent authorities- They are responsible for enforcing new legislations and national procedures and are heavy users of TRACES for animal Journey logs.

- Member state veterinarians- They are responsible for providing the veterinarian certificates for fitness of animals before every loading of animals. These certificates need to be uploaded in TRACES.
 - Organisers- They are responsible for filling section 1 of TRACES. They must adapt to the new digital tools.
 - Transporters- They are affected as they need to fill the animal journey log during the journey.
- **High Influence/Low Impact:** These stakeholders have needs that should be met. They include below stakeholders:
 - European Commission directorate (DG SANTE)- They provide policy direction and legal frameworks. They are not directly impacted by daily animal operations.
 - Policy/Advocacy They are not impacted by the practical changes on the ground.
- **Low influence/High impact-** The stakeholders are supporters of and potential goodwill ambassadors for the change effort.
 - Farmers- They must comply with the animal welfare regulations and have limited involvement in the regulation development.
 - Drivers- They are heavily impacted by training, certifications and regulation and limited influence over what regulation are being implemented.
 - Control post Operators- They must adapt new rules (documentation, rest times, requirements) but have minimal policy or system level input.
 - Small scale transporters- they must follow updated requirements and often lack resources or representation to influence decisions.
- **Low influence/low impact-** The stakeholders can be kept informed using general communications.
 - Local NGO´s- They may advocate for animal welfare but are not always engaged in transport legislations.

The diagram below presents a **Stakeholder Influence & Impact Matrix**, visually grouping stakeholders based on their **influence over** and **impact from** a regulatory change—specifically in the context of animal transport and digitalization (e.g., TRACES system).

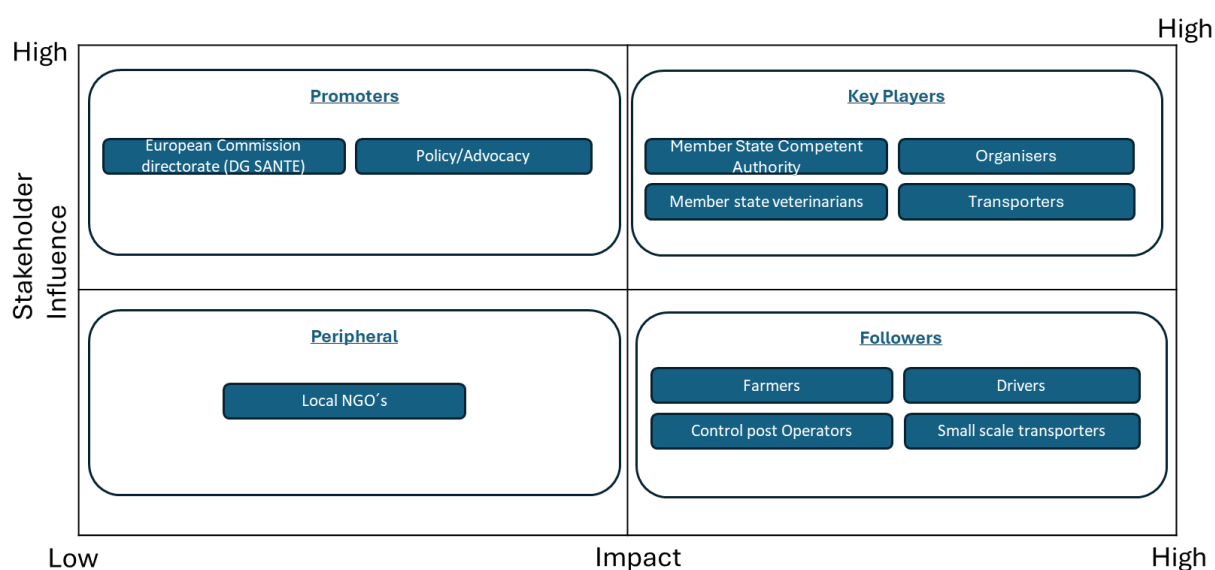


Figure 48 Stakeholder matrix - applied to AWT

c. Stakeholder participation

One of the main challenges of the Consultation phase was to ensure a representative participation of stakeholders, that would take into account the various dimensions described in section 4.2. Special care was taken to ensure a good balance between those dimensions, and to ensure proportional representation within the limits of the contractual framework of the study (1 survey, 40 interviews, 2 workshops).

i. MSCAs

The engagement of MSCAs was secured through three instruments (further defined in section 5); the online survey, targeted interviews as follow up on the survey responses and the MSCA workshop.

Participation in the online survey was very extensive with 26 MSCAs providing answers in the **online tool**.

In a second step, all MSCAs were invited for a **follow up interview**, to which 12 MSCAs responded positively and took part in the interview. The participating MSCAs are listed in *Annex 1 Lists of participating MSCAs*.

Finally, 19 MSCA representatives took part in the **one-day MSCA workshop** held on 21/05/2025. The list of participants is included in *Annex 1 Lists of participating MSCAs*.

ii. Economic operators

Economic operators were engaged through the use of two instruments: targeted interviews and a one-day remote workshop where the operators that took part in the interviews were invited to review and validate the requirements gathered during the interviews.

Geographical representation

The operators targeted for the interviews consisted in a mix of individual economic operators in various geographies and a number of pan-European representative associations.

18 national operators agreed to participate in interviews, with a geographical spread meant to ensure good representation. A complete list of national operators who were invited and participated is available in Annex 2 List of Economic Operators annex.

Stakeholder geography coverage (National operators & associations)

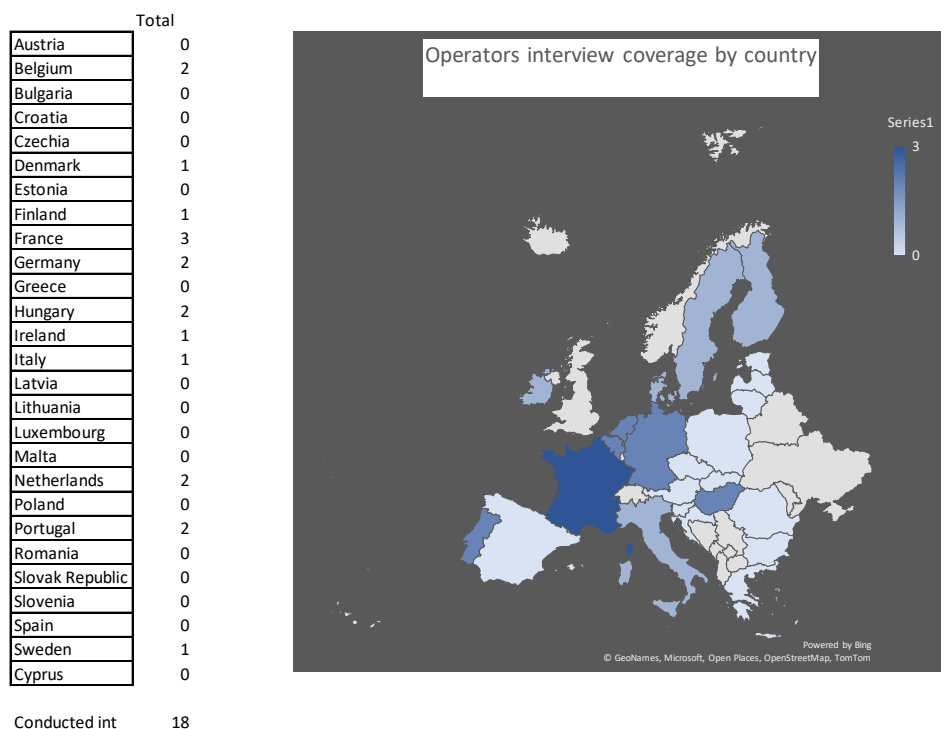


Figure 49 Geographical representation of Operators

On top of those 18 national operators, **5 pan-European operators' associations** took part in the interview process (*Annex 2 List of Economic Operators*).

Sectorial representation

Next to the geographical coverage presented in the previous section, special care was taken to ensure a balanced representation of economic operators by sector of activity. The graph below shows this representation and includes both the national operators and the pan-European sectorial associations who participated in the interviews.

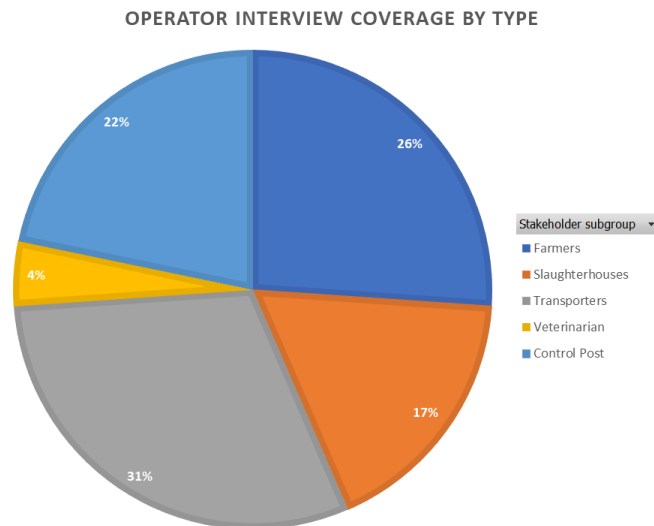


Figure 50 Sectorial representation of economic operators

Finally, all operators that took part in the interview process were invited to take part in the one-day workshop for operators that was held remotely on 19/05/2025.

The list of participants to the Operators' workshop is included in *Annex 2 List of Economic Operators*.

3. Methodology

This section outlines the methodology adopted to conduct the stakeholder consultation and requirements gathering process. The approach was structured, allowing us to engage a wide range of stakeholders while ensuring data quality, traceability, and relevance. The methodology provided the foundation for translating stakeholder inputs into structured, actionable requirements that will shape the design of future digital tools supporting animal welfare during transport.

The domain of animal welfare during transport presents inherent complexity across multiple dimensions: regulatory, operational, technical, and geographic. Capturing this diversity in a coherent and analysable format was a key challenge of the consultation process. Several complexity factors were identified:

- Regulatory diversity: Some countries operate under federal systems (e.g. Germany), others under centralised models, resulting in different coordination and enforcement needs

- Variability in IT infrastructures: While some MSCAs rely mostly on paper-based procedures, others have implemented digital workflows or national systems in parallel with TRACES
- Modal and journey-type differences: The requirements applicable to road, sea, or multimodal journeys differ significantly in terms of duration, rest periods, and infrastructure
- Climatic and geographical constraints: Member States highlighted challenges linked to temperature extremes, mountainous terrain, island access or long-distance planning
- Species-related regulatory differences: Transport conditions, documentation needs and reporting rules vary by species (e.g. unweaned calves, poultry, horses), with Member States often specialising in transport of specific species.

To deal with the multi-dimensional domain complexity described above, a tailored approach was developed by NRB to guide the investigation. The methodology comprised of following key activities.

a. Requirement gathering phase

Preliminary analysis/Desktop research:

This included review of regulatory texts and technical documentation (Technical annex, Proposal regulation) with the aim of understanding the legal basis, policy objectives, and technical requirements proposed by the European Commission for the digitalisation of administrative procedures related to the transport of live animals. The desk research included various reports on the Animal Welfare during Transport published by the European Commission, the European Court of Auditors and various NGOs.

Based on this research phase, a list of stakeholders was drafted for the preliminary and targeted interviews. The list was prepared by NRB and validated by DG SANTE G3.

Preliminary interviews:

The preliminary interviews included stakeholders within the European Commission and other EU institutions (DG SANTE, DG MOVE, and EMSA).

These stakeholders were engaged to gain a preliminary understanding of the new proposed regulation and its distinctions from existing legislation. The interviews also provided valuable insights into the use and functionality of digital platforms such as TRACES, THETIS, and THETIS-EU, as well as the current ("as-is") processes associated with animal transport, including authorization procedures, certification workflows, and the management of animal journey logs

Online survey

An online survey was developed to gather requirements from Member State Competent Authorities and published on the EU Commission survey platform. The questionnaire alternated

closed questions aimed at facilitating quantitative data collection with more open questions that allowed MSCAs to provide more specific information on their national context.

The list of questions used in the survey is provided in the deliverable *Consultation Report - Annexes D02.01.02*.

Targeted interviews:

One-hour interviews were conducted with the stakeholders identified in collaboration with DG SANTE. Structured agendas were provided in advance to allow the interviewees to prepare for the interview and ensure the discussions would remain aligned with the study's objectives.

For MSCAs, the targeted interviews allowed to clarify answers provided in the online survey and provide additional information.

For each interview, a detailed interview report was drafted and submitted to the interviewee for validation.

The individual interview agendas and reports are provided in the deliverable *Consultation Report - Annexes D02.01.02*.

Workshops

Two separate one-day workshops were held for additional validation of the requirements by MSCAs and Operators. It was decided to keep two separate workshops, one for MSCAs and one for operators to keep the participant groups small and facilitate interactions and discussions.

As for the interviews, detailed reports were produced for each workshop, documenting new requirements that surfaced during those sessions.

The individual workshop reports are provided in the deliverable *Consultation Report - Annexes D02.01.02*.

b. Requirement consolidation phase

The requirements gathered from those various sources were systematically collected and summarized in the requirements traceability matrix (RTM).

The raw inputs from the survey, interviews and workshops showed a high degree of redundancy and heterogeneity in formulation. To make the data analysable, a process of consolidation was carried out.

This involved grouping requirements by:

- Functional process (e.g. journey planning, anomaly reporting);
- Impacted capability (e.g. document management, compliance monitoring);
- Source type (regulatory, MSCA, operator);

- Stakeholder needs convergence (e.g. both MSCAs and operators requesting journey log simplification).

During this step, synonymous or overlapping inputs were harmonised and linked to a unified requirement cluster. Each cluster remains fully traceable to its individual sources via RTM references, including original phrasing where needed.

The consolidation allowed the identification of recurring patterns, pain points, and priority topics, while preserving the granularity required to reflect national or sectoral particularities.

It is worth noting that the requirements collected during this phase spanned the spectrum of requirement types as defined in the BABOK® Business Analysis framework:

- **Business requirements:** strategic objectives expressed in regulatory texts or by institutional stakeholders (e.g. enabling full digital traceability of journey documentation)
- **Stakeholder requirements:** operational needs expressed by users or authorities in order to achieve the strategic objectives (e.g. control posts requesting an online booking system)
- **Solution requirements:** functional or non-functional expectations regarding the future solution (e.g. offline mode, multilingual support, integration with geolocation services)

The different types of requirements were not restricted to specific sources: next to the strategic objectives and high-level business requirements, the Proposed Regulation also proved a very rich source of stakeholder or even solution requirements while conversely MSCAs and operators expressed business requirements regarding the strategic objectives alongside more operational needs.

The RTM was provided to DG SANTE as a separate Microsoft Excel artefact.

c. Analysis phase

This comprehensive data was then compiled into this state of play report and the subsequent TRACES report that provide a clear and concise overview of the findings and recommendations.

Of particular importance at this stage of the study is **the interrelation between the present Consultation report (D02.01.02) and the TRACES report (D02.01.01) :**

- the consultation report is primarily a requirement gathering and analysis exercise, that is intended to feed into the subsequent TRACES report.
- Requirements, gaps, best practices identified in the consultations become the basis for an in-depth assessment of current features and functionalities in the TRACES report.

As such, the two reports are intended to be read together.

The overview below summarises the various requirement gathering activities carried out in the consultation phase, their consolidation into the RTM and the ensuing analysis phase in the Consultation and TRACES reports.

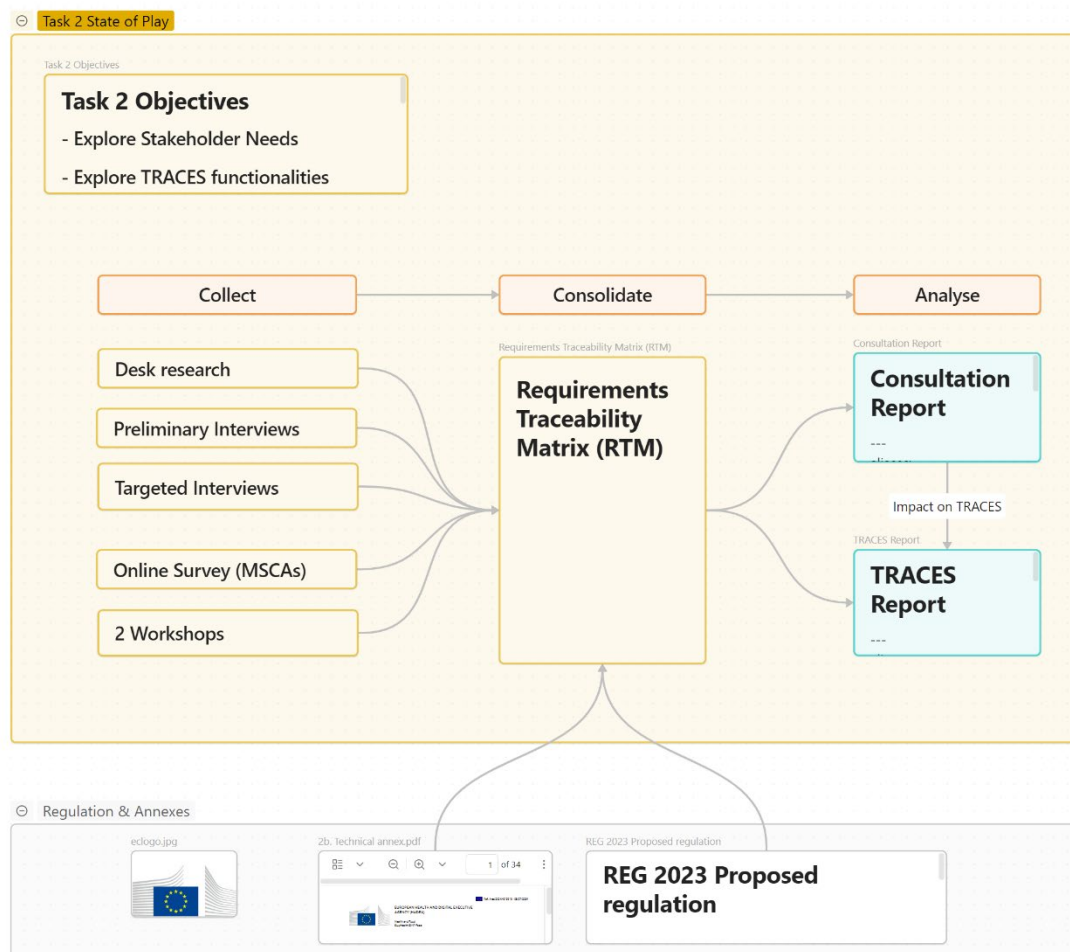


Figure 51 Requirement gathering process

4. Requirement analysis

The purpose of this section is to present the results of the analysis conducted on the requirements gathered during the consultation process. It builds on the methodology described in Section 5 and aims to synthesise a large volume of inputs into a coherent and structured view of stakeholder needs. The analysis covered both functional and non-functional requirements and focused on identifying recurring patterns, capability gaps, and areas of regulatory or operational tension. It provides a basis for the prioritisation of requirements and for the definition of future digital tools supporting animal welfare during transport.

a. Quantitative analysis of the requirements

The methodology presented in the previous section strived to ensure a balanced representation of consulted Stakeholders by ensuring a coverage by type of stakeholder, geography etc..

This balance is reflected in the way requirements were expressed and collected during the consultation process.

While the Proposed Regulation 2023 was in itself a major source of legal and functional requirements, it should be noted that the process stakeholders used the various channels at their disposal to provide a large proportion of the requirements expressed in the process.

% REQS BY SOURCE

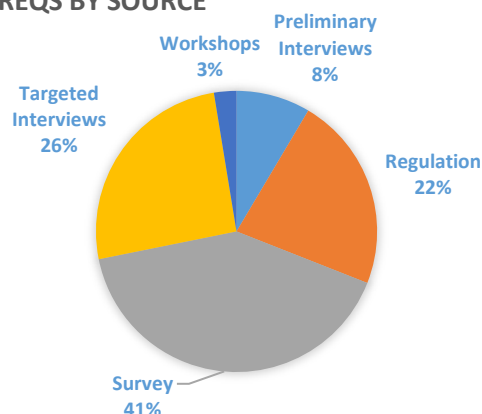


Figure 52 Spread of requirements by source

In a similar manner, the requirements were evenly spread between MSCAs and economic operators, reflecting a balanced coverage and participation between the two. Within the group of economic operators, we also note a good spread of requirements across the various types of economic operator stakeholders.

% REQS BY TYPE OF STAKEHOLDER

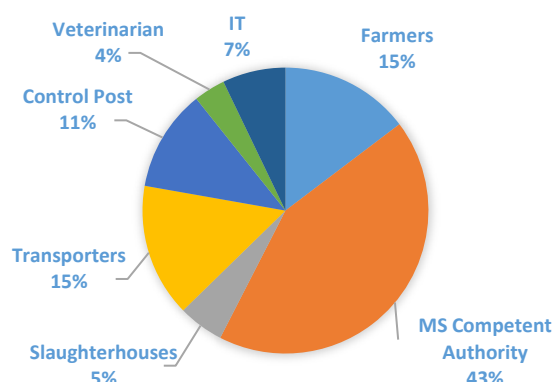


Figure 53 Spread of requirements by stakeholder type

An important dimension for the analysis is the concept of capability. For the purpose of this study, we use the concept in the TOGAF sense, namely as “a particular ability or capacity that a business may possess or exchange to achieve a specific purpose or outcome.” (The Open Group, 2025). Capabilities form the backbone of the TRACES report deliverable where current functionalities and associated user requirements are studied from the capability perspective.

We refer the reader to the TRACES report (D02.01.01 TRACES Report) for a more in depth definition of the capabilities of the solution but from the perspective of the present Consultation report, it was important to ensure that the data collection phase would provide sufficient

coverage of stakeholder requirements across the various capabilities that support the AWT process.

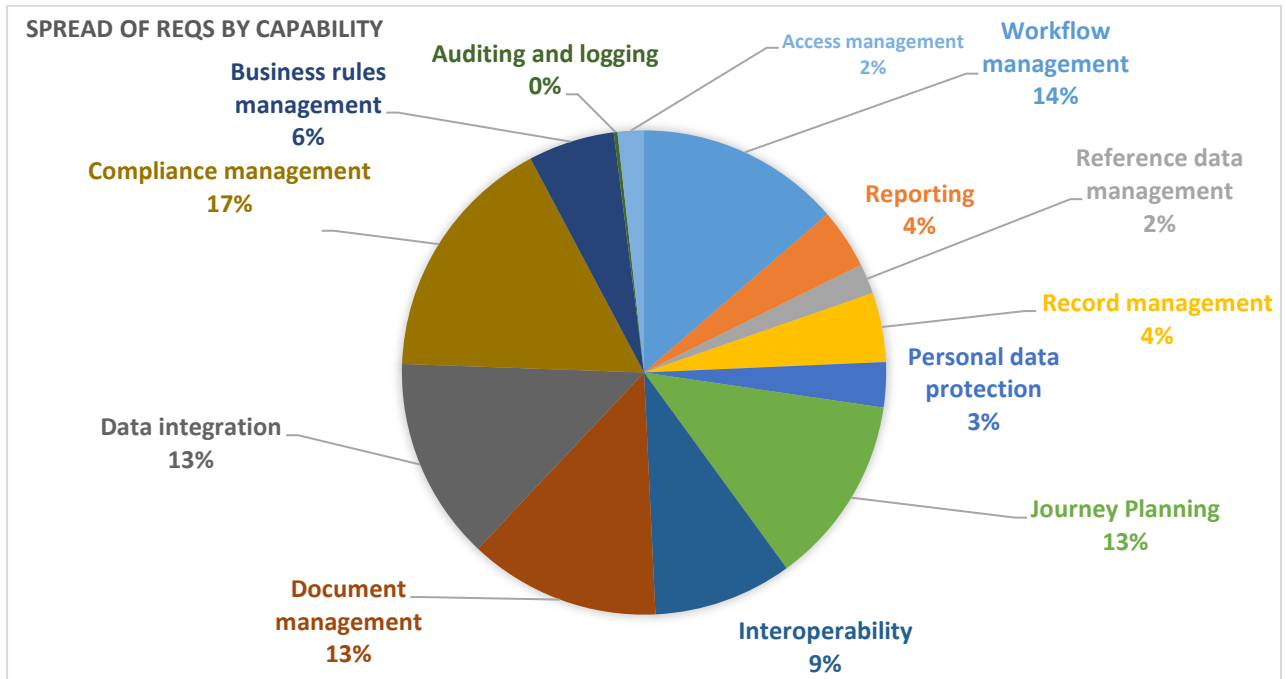


Figure 54 Spread of Reqs by capability

b. The MSCA perspective

i. Key Requirement Areas

The MSCA survey collected a first set of responses around needed features by means of closed / Multiple choice questions. The table below sums the options selected by the 26 MSCA respondents:

Survey question ⁸	Short description	Technology	Total
41. Needs Features Exceptions	User friendly and easy accessibility;	TRACES	23
38. Needs Around AJL	Complete Journey log details (authorisation, certificate of approval, etc.);	TRACES	21
40. Needs Features	Allowing for electronic certification which replaces the use of a paper animal journey log	e-Seal	21
37. Potential Digital Tools	Improved data collection and analysis	TRACES	20
38. Needs Around AJL	Real-time monitoring of animals (Monitoring systems, positioning systems etc.);	GeoLocation	19
40. Needs Features	Alerts and notification - automated alerts can notify users of significant changes or about actions required ensuring timely action and decision-making	TRACES	19
41. Needs Features Exceptions	Harmonisation of documentation formats;	TRACES	19
41. Needs Features Exceptions	Support different modules and features as per the new regulation of animal transportation (certificate of approval, authorisation for organisers etc.);	TRACES	19

⁸ Survey Questions :

- «37. What are the main areas where you see the potential for digital tools to improve animal welfare during transport? »
- « 38. What are the needs of your organisation regarding journey logs and other administrative steps for live animal transport and that you would like to see supported by a future digital solution? »
- « 40. Considering your organisation activities and operations with regard to ensuring animal welfare during transport, what features would you consider important to be integrated in a future digital solution? »
- « 41. What other specific requirements should a future digital solution support regarding exceptions in handling transport documentation for different species? »

37. Potential Digital Tools	Real-time monitoring and tracking of animals	GeoLocation	18
37. Potential Digital Tools	Enhanced communication and coordination among stakeholders	TRACES	18
40. Needs Features	Export options – support for various export formats (e.g., PDF, Excel)	TRACES	18
40. Needs Features	Business workflows for the different issuance, renewal and suspension of certificates	TRACES	16
41. Needs Features Exceptions	Integration with existing digital systems;	TRACES	16
37. Potential Digital Tools	Automation of administrative processes	TRACES	15
41. Needs Features Exceptions	Automated verification of required documents;	TRACES	15
40. Needs Features	Collaboration Tools - which facilitate collaboration on commenting, version control of documents	TRACES	14
38. Needs Around AJL	Performing unannounced evaluation	TRACES	12
40. Needs Features	Data integration – integration with relevant data sources	TRACES	10
41. Needs Features Exceptions	Should support Inspection and reporting currently done by THETIS EU	THETIS	6

Figure 55 Survey responses on new features

This first selection was complemented by open, free text questions which were further delved into during the targeted interviews. Feedback from the MSCAs consistently converged around five main priority areas for improving digital systems supporting animal transport. These reflect both operational challenges and strategic expectations for future-ready solutions.

End-to-End Digitalisation

Many authorities expressed a strong interest in moving away from paper-based processes. They aim to transition to fully digital workflows that support all key actions—from journey authorisation through to final reporting—within a single environment. This includes the ability to digitally sign and submit journey logs, eliminate the use of external documents like Excel spreadsheets, and avoid postal delays. One authority noted that “the journey log should be digitalised to reduce reliance on paper documents,” while another emphasised that “full digital signing and submission of journey logs within TRACES” should become standard practice. The

goal is a transport cycle that is managed entirely online, removing the need for manual transcription or parallel paperwork.

While the support for end-to-end digitalisation is unanimously supported by MSCAs, the consultation process revealed two different sets of expectations on how to reach that objective.

- **“TRACES-Centric” Authorities** focus on using TRACES as their main or only system. Their priorities include improving the platform’s user experience, automation features, and mobile accessibility. These authorities are looking to optimise and build upon the existing TRACES infrastructure.
- **“National Application” Authorities**, on the other hand, operate their own national digital systems either alongside or in place of TRACES. Their main concern is ensuring interoperability. They seek seamless integration between TRACES and national platforms, with flexible data exchange and system compatibility.

The analysis took this dichotomy one step further by looking at the two main processes involved in Animal Transport, namely the certification process and the transport process. See (D02.01.01 TRACES Report) for further definitions and details on the two processes.

Figure 12 summarises the tools used for the two processes under review; the transport process on the left-hand side, with the five main steps being represented by the Journey Log sections and the certification process on the right-hand side listing the various authorisations request and approval steps involved.

For each process step, a value is assigned that represents the current solution used to carry out the step:

- **“TRACES”**: the TRACES application is used to carry out the process step.
- **“TRACES-Mixed”**: TRACES is used in combination with other solutions (Email, MS Office, paper)
- **“Mixed”**: A mix of email, MS Office and paper is used. TRACES is not used
- **“Paper”**: the step relies entirely on paper documents being exchanged
- **“ICT”**: A national software application is used by the MSCA.
- **“ICT-Mixed”**: a mix of the national software application with other means such as email and paper

EUROPEAN COMMISSION

Country	18. Verify Section I	18. Verify Section IV	18. Co-sign Section II	18. Complete Dest. Section III	18. File anomaly report	18. Appl for long journey author	18. Appl for short journey author	18. Manage author . (long)	18. Manage author . (short)	18. Grant certif. Competence	18. Grant certif. MoT (long)	18. Check contingency plan	18. Verify double application	18. Verify tachograph	18. Grant certif Vessel	18. Verify r
Lithuania	TRACES	TRACES-Mixed	TRACES-Mixed	TRACES-Mixed	TRACES-Mixed	ICT-Mixed	ICT-Mixed	ICT-Mixed	ICT-Mixed	ICT-Mixed	ICT-Mixed	ICT-Mixed	ICT-Mixed	Other	Other	
Romania	TRACES-Mixed	Paper	TRACES	Paper	Paper	Mixed	Mixed	Mixed	Mixed	Mixed	Mixed	Mixed	Mixed	THETIS-Mixed	Mixed	
Hungary	TRACES-Mixed	Paper	TRACES-Mixed	TRACES-Mixed	TRACES-Mixed	ICT-Mixed	ICT-Mixed	ICT-Mixed	ICT-Mixed	ICT-Mixed	ICT-Mixed	TRACES	Other	Other	Other	
Greece	n/a	n/a	n/a	n/a	n/a	Mixed	Mixed	Mixed	Mixed	Paper	Mixed	Mixed	Email	Mixed	n/a	n/a
Latvia	TRACES-Mixed	Paper	TRACES-Mixed	Paper	Paper	ICT-Mixed	ICT-Mixed	ICT-Mixed	ICT-Mixed	ICT-Mixed	ICT-Mixed	Mixed	TRACES-Mixed	Other	Other	Other
Slovak Republic	TRACES-Mixed	TRACES-Mixed	TRACES-Mixed	TRACES-Mixed	TRACES-Mixed	ICT-Mixed	ICT-Mixed	ICT-Mixed	ICT-Mixed	ICT-Mixed	ICT-Mixed	Mixed	Mixed	Mixed	Other	Mixed
Netherlands	TRACES	ICT-Mixed	Paper	Paper	Paper	ICT	ICT	TRACES	TRACES	Mixed	TRACES-Mixed	ICT	Mixed	Mixed	Other	Other
Czechia	TRACES-Mixed	Paper	Paper	Paper	Paper	Email	Email	Mixed	Mixed	Mixed	Mixed	Paper	TRACES-Mixed	Other	Other	Other
Spain	TRACES-Mixed	Mixed	Mixed	TRACES-Mixed	TRACES-Mixed	ICT-Mixed	ICT-Mixed	ICT-Mixed	ICT-Mixed	ICT-Mixed	ICT-Mixed	n/a	n/a	Mixed	ICT	TRACES-Mixed
Ireland	TRACES	Paper	Paper	Paper	Paper	Mixed	Mixed	Mixed	Mixed	Mixed	Mixed	Mixed	Email	Other	Mixed	Email
Slovenia	TRACES-Mixed	Paper	Paper	Paper	Paper	ICT-Mixed	ICT-Mixed	ICT-Mixed	ICT-Mixed	ICT-Mixed	ICT-Mixed	ICT-Mixed	Other	Paper	ICT-Mixed	Email
Germany	TRACES-Mixed	TRACES-Mixed	TRACES-Mixed	TRACES-Mixed	TRACES-Mixed	TRACES-Mixed	TRACES-Mixed	TRACES-Mixed	TRACES-Mixed	Mixed	TRACES-Mixed	Mixed	TRACES-Mixed	Mixed	Paper	Paper
France	TRACES-Mixed	Mixed	Mixed	Mixed	TRACES-Mixed	Paper	Paper	TRACES	TRACES	ICT	TRACES	Mixed	Email	Email	THETIS-Mixed	THETIS-Mixed
Finland	TRACES	TRACES	TRACES	TRACES	TRACES-Mixed	Mixed	Mixed	ICT	ICT	ICT	ICT	Mixed	Email	Other	ICT	Email
Austria	TRACES-Mixed	Paper	TRACES	TRACES-Mixed	TRACES-Mixed	Email	Email	TRACES-Mixed	TRACES-Mixed	TRACES-Mixed	TRACES-Mixed	Email	TRACES-Mixed	Other	Other	Other
Poland	TRACES-Mixed	Paper	Paper	Paper	TRACES-Mixed	Paper	Paper	Paper	Paper	Paper	Paper	Mixed	TRACES-Mixed	Mixed	Other	Other
Sweden	Mixed	TRACES-Mixed	TRACES-Mixed	Other	TRACES-Mixed	ICT-Mixed	ICT-Mixed	ICT	ICT	Other	ICT	Other	Email	Paper	ICT	Email
Belgium	TRACES-Mixed	Mixed	Paper	Paper	Paper	Email	Email	Email	Email	Mixed	Mixed	Email	Email	Other	Other	Other
Bulgaria	TRACES-Mixed	TRACES-Mixed	TRACES-Mixed	TRACES-Mixed	TRACES-Mixed	ICT-Mixed	ICT-Mixed	ICT-Mixed	ICT-Mixed	ICT-Mixed	ICT-Mixed	ICT-Mixed	Email	Mixed	THETIS-Mixed	Mixed
Cyprus	TRACES-Mixed	Paper	Paper	Paper	Paper	Mixed	Mixed	Mixed	Mixed	Mixed	Mixed	Mixed	Mixed	Mixed	n/a	n/a
Malta	TRACES-Mixed	Paper	TRACES-Mixed	TRACES-Mixed	TRACES-Mixed	Mixed	Mixed	TRACES-Mixed	TRACES-Mixed	Paper	Paper	Paper	TRACES-Mixed	Other	Other	Email
Estonia	TRACES	TRACES	TRACES	TRACES	TRACES	ICT	ICT	ICT	ICT	Email	ICT	ICT	ICT	Paper	ICT	ICT
Italy	TRACES-Mixed	TRACES-Mixed	TRACES	TRACES	TRACES	Mixed	Mixed	Mixed	Mixed	Mixed	Mixed	Mixed	Email	Email	Other	Email
Denmark	ICT	ICT-Mixed	Paper	Paper	Paper	Email	Email	Email	Email	Mixed	TRACES	Mixed	Email	Other	Email	Email
Luxembourg	TRACES	Paper	Paper	Paper	Paper	Email	Email	ICT	ICT	ICT	ICT	Mixed	TRACES	Other	Other	Other
Portugal	TRACES-Mixed	Mixed	Mixed	Mixed	Mixed	ICT	ICT	ICT	ICT	ICT	ICT	Mixed	Email	Email	ICT	THETIS-Mixed

Figure 56 TRACES As-Is usage

The transport process is largely conducted outside of TRACES (except for the initial steps of the journey log creation and approval) in the As-Is state, by both types of MSCAs, due to the fact that in the current state, economic operators have limited access to the tool and the paper support for the various documents to be used is still required.

The certification process on the other hand shows a stronger divide, with “National Application” Authorities using their national system to digitalise the authorisations and certification process and therefore requiring a tighter integration between the national application and TRACES, while “TRACES” Authorities would consider a wider adoption of TRACES to further digitalise the process.

To accommodate both profiles, the future solution must offer dual support: a robust, standalone version of TRACES for full adopters and an API-based architecture for integration with national systems.

Enhanced Journey Log Functionality

The current journey log is viewed as limited in scope. MSCAs would like it to evolve into a more intelligent and proactive planning tool. The expectation is that the journey log should do more than store data—it should help operators and authorities make better decisions. Several participants proposed features such as route simulation tools that factor in driver working hours and welfare stress indicators, along with real-time alerts in the event of heatwaves or high-risk transport conditions. One Member State suggested that “automatic booking confirmations to control posts” should be built into the system, reducing delays and errors. These capabilities would allow the journey log to function not only as a compliance document but also as an integrated, risk-based management tool.

Improved Accessibility and Usability

Practical accessibility, particularly in the field, was a recurrent concern. MSCAs stressed the need for digital systems that work effectively in real-world environments, including rural areas and mobile settings. Many authorities called for a user-friendly mobile application that includes offline functionality and supports different types of users, especially drivers. One comment underlined that “apps should avoid burdening drivers during transport—use before departure or after arrival,” while another mentioned the usefulness of “pre-filling digital forms based on journey history.” The priority is to create tools that are intuitive and adaptable to real operational workflows, rather than imposing rigid, desktop-bound systems.

Meaningful Data Access and Usage

Authorities consistently pointed to the need for data systems that are not only capable of storing information but can also turn it into useful insight. Access to both real-time and historical data should support planning and help prevent welfare violations before they occur. MSCAs underlined the importance of role-based access rights and full GDPR compliance. Several suggested that “data should be used for prevention, not just enforcement,” and requested

systems that allow for transparency in how data is shared and interpreted. This points to a vision of TRACES as more than a repository—rather, a platform that actively supports regulatory decision-making.

Regulatory Harmonisation and Clarity

Differences in the interpretation and application of regulations between countries are seen as a major barrier to smooth cross-border cooperation. MSCAs called for shared templates, harmonised certification standards, and clear, centralised instructions on how and what to report. Examples included requests for “a harmonised EU certificate for livestock drivers” and the need for “TRACES templates in one downloadable location.” Many also emphasised the value of training and guidance to ensure that everyone interprets the system’s requirements in the same way. These elements would help reduce confusion, improve coordination, and simplify compliance.

It should be noted that from the MSCA’s perspective, the regulatory harmonisation and clarity requirements listed above also extend to areas beyond the scope of the present study such as Health certificates, operator training, knowledge sharing etc.

ii. National legal requirements and constraints

The MSCA were also queried about perceived potential challenges and roadblocks to improvement initiatives.

Survey question ⁹	Short description	Total
39.Potential Roadblocks	Interoperability with other EU IT systems;	21
39.Potential Roadblocks	Data protection regulations	19
39.Potential Roadblocks	Interoperability with IT systems from your organisation;	18
39.Potential Roadblocks	User interface changes in TRACES modules (If you use some modules)	10

Figure 57 Perceived roadblocks

Digital roadmap

Several MSCAs clearly expressed doubts as to the availability of funding for plans to further integrate TRACES with their national application. It should be noted however that MSCAs

⁹ Survey question : “39. What are potential practical or legal requirements which need to be considered when implementing the digital solutions arising from the proposal? »

contacted as part of the study's scope were representatives of the business side of the competent authority and did not necessarily have a view on the digital roadmap of the application they use.

Data protection

Data protection was mentioned by several MSCAs as a major constraint as they perceive the concerns of Economic Operators around the topic (see 6.6.2 Data protection dimension) and are aware of the workload involved in ensuring GDPR compliance for sensitive personal data such as GPS location tracking.

Role of national application in the certification process

One survey question ¹⁰ focussed specifically on whether there would be legal hindrances on moving the certification process to TRACES. The responses could be grouped in different categories:

- 11 Countries indicating that there are no legal impediments to such a move (Category 1)
- 5 Countries indicating that there are legal dispositions on the topic, but this could be changed (Category 2)
- 6 Countries indicating that the certification process is handled outside of TRACES and should be subject to an integration (see above) or that the handling within TRACES is not desirable due to increased workload (Category 3)

Country	Cat	Response
Lithuania	3	Application for an authorisation, approval or a certificate of competence, submitted in TRACES will require changes in national legislation. For authorization, licensing, registering of operators License Information System is used in Lithuania. It is owned by National Center of Registers (NCR), the integration with TRACES must be initiated by NCR. For the moment we foresee that there is the risk of double keying of data into different IT systems.
Romania	1	We do not have specific national legislation
Hungary	3	The administrative system (regulation) in HU does not allow such procedures to be carried out solely through a Commission-managed online platform, and even the initiation of a procedure cannot be based solely on a notification received via TRACES. The application must be done in person .

¹⁰ Survey question : « 19. In your opinion, would an application for an authorisation, approval or a certificate of competence, submitted in TRACES initiate the administrative procedure in your Member States, or are there national rules on administrative procedure which require such applications to be submitted in another way? »

		Imposing such a requirement in this form would place a significant administrative burden on the authorities.
Greece	1	No relevant national rules are available in Greece.
Latvia	2	Administrative procedure are regulates with the national rules.
Slovak Republic	2	Yes, there are national rules on administrative procedures.
Netherlands	1	there is no national legislation that would hinder the use of Traces for this purpose
Czechia	2	Yes, there are national rules on administrative procedures which require applications of transporter and approval of means of transport to be submitted in another way.
Spain		
Ireland		At present such applications are submitted by email /post to the relevant section of the Department.
Slovenia	2	There are national rules, application outside TRACES, but if there would be EU legal basis we could adapt.
		We received various replies from “No” to “Is desirable”. Here are some further comments we received:
		National rules: applications (templates and supporting documents) are usually submitted by mail/ emails.
		Due to the many minor problems and inconsistencies in TRACES, its effect as an ‘official application portal’ is currently not sufficiently established for economic operators. As a result, business operators or incompetent authorities repeatedly make incorrect applications for consignments or company registrations. In particular, non-existent companies are repeatedly created at the point of entry, as these are fraudulently selected on the shipping documents and the border control posts are unable to check whether this company does not exist or has simply not yet been entered in TRACES. It should also be noted that the written form can only be replaced by an electronic form if the electronic form bears a qualified electronic signature (national law: VwVfG). TRACES does not currently offer this option. Therefore, a direct application to the authority is necessary for an unhindered process flow.
Germany	3	
France	1	As think it may be possible into Traces (without absolute certainty however)
Finland	1	None

Austria	3	Applications are submitted to the district administrative authority; no program such as TRACES is currently required.
Poland	2	The Polish Law on the Protection of Animal Health and Control of Infectious Diseases of Animals does not specify how an application can be submitted, but an application transmitted electronically should be confirmed with a qualified electronic signature, as is required by other regulations on the functioning of public administration.
Sweden	1	There are some administration already nationally, but I think it could be initiated in TRACES as well.
Belgium		
Bulgaria		This procedure is applicable for long journey
		Currently, there is an administrative procedure in place that is primarily paper-based.
Cyprus	3	The main concern, should all procedures be required to transition to TRACES, is the feasibility of handling the volume, uploading, and processing of supporting documents for each application.
Malta	1	No national rules, TRACES application would apply
Estonia	1	TRACES would be best for authorisation.
Italy	1	In theory it could be a good idea but I am not sure if the local AC would have enough personnel to use this opportunity. Would it be really better for them? Or just only a new administrative burden?
Denmark	1	No national rules
Luxembourg	1	LU supports the idea of moving administrative procedures regarding authorizations and approval to TNT. LU will adapt its procedures accordingly
		We have a national database much more complex (and with more information than TRACES), for the purpose of issuing transporter authorisation and means of transport certification. This database also includes the information on the controls and the cleaning and disinfection of the means of transport. Also this database is linked with national movement database and will be linked slaughterhouses database in a near future. We think that the TRACES must be linked to the national transporter database to avoid duplication of the CA, transporters and organisers workload. If not this would impose big constraints on the implementation of the REGulation either for the CA or the stakeholders.
Portugal	3	

Figure 58 Role of the national application in the certification process

A last constraint needs to be mentioned more specifically for the authorisation/certification process.

Even if not explicitly mentioned as a constraint for an integration of the certification process by MSCAs, there is a wide disparity in how the certification process is being handled across Europe. While some countries operate this process from a central point, others have delegated the issuance of the certificate to regional administrations. Furthermore, in some of these delocalised scenarios, a common application can be used, but in others, the certification process is not integrated between regional and central administrations, and the Operators have to request and obtain the certificates from the regional authority and then hand it over themselves to the national MSCA.

This disparity in processes and actors involved will add a layer of complexity to integration efforts around the certification process described in section 6.2.1.1 End-to-End Digitalisation

Electronic signature

Two MSCAs indicated that if the current paper-based journey log is to be completely digitalised, they would have a requirement under their national legislation for the signoff of journey log sections to be done by means of a **qualified electronic signature**. (Netherlands, Poland). Germany mentioned a similar requirement as a constraint for moving the certification process to TRACES (see above). The number of countries requiring a qualified signature might be higher as other MSCAs contacted were not always aware of legal requirements in that area.

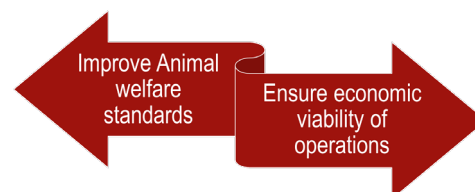
iii. Summary of Common Insights

While digital maturity varies from one Member State to another, the feedback gathered during the consultation reflected a **strong convergence of priorities**. Authorities across the board are calling for systems that are **mobile-friendly, offline-capable, and easier to use in real-world conditions**. They want the journey log to become more than just a static record, transforming it into a **dynamic tool** for planning, coordination and compliance monitoring. There is a consistent demand for **clearer definitions** of user roles, standardised formats, and a regulatory framework that reduces administrative burdens rather than adding to them.

Whether through improvements within TRACES or better integration with national systems, MSCAs are united in seeking practical, harmonised, and future-proof solutions that align with both enforcement needs and operational realities.

c. The Operators' perspective

The Proposed Regulation 2023 strives to maintain a balance between the stated objectives of improving animal welfare and safeguarding the economic feasibility of transport operations (European Commission, 2023).



It is therefore not surprising that many requirements expressed by process stakeholders tend to lean on one or the other side of that divide, with MSCAs and NGOs insisting on the need for improved controls and compliance and Economic Operators insisting on ease of use, digitalisation and uniformization/clarity of rules.

However, a closer look at some key requirements grouped by capability provides a more nuanced picture. When grouping requirements by capability, and then by type of stakeholder (MSCA vs Economic Operator), one can see that the number of requirements expressed under the 4 dimensions listed below is largely equivalent (with the exception of the interoperability/Data integration, see below), suggesting that those dimensions are equally important to both groups of stakeholders.

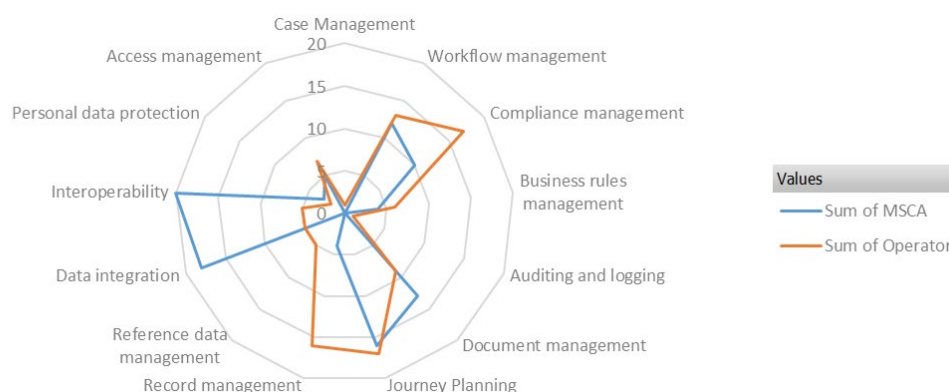


Figure 59 Requirements by capability - MSCA vs EO

i. Compliance dimension

(Workflow, Compliance and Business Rules capabilities)

The number of requirements falling under the capabilities Compliance management, Workflow management and Business rules management show an interesting alignment between MSCAs and EO.

Obviously, the reasons why requirements are expressed around compliance may differ, with MSCAs insisting on tools that allow them to trace compliance more effectively and Economic operators focusing more on the need to see :

- more consistency in rules, forms, documents, etc in international transport
- more focus on the actual enforcement of existing rules than introducing new rules
- more focus on welfare in other stages of an animal's life than transport

However, the operators that took part in the consultation process were very much aware of the need for more enforcement of compliance rules as the behaviour of certain non-compliant operators is clearly perceived

1) as detrimental to how the sector is perceived in the general public and

2) as a source of unfair competition for compliant operators.

For instance, some long-distance transporters were in favour of a feature allowing to upload videos of loading/unloading operations to be uploaded to the AJL to provide evidence of proper handling, even if this is not currently a requirement of the Proposed Regulation 2023.

ii. Data protection dimension

(Personal data protection, Access management capabilities)

Both MSCAs and Operators are concerned about the level of protection and security that will be provided around personal data. This is especially clear around the collection of geolocation data of individual transports. While MSCAs insisted on the need to collect (near-) real time data to better track non-compliance, they were very clear about the need to ensure the concerns of operators around the privacy of their drivers were met.

iii. Usability dimension

(Document, Journey, Record management capabilities)

Just like for MSCAs, the usability dimension is a core concern of economic operators and improvements on that dimension are widely perceived as a way to counterbalance the operational costs of increased compliance monitoring.

In the AJL process, the end-to-end digitalisation is the key factor for transporters, with the mobile application being cited as a must to ensure on the road access to key AJL functions (See 6.4.1 Mobile-Related Requirements).

Often cited required features include :

- Need for an interface that allows quick detection of possible non-compliances and supports decision making

- Need to streamline administrative burden on recurring / routine transport routes
- Need to streamline the certification process
- Need an easy, single-stop access to all required certificate documentation for a journey
- Digitalise form-filling (avoiding data double entry) and implement electronic signature
- Facilitate compliance by helping organisers and transporters to easily visualise non-compliant areas of a planned or actual journey log.

Usability requirements that apply more specifically to the mobile application are presented in section 6.4.1 Mobile-Related Requirements .

iv. Interoperability dimension

(Data integration and Interoperability capabilities)

The data integration / interoperability dimension is less often cited by Economic operators than by MSCAs but this is probably due to the fact that they have less exposure to TRACES than the MSCAs and tend to express requirements related to data integration and interop as compliance or usability requirements.

Nevertheless, there is clear support for enhanced integration, especially where it can ease the administrative burden involved with the certification and the journey log processes. In particular, we found Economic Operators were very supportive of features that would enhance the journey log with weather forecast and journey duration calculations.

d. Priority Features

As we have seen in sections 6.2 and 6.3, MSCAs and operators obviously have diverging interests on the compliance axis (animal welfare <-> economic sustainability) but despite that, there is a very interesting level of convergence in their views on requirements for studied dimensions such as compliance, data protection , usability and interoperability.

Three groups of requested functionality stood out in the consultation process as priority features for both MSCAs and economic operators and are listed below.

i. Mobile-Related Requirements

Considering the new proposal regulation and the intent to digitalise the end-to-end process, the topic of 'mobile' access emerged across multiple requirements in the RTM, particularly in relation to real-time data entry, field inspections, and transport monitoring. These requirements reflect a strong demand from stakeholders — especially Member State Competent Authorities (MSCAs), inspectors, and transport operators — for system functionalities that can be used directly on-site, in the field, or during transit.

- **System must be accessible on mobile devices (Technical Annex)**

Ensures that users can access the platform from smartphones or tablets, using a responsive web interface or native app. The system must be mobile-optimised and tested for smaller screen sizes and constrained connectivity.

- **Ability to submit and sign off AJL sections on the road**

Ensures the end-to-end digitalisation of the AJL process ; forms must no longer be signed on paper, provided back to the MSCA after the journey, encoded in TRACES or national app, ...

- **Support for offline functionality with data sync (Workshops, Technical Annex)**

Users should be able to input or retrieve data without internet connectivity, and the system should sync data once reconnected. This supports remote or rural work environments.

- **Real-time geolocation from mobile devices (Regulation, Technical Annex)**

The system should retrieve and track live GPS location data during transport. This supports the enforcement of animal welfare rules related to route, rest periods, and journey duration.

- **Notification alerts on mobile for key events (Interviews)**

Users should receive alerts — such as for validation errors, upcoming inspections, or journey issues — directly on their devices. Push notification capability is essential.

- **Mobile data entry for inspection results (Workshop, Survey)**

Inspectors should be able to complete and submit inspection results on-site via mobile, reducing reliance on paper and enabling real-time reporting.

- **Access to animal transport documentation on mobile (Regulation)**

Users must be able to access and verify documents like journey logs, transport certificates, and consents from their mobile device. This supports real-time validation in the field.

- **Upload of photos and videos to support compliance**

ii. Geolocation requirements

The requirements on geo location focuses mainly on conducting market analysis of the latest technology for geolocation that should be installed and used by vehicles with consignment of live animals, as introduced in the Proposal Regulation.

The requirements which were identified during the preliminary and targeted interviews came from different Member states authorities.

Real time tracking-

The large support of geolocation shows that many countries are asking for near real-time tracking in improving animal welfare and regulatory compliance during transport. Countries such as Ireland, France, Denmark, and Portugal emphasize the integration of GPS and sensor data directly into TRACES or national systems to enable full-journey oversight by competent authorities. The Netherlands and Spain advocate for automated, continuous data transmission to reduce manual checks and enhance data reliability.

Data Protection: -

Another important aspect is data protection. Some stakeholders, such as UECBV, have expressed concerns regarding the privacy and security of drivers' personal information, fearing that such data could be vulnerable to hacking. In contrast, other stakeholders, like the Member State Ireland, emphasize the practical benefits of access to this information. Ireland highlighted that having real-time data—such as temperature forecasts—can significantly aid in planning animal transport routes more effectively. For instance, they actively monitor transports crossing some areas in Southern Europe that they know from experience are subject to very rapid changes in temperature. With timely data, authorities could proactively advise drivers to avoid these areas during peak heat hours or wait in a control post. They can start their transport during night or early morning.

Administrative burden: -

As mentioned by various Member State, stakeholders often need to manually request critical information such as GPS tracking data, temperature logs, or weather conditions from transporters.

For instance, instead of having automatic, real-time access to data via systems like TRACES, authorities must contact transporters individually, follow up on missing details. This introduces delays, increases the risk of errors or omissions, and is very time-consuming and inefficient.

Single source of truth

Several MSCAs and operators highlighted the benefits of having a single source of truth for geolocation data and more particularly, forecasted temperatures at a particular location on the journey. The use of different, sometimes contradictory, sources of forecast data between MSCAs and operators leads to discussions and unnecessary frictions.

iii. Control post booking requirements

A recurring topic across both MSCA and operator consultations was the complexity and operational inefficiency surrounding the current booking process for control posts (CPs). At present, reservations are often managed manually, through emails or direct calls, without formal confirmation protocols or integration into TRACES or other transport management systems.

Stakeholders – especially transporters operating across borders (e.g. between Bulgaria and Turkey) – highlighted major issues related to unpredictability, such as unavailable slots at CPs on arrival, leading to unnecessary rerouting, fines, or animal stress (Commission, 2019). In some Member States, post-reservation confirmations are informal, and lack of digital validation can result in operational delays and a breakdown of traceability. Multiple operators and national authorities emphasised the absence of a shared calendar or booking module as a limiting factor for planning and compliance.

The emergence of requirements related to CP booking reflects a convergence of concerns raised during the consultation:

- **Traceability:** Booking confirmation is crucial to validate journey logs and ensure animals will have an approved place to rest. This was particularly emphasised in the *Final Overview Report on animal welfare during export by road* (European Commission, 2019, p. 12).
- **Efficiency:** Stakeholders cited concrete administrative inefficiencies, such as revalidating journey logs due to CP booking uncertainty or having to pause at border control points awaiting slot confirmation.
- **Regulatory alignment:** Several competent authorities expressed concerns that existing tools may not be aligned with the future obligations set out in Article 15 of the proposed revision of Regulation (EC) No 1/2005.

While stakeholders did not propose a single technical solution, many expressed the need for the following features:

- A digital interface to consult availability.
- A centralised module to request, confirm, and cancel CP bookings.
- Integration with TRACES to automatically cross-check and record confirmed bookings within the journey log process.
- Notification systems for automatic updates in case of overbooking or slot cancellation.

In interviews, French and Irish stakeholders described informal coordination mechanisms, whereby booking confirmation is required before transporters may proceed to the control post. Although these tools are not formalised in a single IT application, they serve to mitigate scheduling conflicts and ensure space availability at the time of arrival.

While stakeholders did not comment on technical implementation challenges, some highlighted interoperability constraints or national dependencies that could affect deployment timelines or require coordination with local infrastructures.

Accordingly, the consolidated requirements were categorised in the RTM under the capabilities “Journey Planning”, “Workflow Management”, and “Interoperability”, based on the nature of the expressed needs.

e. How These Requirements Connect

The analysis of the requirements expressed by MSCAs and Economic operators reflects the expected dichotomy of focus and priorities that is inherent in the domain, namely the tension between the efforts to improve animal welfare standards while preserving the economic viability of the live animal transport industry.

It is clear for economic operators that the introduction of the Proposed Regulation 2023 would bring new rules and increased limitations on their activities, resulting in more administrative burden and challenges.

The introduction of geolocation tracking also bring in concerns around privacy and data protection. Lastly, the new rules will have to be monitored closely and will require very careful planning and execution from operators to remain compliant.

However, we saw in the consultation process a realisation by the MSCAs and operators alike that opportunities could be unlocked from those challenges if tackled in the correct way.

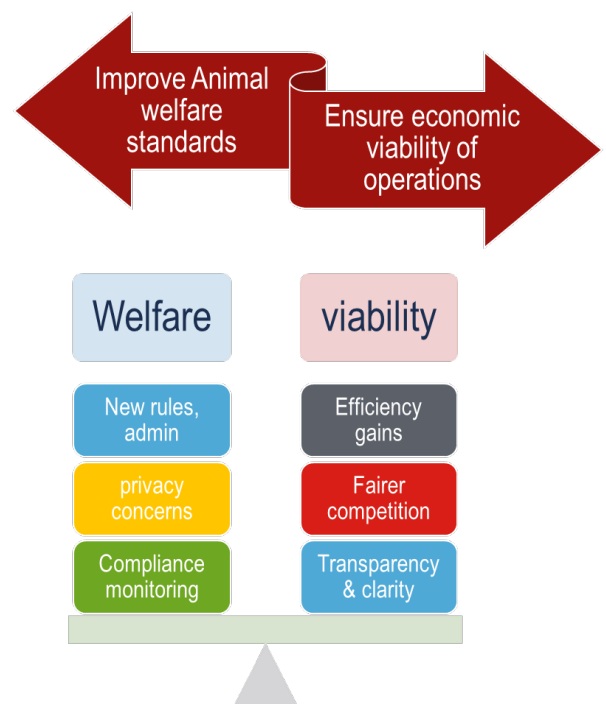
The new rules and associated administrative burden could be offset by usability and efficiency gains in many areas of the software solution, the most quoted example being the end-to-end digitalisation of the journey log.

The concerns around privacy should be addressed if geolocation is to be used but operators also saw opportunities in the introduction of such technology, as they perceive that non-compliance by some operators leads to unfair competition.

The enhanced monitoring of compliance, including near real time tracking of transports can also lead to increased transparency and clarity of rules. Interfaces can be designed in a way to help operators plan and execute journeys in a compliant manner, integrations with weather forecasts can reduce the uncertainty around different temperature readings being used by operators and MSCAs , etc..

5. Conclusions

The study of modalities of animal welfare during transport provides essential insights into the current processes and tools used by different stakeholders. The study has allowed to gather



requirements from different stakeholders more concretely which brought more transparency on their processes.

In addition, the individual reports with different stakeholders highlighted areas of efficiency and pinpointed significant bottlenecks and redundancies hindering their day-to-day work.

- **Efficient Processes**

Use of Digital Platforms (e.g., TRACES): Many Member States emphasize the value of digital tools like TRACES for journey logs, certification, and traceability, enabling centralized data management and cross-border coordination.

Real-Time Monitoring Technologies: GPS tracking and temperature sensors are recognized as effective means for monitoring animal welfare during transport, improving oversight and compliance.

Interoperability Efforts: Efforts to link national databases with TRACES and enable data exchange between systems demonstrate progress towards harmonized seamless digital processes.

Mobile and Offline Capabilities: Adoption of mobile applications with offline functionality allows officials to work efficiently even in remote or connectivity-challenged areas

- **Bottlenecks:**

Paper-Based Journey Logs and Certificates: This is particularly evident in the case of animal journey logs, which are still largely maintained in paper format for long journeys. The reliance on paper-based logs significantly hinders the efficiency and effectiveness of competent authorities in performing their duties as they need to follow up with transporters/organisers for the detail.

Data Standardisation Challenges: There is a lack of harmonisation in the use of GPS and weather forecast data, requiring competent authorities to repeatedly request this information from transporters to conduct retrospective checks.

Usability Issues in Digital Platforms: Complex login systems, non-intuitive interfaces, and inadequate user guidance limit operator engagement and effective use of digital tools.

- **Redundancies:**

Duplicate Data Submission: Operators often need to submit journey logs both in paper form and electronically (e.g., in TRACES), leading to redundant work and increased error risks.

Manual Verification Steps: Despite digital data availability, many verification and validation steps still require manual intervention, slowing down processes and increasing administrative burden

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7. Annex 2 Lists of participating MSCAs

26 MSCAs participated in the online survey.

Out of those 26 countries, 12 accepted to participate in a follow-up interview to validate the answers provided in the online survey. Those 12 countries are listed below and the individual interview and workshop reports are available in (D02.01.02 Consultation Report – Annexes).

a. MSCAs who participated in targeted interviews

Name/Stakeholder	Stakeholder group	Geography
Swedish board of agriculture	Member State	Sweden
Danish Veterinary and Food Administration	Member State	Denmark
General Direction of Food and Veterinary	Member State	Portugal
General Direction of Food and Veterinary	Member State	Portugal
Bulgarian Food Safety Agency	Member State	Bulgaria

Federal Ministry of Social Affairs, Health, Care and Consumer Protection	Member State	Austria
Ministry of Agriculture	Member State	France
Ministry of Agriculture	Member State	Hungary
Department of Agriculture, Food and the Marine	Member State	Ireland
Ministry of Agriculture of Latvia	Member State	Latvia
The Netherlands Food and Consumer Product Safety Authority	Member State	Netherlands
Directorate-General for Agri-Food Production Health and Animal Welfare	Member State	Spain

b. MSCAs who participated in the MSCA Workshop

Geography
Portugal
Portugal
Portugal
Portugal
Latvia
Latvia
Czech Republic
Spain
Spain
Denmark
Netherlands
France
Hungary
Cyprus
Croatia

Bulgaria
Bulgaria
Ireland
Austria

8. Annex 3 List of Economic Operators

- a. National Operators or national associations who were invited to and/or participated in, the targeted interviews

The last column indicates whether the contacted stakeholder actually took part in an interview.

Name/Stakeholder	Stakeholder group	Stakeholder subgroup	Geography	Interview conducted
ADT - Arbeitsgemeinschaft Deutscher Tierzüchter e	National Association	Farmers	Germany	Interview conducted
Board of Hunland Group (HU)	Operator	Transporters	Hungary	Interview conducted
Hagric Woźniecki sp. z o.o. sp.k.	Operator	Transporters	Poland	Invitation sent
JAN KAUC Usługi Transportowe	Operator	Transporters	Poland	Invitation sent
FEBEV	National Association	Slaughterhouses	Belgium	Interview conducted
Irish Farmers' Association	National Association	Farmers	Ireland	Interview conducted
Port of Rotterdam	Operator	Transporters	Netherlands	Invitation sent
FEBETRA	National Association	Transporters	Belgium	Interview conducted
TLN (Transport en Logistiek Nederland)	Operator	Transporters	Netherlands	Invitation sent
FTA Ireland	National Association	Transporters	Ireland	Invitation sent
Vion Food Group	Operator	Slaughterhouses	Netherlands	Invitation sent
Müller Fleisch GmbH	Operator	Slaughterhouses	Germany	Invitation sent
German Farmers' Association (DBV)	National Association	Farmers	Germany	Invitation sent
CLDN	Operator	Transporters	Luxembourg	Invitation sent
AIA	National Association	Farmers	Italy	Interview conducted
Vroon (Livestock Express B.V)	Operator	Transporters	Netherlands	Interview conducted
Port of Setúbal Inspectors	Operator	Transporters	Portugal	Interview conducted
Finnish Fishfarmer Association	National Association	Farmers	Finland	Interview conducted
Ganados Vicente Fernandez	Operator	Farmers	Spain	Invitation sent
Federation of Swedish Farmers	National Association	Farmers	Sweden	Interview conducted
Centre de Liaison des Industries Transformatrices	National Association	Slaughterhouses	EU	Invitation sent
LECH-DRÓB sp. z o.o. Poultry Plant	Operator	Slaughterhouses	Poland	Invitation sent
EMN - European Meat Network	National Association	Slaughterhouses	Denmark	Interview conducted
Finnish meat producers	National Association	Slaughterhouses	Finland	Invitation sent
Spanish National Association of live animal transporters	National Association	Transporters	Spain	Invitation sent
Association of Danish transporters focused on import	National Association	Transporters	Denmark	Invitation sent
Hungarian Meat Industry Federation	National Association	Slaughterhouses	Hungary	Interview conducted
Transporter Interview on GPS data	Operator	Transporters	Portugal	Interview conducted
STIMEX	Operator	Control Post	France	Interview conducted
SEPAB	Operator	Control Post	France	Interview conducted
Qualivia	Operator	Control Post	France	Interview conducted
Berghuis	Operator	Control Post	Germany	Interview conducted
Paligroup	Operator	Control Post	Netherlands	Interview conducted
Maximir	Operator	Control Post	Poland	Invitation sent
New Zealand sea transport booking system	Operator	Control post	New Zealand	Invitation sent

- b. European associations of Operators who were invited to and/or participated in the targeted interviews

The last column indicates whether the contacted stakeholder actually took part in an interview.

Name/Stakeholder	Stakeholder group	Stakeholder subgroup	Geography	Interview conducted
Copa-Cogeca	EU Association	Farmers	EU	Interview conducted
International Road Union	EU Association	Transporters	EU	Invitation sent
Euro group for animals	NGO	Advocacy/Policy	EU	Interview conducted
Animal Transportation Association (ATA)	EU Association	Transporters	EU	Interview conducted
Federation of Veterinarians of Europe	EU Association	Veterinarian	EU	Interview conducted
UECBV	EU Association	Slaughterhouses	EU	Interview conducted

- c. Operators who participated in the Operators' workshop

Organisation name	Operator type	Geography
Berghuis	Control post	Germany
SEPAB	Control post	France
Board of Hunland Group	Transporters	Hungary
European Meat Network	Slaughterhouse	Denmark
ADT – German Animals Breeders Federation	Farmers	Germany
Federation of Veterinarians of Europe	Veterinarian	EU
Copa – Cogeca	Farmers	EU
FEBEV	Slaughterhouse	Belgium

6.3 D.03.01. Market analysis report

- Introduction and context

The European Commission, through the EU4Health and Single Market Programme and under the authority of the European Health and Digital Executive Agency (HaDEA), has launched a study to support the revision of the EU legislation on animal welfare during transport (AWT). The initiative is driven by the growing recognition that digitalisation can play a pivotal role in strengthening the enforcement of animal welfare rules, improving data quality, and reducing administrative burdens.

Currently, TRACES (Trade Control and Expert System) serves as the EU's central IT platform for managing veterinary certificates, journey logs, and authorisations related to live animal transport.

The functionalities that are currently available in TRACES were introduced voluntarily to satisfy the requirements of Regulation 01/2005. Consequently, they are not yet fully aligned with the latest regulatory and operational expectations, especially those set out in the newly proposed **Regulation on the Protection of Animals during Transport** (COM (2023) 770). The legislative proposal calls for a more advanced, fully digital ecosystem that should include:

- Full digitalisation of administrative procedures
- Mandatory digital journey logs
- Real-time positioning and geolocation tracking of consignments
- A mobile application to increase accessibility for users in the field

- Greater interoperability with national and EU systems such as THETIS (maritime transport) and meteorological data platforms.
 - Objectives

This report contains the objectives of task 3 in the study on modalities of Animal Welfare during transport (AWT). Three objectives of this task 3 were identified:

- a market analysis of the commercialised position equipment and systems for geolocation data collection and tracking suitable for vehicles used for animal transport (both in the EU and outside of EU markets)
- evidence of the most advanced technology and infrastructure in the market for a later compatibility analysis with the current Global Navigation Satellite System (GNSS)
- a plan for the setting up of the positioning system which ought to be partially or fully connected to TRACES.

Equipment for vehicle geolocation collection

- Equipment components

To enable the collection of the geolocation of vehicles transporting animals, several components are necessary. The following overall schema depicts the different components.

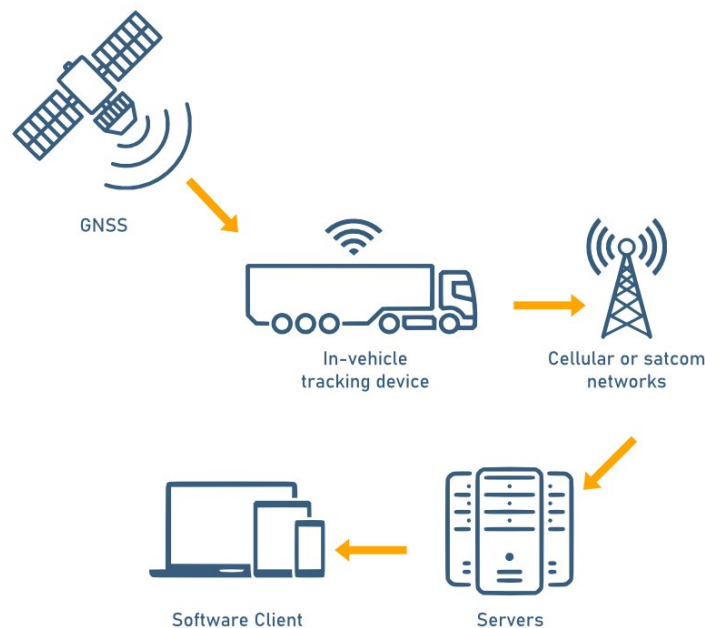


Figure 60 Equipment components for the collection of geolocation data

The different components are:

- GNSS System
 - A satellite-based navigation system (e.g. GPS, Galileo, GLONASS).

- To provide accurate position (latitude, longitude, altitude), speed, and time information.
 - Note: Many systems use multiple GNSS constellations for better accuracy and redundancy.
- In vehicle tracking device
 - In the truck the tracking device is the hardware unit, that can be independent from the truck, or part of the inbuild telematics device, sold with the truck.
 - To receive satellite signals and calculate the truck's position.
 - Common types: Standalone GNSS modules, inbuild tracking device, smartphones/tablets with GNSS sensor.
- Communication Network
 - Primary: Cellular network (e.g., 4G, 5G, NB-IoT).
 - To transfer the truck's geolocation data to central servers.
 - Optional/Alternative:
 - Satellite communication (for remote or non-cellular areas)
- Software Client, generally part of the Fleet Management System
 - Web or mobile platform used by logistics/fleet operators.
 - To visualize and analyze truck locations, driver behavior, route efficiency, compliance.
- Server Infrastructure
 - Cloud or on-premises servers.
 - To collect, store, process, and make geolocation data accessible for analysis, dashboards, alerts, or API access.
- Security Infrastructure
 - Encryption (e.g., TLS), authentication (e.g., OAuth), and firewalls.
 - To ensure secure transmission and access to location data.
 - Important for: GDPR compliance and data integrity.

The first 4 components are further analysed in the following sections. The last 2 components (server infrastructure and security infrastructure) are not part of the market analysis.

- GNSS System

▪ Existing GNSS

Today, trucks across Europe commonly use several GNSS (Global Navigation Satellite System) systems for various applications such as fleet management, vehicle tracking, and electronic tolling. The below table provides an overview of the existing GNSS systems in use in the world.

GNSS	Operator	Accuracy	Coverage in Europe
Global Positioning System (GPS)	USA	<i>Standard</i> <i>With a clear view of the sky: about 3 to 5 m.</i> <i>In real-world conditions: about 10 to 20 m</i> <i>Augmented</i> <i>DGPS: 1 to 3 m</i> <i>WAAS: less than 3 m</i>	Yes
Galileo	European Union	<i>Standard Positioning Service (SPS):</i> <i>Horizontal positioning accuracy: 1 m</i> <i>Vertical positioning accuracy: similar to horizontal accuracy</i> <i>High Accuracy Service (HAS):</i> <i>Horizontal positioning accuracy: up to 20 cm</i> <i>Vertical positioning accuracy: similar to horizontal accuracy</i>	Yes
GLONASS	Russia	<i>Horizontal positioning accuracy: 5 to 10 m</i> <i>Vertical positioning accuracy: ~ 15 m</i>	Yes
BeiDou	China	<i>Standard Positioning Service (SPS):</i> <i>Global accuracy: about 3,6 m</i> <i>Accuracy in the Asia-Pacific region: about 2,6 m</i>	Partially
QZSS (Quasi-Zenith Satellite System)	Japan		No

NavIC (Navigation with India
Indian Constellation)

No

- Areas of low GNSS signal and without signal

The GNSS signal is emitted by a constellation of satellites, providing a wide coverage all over the globe. However, some specific areas are less or not covered on the globe. It concerns the following areas:

- Urban Canyons (Dense built-up city centers)
 - Tall buildings and narrow streets limit direct line-of-sight (LOS) to satellites—often leaving fewer than four visible satellites and forcing receivers to rely on reflected (NLOS) or multipath signals, which significantly degrade accuracy or prevent a fix entirely.
 - Multipath effects, where signals reflect off facades or canyon walls, introduce timing errors that distort measurements and position solutions.
 - Accuracy can degrade to ± 30 m in dense transit environments unless augmented methods are used.
- Tunnel, Underground, & Interior Spaces
 - GNSS signals cannot penetrate tunnels, underground garages, subways, buildings. Signal loss is essentially total.
 - Indoor positioning with GNSS alone fails due to attenuation and multipath; alternatives like Wi-Fi are used instead.
- Indoor–Outdoor Transition Zones
 - At entry points (e.g., doorways, building overhangs), signals become intermittent and uncertain, causing positioning to fluctuate or lose lock entirely.

For truck geolocation, mitigation in these areas can be done using a combination of onboard sensors: wheel speed (odometer), heading sensors (gyros), and accelerometers to estimate movement during GNSS outages. As drift accumulates over time, especially if not regularly recalibrated, a high-quality IMU is critical for minimizing drift.

- Existing SBAS networks

Satellite-Based Augmentation Systems (SBAS) network aim to improve the accuracy, integrity, and availability of GNSS signals globally. SBAS uses a network of ground-based reference

stations to monitor GNSS signals. These stations detect errors caused by atmospheric disturbances, satellite orbit inaccuracies, and clock discrepancies. The ground stations send this error information to master stations, which calculate correction data. The correction data is then transmitted to geostationary satellites, which broadcast it to GNSS receivers. GNSS receivers use the correction data to improve their positional accuracy, achieving precision levels suitable for critical applications.

The figure below shows an overview of the SBAS network coverages.

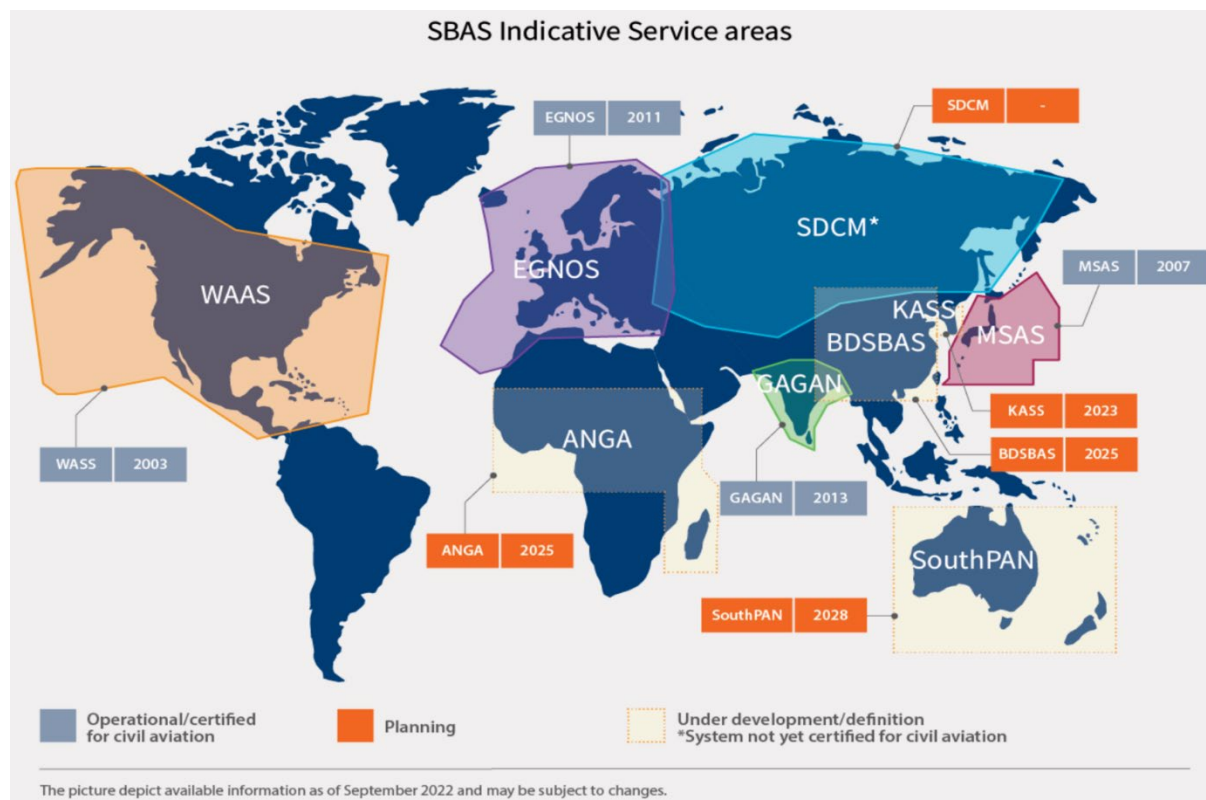


Figure 61 SBAS Indicative Service Areas

- Compatibility of receivers with existing GNSS constellations and SBAS

GPS signal

Manufacturers of GPS receivers for military users—Texas Instruments, Rockwell Collins, Magnavox, and Interstate Electronics—were the first to offer them to civilians, especially scientists and surveyors. Receivers gradually grew smaller, more portable, and more user-friendly. Around the year 2000, demand exploded as new devices and more accurate signals gradually became available.

Until the 2010 decade, all civilian positioning devices were using the American GPS signal.

GLONASS signal

First devices compatible with the GLONASS signal appeared in Europe around 2011.

Various smartphones from 2011 onwards have integrated GLONASS capability in addition to their pre-existing GPS receivers, with the intention of reducing signal acquisition periods by allowing the device to pick up more satellites than with a single-network receiver.

Galileo signal

All major GNSS receiver chips support Galileo and hundreds of end-user devices are compatible with Galileo.

As of July 2019, there were more than 140 Galileo-enabled smartphones on the market of which 9 were dual-frequency enabled. An extensive list of enabled devices, for various uses, on land, sea and in air is frequently updated at the EU website. On 24 December 2018, the European Commission passed a mandate for all new smartphones to implement Galileo for E112 support, the location-enhanced version of the emergency service 112.

- Availability outside Europe

GPS, GLONASS and Galileo signals are available globally, including Europe's neighboring regions: Central Asia, the Middle East and Africa.

- Conclusion

The vehicle geolocation tracking is dependent on the good functioning of GNSS satellites. Several constellations exist for Europe, being GPS, Galileo and GLONASS, which perpetuates a GNSS service over time.

Nearly all commercially available GNSS receivers on the market are compatible with one of the three constellations. Moreover, most of the chips in smartphones today are multi-GNSS, meaning they use data from more than one GNSS constellation.

All three constellations provide enough accuracy, from a few cm to 20 m, for the purposes of vehicle geolocation tracking for live animal transportation.

- Telecommunication networks

- Cellular networks

The truck geolocation data are most commonly transmitted through cellular networks, to the central servers that will further process the data.

These cellular networks commonly are 4G and 5G, but previous technologies can still be in use

Required technology for geolocation data transmission

A rough timeline of cellular network technologies from 2000 up to today is summarized in the table below.

Generation	Overall Period	Tech	Max Speed	Key Features
2.5G	2000–2003	GPRS	~114 kbps	First mobile data (packet-switched)
2.75G	2003–2006	EDGE (E)	~384 kbps	Faster data, better browsing
3G	2004–2010	UMTS	~384 kbps	Mobile internet, video calling
3.5G	2006–2010	HSPA / H+	~42 Mbps	App ecosystem, faster streaming
4G	2010 onwards	LTE / LTE-A	~100–300 Mbps	All-IP, VoLTE, mobile HD video
5G	2020 onwards	5G NR	~1–10 Gbps	Low latency, IoT, ultra-fast data

Depending on the type of transmission of truck geolocation data, different max speed are required:

- For a real-time transmission of geolocation data
- For an on demand, occasional transmission of geolocation data

If we consider that a geolocation data message sizes around 200 to 500 bytes (including: longitude, latitude, altitude, timestamp, speed, heading, accuracy, vehicle ID, status, message header, protocol overhead), we will need the following speed:

- For real-time geolocation data transmission: **~ 5 kbps**
- Event based reported (e.g. geofencing) : **~1 kbps**
- On demand (user request) : **~1 kbps**
- Complete telematics: **~10 – 50 kbps**

As a result, **all cellular network technology generation can afford** the transmission of vehicle geolocation data, from GPRS to 5G.

Decommissioning

Important to know is that telecommunication companies are increasingly decommissioning the older technologies, impacting the older truck devices that are only using GPRS, EDGE, H+ and even 3G. Truck and trailer constructors as well as transport companies have to take this into account when willing to send their truck geolocation data through the networks.

As technology is evolving quickly, the life cycle of such GNSS devices is much shorter than the life cycle of the trucks. Therefore, if trucks from the 2000s and 2010s are equipped with build-in GNSS devices, these are increasingly incompatible with the cellular network technology.

Truck builders and transport companies have to take this into account, when striving compliancy with vehicle geolocation data exchange. Devices inside older trucks may be incompatible with the telecommunication technology in the future, due to decommissioning.

Availability outside Europe

Accessibility to cellular networks varies in Central Asia, but for most countries, 4G technology is available . Where 4G is less available (like in Turkmenistan up to 2023), other telecom technologies are available for data transmission.

Cellular network coverage in Turkey is extensive and considered very good, with all three major operators—Turkcell, Vodafone, and Türk Telekom—offering nationwide 2G/3G services and strong 4G/LTE in cities and major routes. Turkcell is generally considered to have the best overall coverage, particularly in rural and mountainous areas.

Cellular network coverage in the Middle East varies, with significant improvements but remaining hurdles such as vast, sparsely populated terrains, and infrastructure costs. Countries like Saudi Arabia and the UAE show leadership, while others face challenges due to geographical difficulty, regulatory frameworks, and socioeconomic disparities. Coverage along main roads is considered fair, even in remote areas.

- Satellite networks

Whereas truck geolocation data is most communicated via cellular networks, ship geolocation data are most commonly communicated via satellite networks.

Even if cellular networks are not available in all parts of remote Europe and the world, it is more common to foresee an offline data collection on the GNSS devices (when cellular networks are not available) than to acquire expensive satellite communication devices and subscription.

Offline data collection on a mobile device uses data buffering to temporarily store information locally on the device, enabling data collection in areas with no internet. When a connection becomes available, the app automatically syncs the buffered data to a server, allowing for continuous data gathering in challenging network environments. To manage buffering, the app has to be designed for offline use.

- In Vehicle tracking device

The in vehicle GNSS device is receiving satellite signals and calculates the truck's position. These devices can be standalone GNSS modules, inbuilt tracking device or smartphones/tablets with GNSS sensor.

- Stand-alone GNSS navigation devices

Stand-alone GNSS navigation devices for truck drivers exist on the market.

The hardware unit contains firmware / software to run the device. This software contains **functionalities and data**:

- Navigation functionalities,
 - o allowing the driver to plan a journey,
 - o propose alternative itineraries based on traffic
 - o other standard functionality comprised in a GNSS navigation device.
- Geodata with the road network
- Geodata contain truck specific data like
 - o roads restricted for certain larger and heavier vehicles,
 - o size of roads, bridges and tunnels,
 - o more generally one way roads;

Some well-known brands of such device for trucks on the European market include:

- Garmin dēzl LGV & dēzl 710/720/810
- TomTom GO Expert Plus Truck (see illustration below)



Figure 62 Interface of the TomTom Expert Truck, a stand-alone GNSS navigation device

However, these standalone GNSS navigation devices are primarily made for navigation and do not natively support sending geolocation data to a server via cellular network for external integration. As a result, they are **not considered tracking devices**.

- Smartphone as a tracking device

Smartphones have all necessary sensors and hardware to act as a tracking device.

- The GNSS sensor can calculate the geolocation. As analysed before, most smartphones GNSS sensors acquire multiple signals, from GPS, Galileo, GLONASS, ...;
 - When GNSS signal is low, smartphones can calculate geolocation using the Wi-Fi sensor and the available Wi-Fi signals in the surroundings;
- Smartphones have built-in cameras to take photos in the field;
- Dedicated applications can be installed on the smartphone to process geolocation data and prepare them to be transferred;
- Smartphones are connected to cellular networks to transfer the collected geolocation data and photos to a server.
 - Tracking device of an FMS

Refer to the next paragraph for a more detailed analysis on tracking devices as part of a Fleet Management System (FMS).

- Fleet Management Systems (FMS)
 - Components and purposes

The FMS of software and devices, typically **comprising** the in-vehicle tracking device, the servers (in cloud or on premise) and the fleet management software, are illustrated in the figure below.

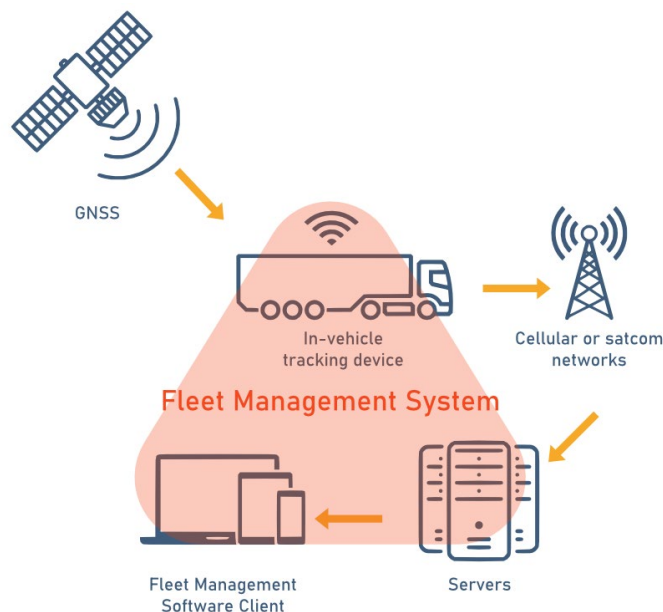


Figure 63 Components of the Fleet Management System

Apart from vehicle tracking and route optimization, the **purpose** of a FMS is to ensure the fuel management, better maintain the trucks and diagnose issues in time, dispatch and schedule

transport jobs, communicate with drivers, ensure security and theft recovery and even monitor driver behaviour.

The FMS is increasingly necessary for regulatory **compliance**, main purpose in the context of the regulation for AWT.

- In vehicle tracking device

The in-vehicle tracking device includes the **same** functionalities as GNSS navigation devices (see previous paragraph), including:

- Navigation functionalities,
 - allowing the driver to plan a journey,
 - propose alternative itineraries based on traffic
 - other standard functionality comprised in a GNSS navigation device.
- Geodata with the road network
- Geodata contain truck specific data like
 - roads restricted for certain larger and heavier vehicles,
 - size of roads, bridges and tunnels,
 - more generally one way roads;

Moreover, the in-vehicle tracking device is embedded in a larger FMS. Consequently, it includes several specific features and functionalities that are related to the vehicle tracking. These features are amongst others :

- collection of geolocation, vehicle speed, fuel consumption, engine RPM, total engine hours, odometer, accelerator pedal position, brake status, door open/close status
- data buffering when offline,
- geofencing,
- edge analytics (e.g., speed thresholds, idling detection),
- ...

It is interesting to note that the newer devices provide the ability to connect to the **trailer** and receive data from there (trailer identification, sensor data inside the trailer, ...). Refer to the specific paragraph on tractors and trailers for more detailed information.

- Main brands

Today, all main truck constructors are including an FMS in their vehicles as a standard.

The table below provides a non-exhaustive list of the **European truck constructor** companies and the FMS they are using. Some systems are native to the truck constructors, others are integrated with existing FMS software in the framework of an OEM (original equipment manufacturer).

European Truck Builder	Fleet Management System
Volvo Trucks (Sweden)	Volvo Connect
Scania (Sweden)	Scania Fleet Management
DAF Trucks (Netherlands)	PACCAR Connect
Mercedes-Benz Trucks (Germany)	Fleetboard
MAN Truck & Bus (Germany)	MAN DigitalServices
Iveco (Italy)	Iveco ON
Renault Trucks (France)	Optifleet

FMS that are independent from any truck brand also exist. A non-exhaustive list of the main software companies is listed in the table below.

FMS software company	URL	Head office
Webfleet	https://www.webfleet.com	Bridgestone Mobility Solutions B.V., Amsterdam, NL
Motive	https://gomotive.com	San Francisco, CA, USA
Samsara	https://www.samsara.com	San Francisco, CA, USA
Verizon Connect	https://www.verizonconnect.com	Atlanta, GA, USA

- rFMS data standard

Many transport companies have a multi-brand fleet of trucks. Collecting geolocation data (as well as other vehicle data) from the different truck types and brands is made possible through the FMS standard. This is a vehicle data interface specification that was developed to standardize the access to vehicle data across different truck manufacturers, primarily in the European commercial vehicle industry.

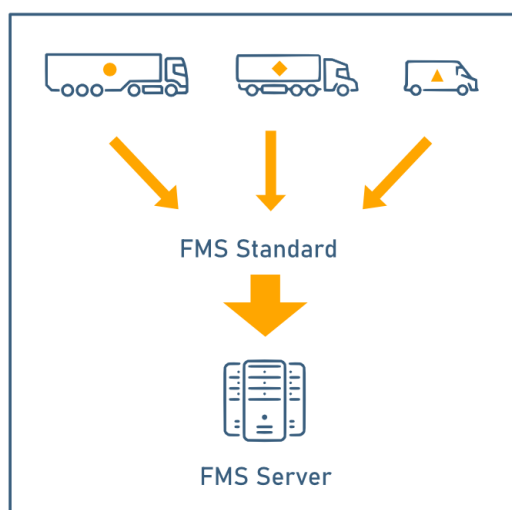


Figure 64 Principle of the FMS standard

The standard is an initiative of seven major European truck manufacturers (Daimler/Mercedes-Benz, MAN, Scania, Volvo, Iveco, DAF, Renault Trucks) who collaborated under the European vehicle manufacturers' organisation ACEA, to define the common standard. The result was the FMS Standard (Version 1.0) in 2002 – a specification defining which vehicle data points can be accessed, and how they are transmitted, using a standard CAN bus protocol. The table below provides an overview of the major evolutions of the FMS standard from 2002 onwards.

Year	Milestone
2002	FMS Standard 1.0 launched by 7 major OEMs
2007	FMS 2.0 released with expanded diagnostics
2010s	Broad industry adoption; supported by most telematics providers
2020s	FMS extensions for electric vehicles, CO ₂ metrics, and safety regulations
2020s	FMS is a global standard for truck telematics integration in mixed-brand fleets
2025	rFMS Version 5 released in July

The FMS standard was a major step forward in fleet data interoperability, enabling unified access to key vehicle data regardless of brand. The standard is still managed under the umbrella of the ACEA. The standard is implemented much more widely than only by the seven European truck manufacturers that initiated it. As an example, the (truck brand independent) Webfleet FMS is compatible with the FMS standard.

In the framework of the modalities on Animal Welfare during Transport (AWT), this standard further encourages the acquisition of truck geolocation data through existing systems that are

already collecting these necessary data. Moreover, it remains a cornerstone of European fleet telematics and continues to evolve with new vehicle technologies and regulatory needs.

- Compatibility of older and smaller trucks with an FMS

Older trucks do not have integrated in-vehicle FMS devices. As a truck is a considerable investment and lasts over time, whereas FMS devices are a relatively recent evolution, an important percentage of trucks driving on our roads is still not equipped with an integrated FMS device. Moreover, the FMS systems evolve over time and older devices are not as complete, integrated and usable as the newer ones.

As an example, for the Volvo trucks:

- Geolocation data and transmission to an FMS are available for Volvo trucks built since 2006.
- From 2021 onwards, the trucks are equipped with the integrated Android in-vehicle system.
- Trucks older than 2021 can still transmit data via cloud APIs or after software/gateway updates. This is due to the fact that the older systems only use early cellular network technology (2,5G and 2,75G) that is not always compatible any longer.

For older trucks, solutions are available, like installing brand-independent FMS devices (e.g. Webfleet) or updating software and gateways of already installed FMS devices.

- Real-time tracking VS event-based geolocation

Independently from the necessary components to collect geolocation data, several scenarios are possible when tracking a vehicle in movement. These scenarios all have different collection frequency, results and impact on involved technology. The three main scenarios are developed in the following paragraph:

- Tracking via specific points
 - Real-time tracking at low frequency
 - Real-time tracking
- Tracking via specific points

In this scenario, the tracking is done by gathering the geolocation at a few points in space and time. Generally, this comprises: start, at resting points (control post), arrival, and a few additional check points can be added.

In this case, the tracking is done via events:

- At start, control post and arrival, the event will be: 'engine start' and 'engine stop'. When the truck engine is started, an event is triggered, sending the geolocation and timestamp to the server.
- When additional check points are added (e.g. by the competent authority), a geofence of a certain diameter (e.g. 500 m) is added and an event is triggered as soon as the truck enters the geofence circle, sending the geolocation and timestamp to the server. The principle of geofencing is illustrated in the figure below.



Figure 65 A geofence is a virtual geographic boundary around a physical location

The tracking is done only via events. The impact on data transmission (via cellular network), on server and database are limited:

- A big data database is not necessary to store and handle the data.
- The amount of data that has to be transmitted via cellular network is very limited, without impact for standard mobile data subscription fees.

To enable geofencing demands (like the one of competent authorities), it is important to mention that another system will have to register the geolocation data into more detail (geolocation at low, medium or high frequency). These geofenced locations are indeed corresponding to no specific events (like 'engine start' and 'engine stop'), so a detailed path is necessary to check when the 'fence' was passed.

The illustration below provides an idea of the result from such tracking via specific points. No more detailed itinerary can be extracted from the data, except the events. The figure contains a zoom on Stuttgart, Germany, as an example. With a registration at some specific points, other points will be missed, like the city of Stuttgart, where the truck passed but which is not visible with a restricted amount of specific points.

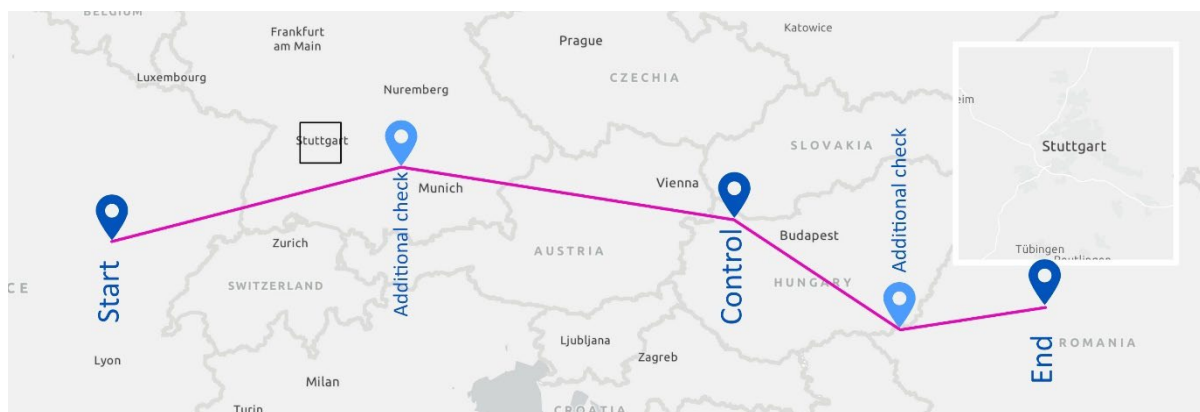


Figure 66 Journey map resulting from geolocation tracking at specific points

- Real-time tracking at low frequency

In this scenario, the tracking is done in real-time, by gathering the geolocation at medium to low frequency in space and time.

The tracking is done both via events and real-time tracking. The impact on data transmission (via cellular network), on server and database are limited:

- A big data database may not be necessary to store and handle the data, as the amount of data is limited.
- The amount of data that has to be transmitted via cellular network is limited, with a very limited impact for standard mobile data subscription fees.

The illustration below provides an idea of the result from such tracking at low frequency. The performed itinerary can be extracted with a fair resolution, like the zoom on Stuttgart is showing.

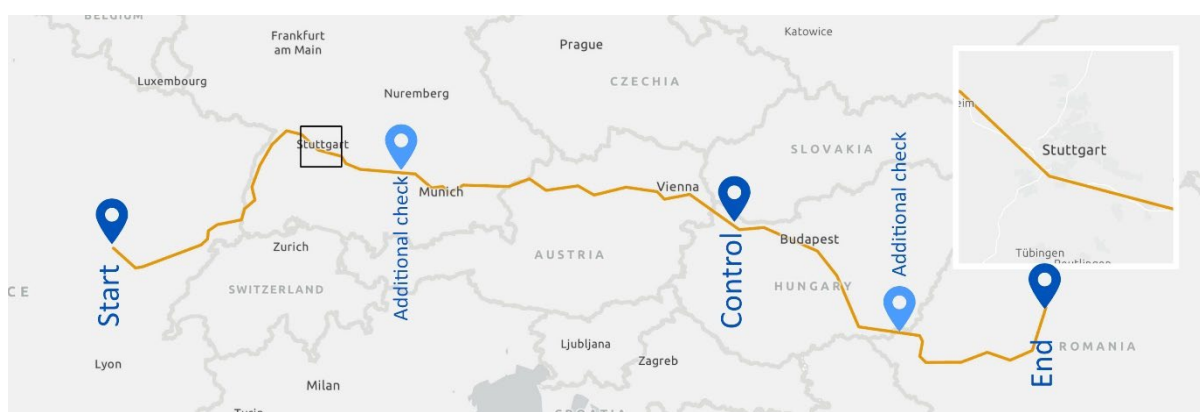


Figure 67 Journey map resulting from geolocation real-time tracking at low frequency

It is interesting to mention that filtering can be set up to further lower the amount of collected points on the journey. As an example, points that are collected every 15 minutes, but are still very near to each other (due to traffic jam, for example), can be ‘thinned out’, keeping only one point with timestamp, rather than the entire series next to each other.

- Real-time tracking

In this scenario, the tracking is done in real-time, by gathering the geolocation at highest possible frequency in space and time.

The tracking is done both via events and real-time tracking. The impact on data transmission (via cellular network), on server and database have to be taken into account:

- A big data database is necessary to store and handle the data, as the amount of data is important. This has a higher cost than a standard database, in terms of necessary hard- and software.
- The amount of data that must be transmitted via cellular network is important, which can have an impact on the mobile data subscription fees.

The illustration below provides an idea of the result from real-time tracking. A detailed performed itinerary can be extracted from the data, like the zoom on Stuttgart is showing

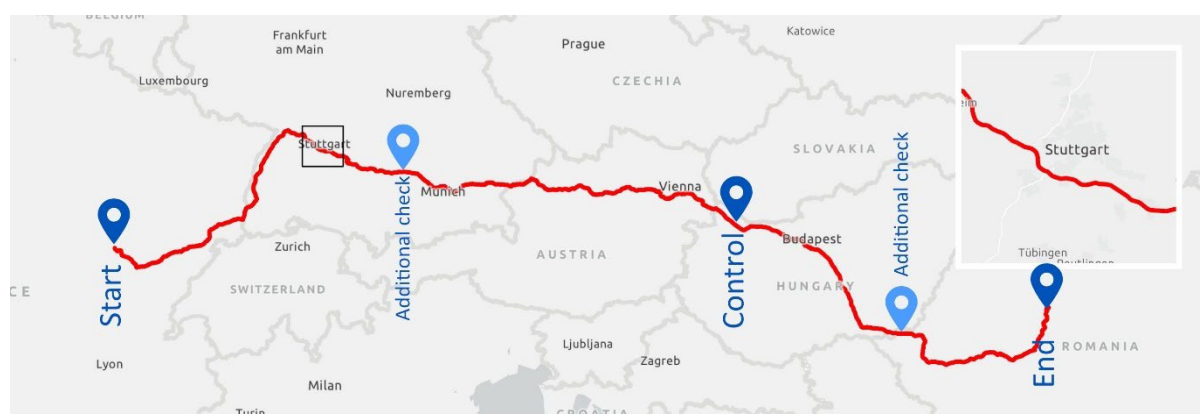


Figure 68 Journey map resulting from geolocation real-time tracking

- Conclusion

The table below summarizes the impact on the amount of data collected, depending on the scenario explained above (taking **rough** assumptions such as 20-hour journeys in average and 10000 journey logs per year on average, just for the purpose of the example).

Scenario	points per journey log	points per year (10k JL)
tracking via specific points	5	50.000

Real-time tracking at low frequency	100	1.000.000
Real-time tracking (1pps)	72.000	720.000.000

Whether the geolocation data collection is performed by the European Commission or by another party, the required frequency of geolocation data has an important impact on the required technology, especially on the server side.

The higher the data frequency, the higher the impact on the hard- and software to collect, process and analyse the received data. The tracking via events has a much lower impact than real-time data collection.

We conclude that standard real-time tracking (at highest frequency) is too impacting for data transmission, storage and processing and more importantly not necessary for the AWT requirements.

We recommend the real-time tracking at low frequency option (15 min) as this seems to be the best compromise, allowing the collection of geolocation and the resulting ability to re-construct the actual journey log as defined in (D04.01 TRACES Recommendation report) while limiting the processing and storage impacts.

- Compatibility assessment of commercialised equipment with the future positioning system

We envisage several scenarios for the collection of truck geolocation data, having all their advantages and disadvantages:

- Scenario 1 – A smartphone app collecting the geolocation data;
- Scenario 2 – A synchronisation with data collected by the FMS;
- Scenario 3 – An app on the in-vehicle integrated device;
- Scenario 4 – A dedicated device (OBU), collecting the geolocation data;

The different scenarios are further analysed here.

- Scenario 1 – smartphone app

In this scenario, a smartphone app is developed, dedicated to the collection of geolocation data for the AWT. The figure below presents the scenario schematically.

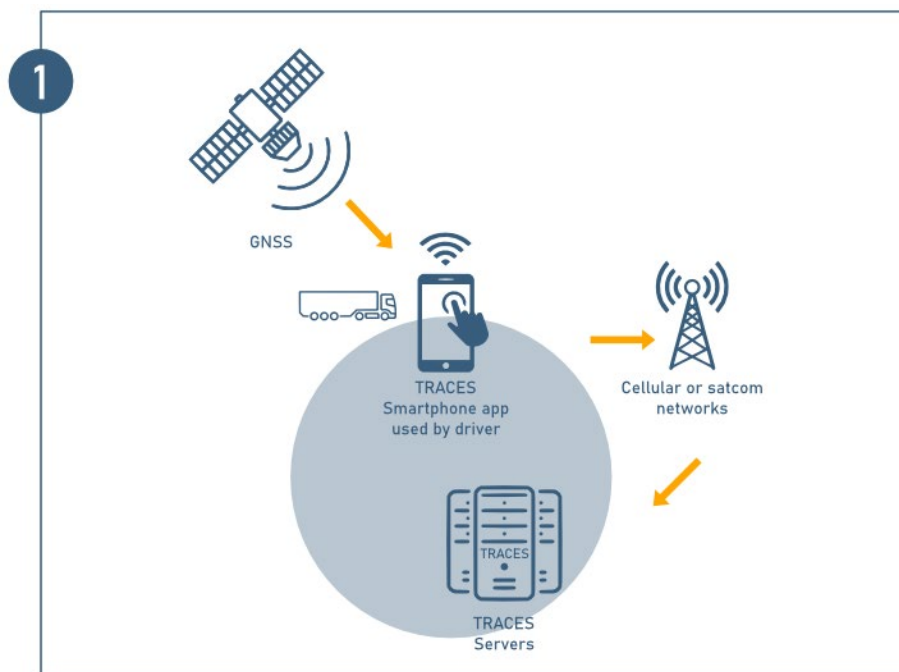


Figure 69 Scenario 1 – smartphone app for the collection of geolocation data

The truck driver has the smartphone app installed on his smartphone and activates the app at the start of the journey.

Generally, there are two main smartphone strategies for companies: BYOD and COPE.

BYOD (Bring Your Own Device)

- Device Ownership: Employees own their devices.
- Control & Security: Employees have high control over their devices, but security and data protection are harder for the company to enforce.
- Cost: Lower cost for the company, as they don't purchase devices.
- Flexibility: High flexibility and employee satisfaction, as they use familiar devices.
- Data Management: Harder to separate personal and corporate data, creating security risks if a device is lost or an employee leaves.

COPE (Corporate-Owned, Personally Enabled)

- Device Ownership: the company owns and provides the device.
- Control & Security: The company has full control over the device, enforcing security policies and managing updates centrally.
- Cost: Higher costs for the company due to the purchase and maintenance of devices.

- Flexibility: Offers a balance, providing a standard device for work while allowing for personal use.
- Data Management: Allows for clear segregation of work and personal data using containerization or other tools, improving security.

It must be noted that many transport companies adopt the COPE strategy for smartphone and tablets. These devices contain a Mobile Device Management (MDM), enable the setup of rules to restrict the use to formal professional use (without any possibility for private calls, movie streaming, ...). Typically for transport companies, a MDM rule is to disable switching off the GNSS connection, so the device is constantly sending geolocation. This kind of devices can typically contain the smartphone app for AWT.

▪ Advantages

This scenario offers large flexibility on the data frequency (event based versus real-time) and is independent from other systems and software (except Android and iOS). At the side of TRACES and the European Commission, this scenario does not need interoperability with third party systems such as the truck constructors (everything is depicted in blue in the figure). At the side of the transporters, this scenario functions without any FMS, which is not necessarily available at the smallest companies. As a result, it is rather cost effective.

Another advantage is that this solution offers other functionalities and capabilities, especially the ability to add the Journey Log ID to geolocation data transmitted to EC servers (which is not possible in scenario 2 and 4, which have no frontend for the driver). Implications are further discussed in the TRACES Recommendation report.

Finally, many smartphones have a camera, offering the possibility to add (geotagged) photos using the dedicated app when in the field. This adds convincing material to the journey log.

▪ Disadvantages

The most important disadvantage is the necessity of a manual interaction from the driver. The driver's responsibility is high, which is an issue in larger companies with many drivers but may be less problematic in small transport companies.

Another disadvantage is the lack of data recovery when the smartphone is off (e.g. when the battery is low).

To be able to perform geofencing on some specific locations (e.g. added by the competent authorities), the smartphone will have to collect geolocation data at medium interval during the journey. Otherwise, it will only be possible to get geolocation data when the transporter uses the app (e.g. when pushing the start/stop button, when taking photos, ...).

This scenario is also sensible to fraud, as we do not track the trailer with the animals, nor even the tractor, but the driver.

▪ Compatibility of commercialised equipment

Smartphones are widely used and available. All smartphones on the market have the necessary sensors to register GNSS data (see previous chapter in this document), connect to cellular networks to send data and even make photos in the field.

As a result, this scenario is highly compatible with commercialised equipment.

- Scenario 2 – FMS sync

Many transporter companies already invested in an advanced FMS that is collecting and processing many types of data from the truck.

In this scenario, the FMS of the transporter company, with the in-vehicle device, the servers and FMS software is used to collect and process all the geolocation data of the truck. The FMS offers an API sending the required data to the TRACES servers. The figure below presents the scenario schematically.

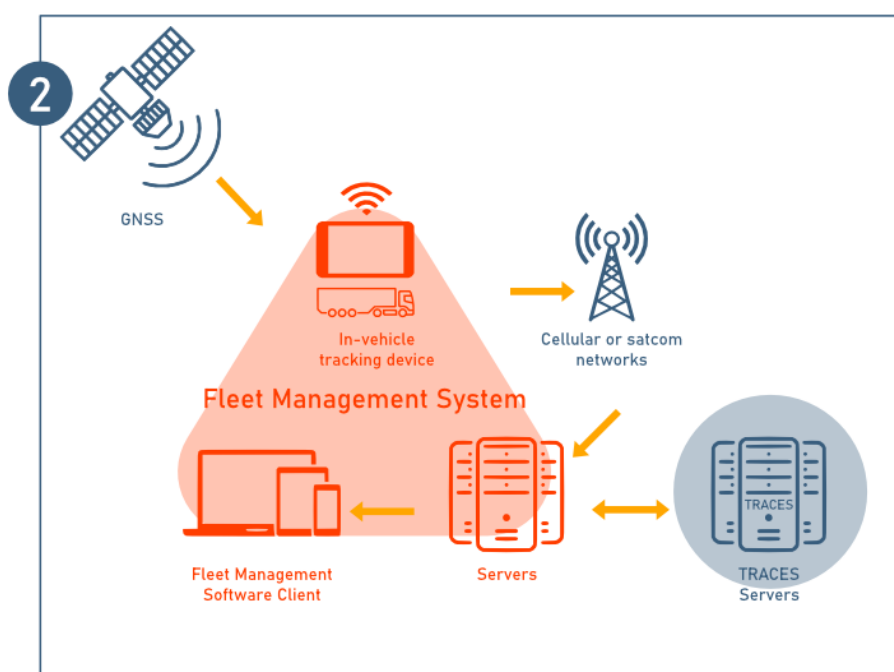


Figure 70 Scenario 2 – Synchronisation with the FMS for the collection of geolocation data

- Advantages

The truck driver and the office colleagues do not need to bother about data collection, as the process is using existing processes and is entirely automated. Therefore, the process is not sensitive to human errors or oversight, making it robust and reliable.

The in-vehicle device is always powered when necessary, so data loss is minimal and issues with low battery are avoided. When the truck is outside cellular network reach, the devices are collecting data offline and synchronising again when back online.

From the side of the transporter companies, the extra cost of geolocation data collection will be low or inexistent, as existing systems are used.

The FMS standard ensures that standard communication via APIs can be set up, avoiding customised adaptations to the different FMS.

- Disadvantages

From the side of the European Commission, it is more work intensive to set up the connections to the different FMS (via API) and maintain the system (than with scenarios 1, 3 and 4). Even if the FMS standard exists and sensibly simplifies the process, there are different versions of the standard and not all FMS are respecting the standard. Interoperability is necessary, as shown in the figure, where the items external to (not managed by) the EC are depicted in red.

From the side of the transporter companies, the entire investment in an FMS is necessary. Even if many companies already did this, it may not be the case for their entire fleet, nor for smaller transport companies.

This scenario can be sensible to fraud, as we do not track the trailer with the animals but the tractor. However, some systems offer connectivity with the trailer.

A last disadvantage concerns the absence of a camera function, to collect proof material of AWT. Solutions with an in-build camera in the trailer exist, but connectivity and compatibility with the tractor FMS system is necessary.

- Compatibility of commercialised equipment

We refer to the paragraph 3.5 on the FMS, that discusses the commercialised equipment and the compatibility in detail.

Summarizing this analysis:

- The large majority of the trucks on the market are equipped with an FMS.
- Moreover, these FMS mostly follow FMS standards, making trucks among the (multi-brand) fleet compatible between each other, regardless of the brand.
- For older trucks, solutions are available, like installing brand-independent FMS devices or updating software and gateways of already installed FMS devices.

Concerning the connectivity with the trailer, some FMS devices offer this possibility. Refer to the paragraph on sensors inside tractors vs inside trailers for further analysis.

- Existing tools using FMS data

Today, several European authorities have legislation to enforce the collection of geolocation data by transport companies. Examples are the following:

- SENT in Poland
- RO e-Transport in Romania. Road carriers moving “high fiscal risk” goods must equip vehicles with GPS/telematics and transmit live location to the authorities (ANAF) during the trip. Non-compliance is fined.
- MYTO in Slovakia, the electronic toll system;
- MYTO in Czech Republic, toll system, distance and GNSS based.
- HU-GO e-toll, distance and GNSS based.

Only for the first 2 listed examples, in Poland and Romania, there is room for **FMS integration** if the provider is certified/connected to the government system. For Hungary, Slovakia and Czech Republic (tolling systems), only the official on-board units (OBU) are accepted, FMS data cannot substitute them.

○ Scenario 3 – app on the integrated device

In this scenario, an app is developed, dedicated to the collection of geolocation data for the AWT. This app is installed on the truck’s integrated device. Hence, the app has access to the truck’s telemetry (geolocation and other data) and is sending these data towards TRACES servers (or servers dedicated to the AWT), without any third party in between. The figure below presents the scenario schematically.

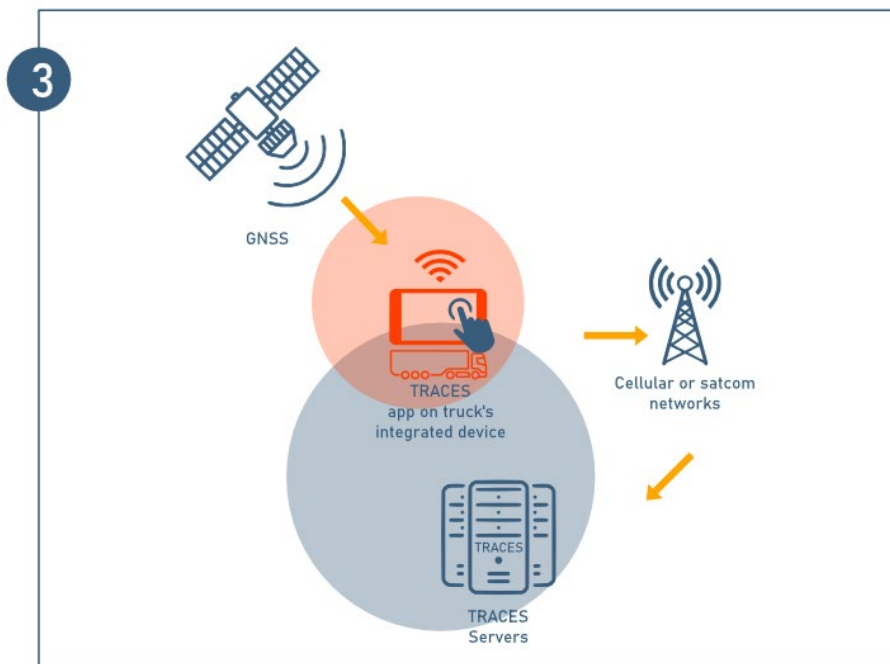


Figure 71 Scenario 3 – App on the integrated device for the collection of geolocation data

- Advantages

This scenario is combining the advantages of a smartphone app with the one of the FMS.

This scenario offers large flexibility on the data frequency (event based versus real-time) and is independent from other systems and software (except Android and iOS). At the side of TRACES and the European Commission, this scenario does not need interoperability with third party systems such as the truck constructors.

The truck driver and the office colleagues do not bother about any data collection, as the process is using existing processes and is entirely automated. Therefore, the process is not sensitive to human errors or oversight, making it robust and reliable.

The in-vehicle device is always powered when necessary, so data loss is minimal and issues with low battery are avoided. When the truck is outside cellular network reach, the devices are collecting data offline and synchronising again when back online.

At the side of the transporter companies, the extra cost of geolocation data collection will be low or inexistent, as existing systems are used.

The app developed for the smartphone may be also installable on the truck's integrated device.

- Disadvantages

The main disadvantage here is the commercial compatibility (see further).

As for the smartphone app and the FMS scenario, we do not track the trailer with the animals but the tractor. Again, some systems offer connectivity with the trailer, which can be a solution here. Especially the trucks equipped with the latest devices offering this possible scenario, are also equipped with trailer connectivity.

As the FMS scenario, there is no camera function to collect prove material of AWT, but trailer connectivity can again be solution, provided that the trailer has one or several in-build cameras.

- Compatibility of commercialised equipment

This scenario is compatible with the latest in-build devices on certain brands.

For example, at Volvo Trucks, the vehicles are equipped with the integrated Android in-vehicle system from 2021 onwards. The system can accept apps that are developed for Android smartphones and will require minor adaptations to function on both smartphone and in-build device.

Even if today, this scenario can only be implemented to a limited extent, it is a scenario of the future due to its main advantages.

- Scenario 4 – dedicated OBU

In this scenario, an on-board unit (OBU) that is dedicated to the collection of geolocation data for the AWT, is installed in the truck or the trailer. The figure below presents the scenario schematically.

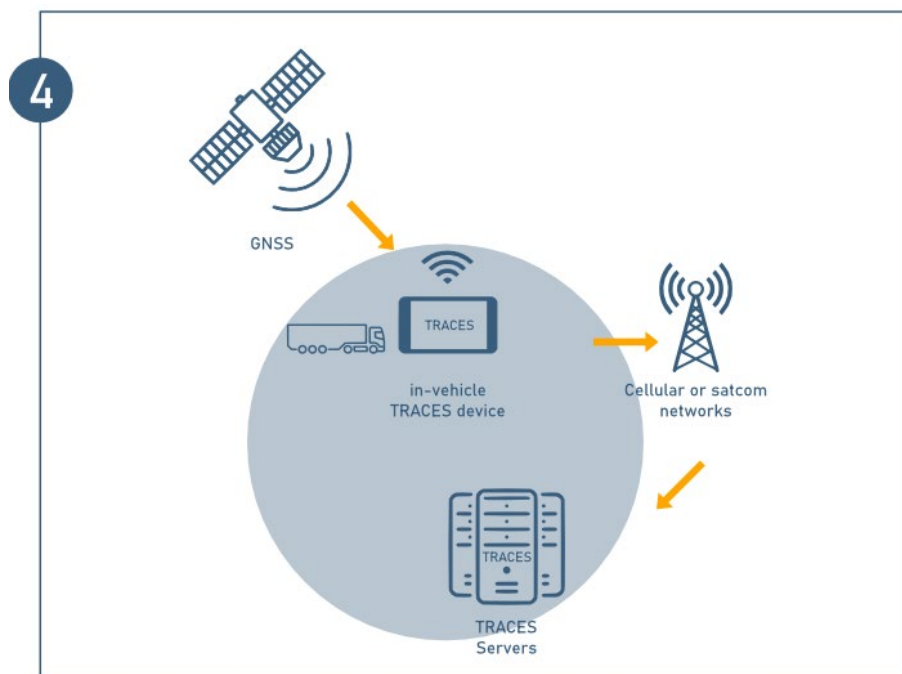


Figure 72 Scenario 4 – Dedicated device for the collection of geolocation data

- Advantages

The main advantage of the OBU is the independent management of the data collection, completely in hands of TRACES. There is no integration with external systems necessary.

Another important advantage is that the OBU can be installed in the trailer (rather than the tractor for the other scenarios), where the animals are located. Events like the opening and closing of the trailer doors are used to trigger geolocation data collection and transmission.

- Disadvantages

The main disadvantage of this scenario is the financial cost for all parties.

On the one hand, it requires indeed the design, development and distribution of the device.

On the other hand, the transport companies have to buy the device and install it on the trailers. It is an additional device that collects geolocation data, like other devices are already doing on the truck (mainly in the tractor, but possibly also in the trailer).

- Compatibility of commercialised equipment

Several solutions may be possible:

- The device can be an existing device such as a tracker (e.g. Apple AirTag, Samsung SmartTag, ...);
- The device can be an adapted tracker to the needs of TRACES.
- The OBU can be newly designed;

Tags

The Apple AirTag functions with a Bluetooth connection and relies on the Apple Localiser network to detect the AirTag and transmit the position. In other words, it needs another Apple device in the immediate vicinity of the device transmit the position, as a Bluetooth signal is limited in range (50 m to 100m without obstacles, less with obstacles). This makes the AirTag solution a vendor lock-in with Apple, restricting its roll-out. Finally, the tags work on batteries and are not connected to any power supply.

Very similar observation can be done for the Samsung SmartTag, needing also a Samsung device to collect and transmit the geolocation data properly, having similar Bluetooth range from tag to smartphone device and functioning also on batteries, without possibility to connect to a power supply.

Moreover, these tags only transmit geolocation data, without any other data trailer door opening and closing events.

Even if these are commercially off-the-shelf solutions, we must conclude that they are rather limited and difficult to apply as a reliable stand-alone solution.

Specific OBU

Different systems exist for the collection of geolocation data in the context of the electronic toll systems based on travelled distance. Examples are:

- The company DKV offers the 'DKV BOX EUROPE', a device that is integrated with the existing toll systems in many different European countries.
- The company Eurowag provides an OBU functioning in most European countries.

Important to mention is that these systems collect geolocation data, but immediately process them to toll prices, without keeping any geolocation data. As a result, these existing systems cannot be combined as such with the requirements set for AWT, where specific locations are tracked.

Aim of this section was to mention that such systems exist. But monitoring of AWT would require a separate OBU than the ones for tolling.

- Sensor inside tractor VS inside trailer

In the context of AWT, competent authorities mention the importance of obtaining data from the trailer containing the animals.

Therefore, we summarise our findings mentioned previously, specifically focusing on the possibility to collect data from the trailer. The figure below shows an overall summary of the scenarios concerning their position for tractor and trailer tracking.

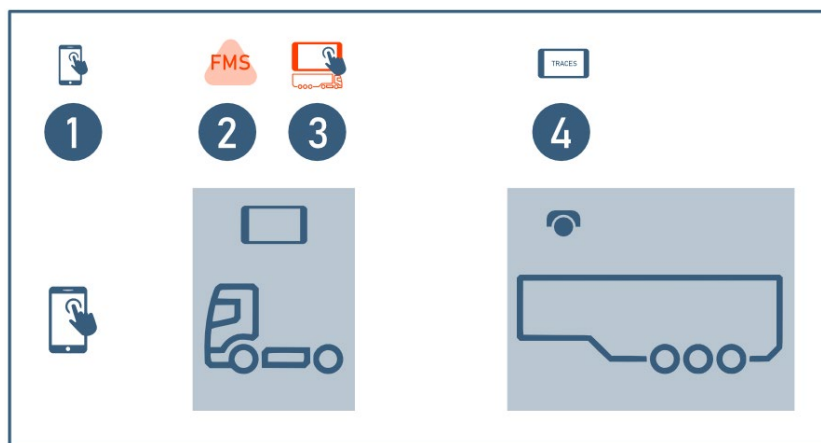


Figure 73 The four scenarios concerning their position for tractor and trailer tracking

- Scenario 1 proposes an app on the smartphone, that is not fixed in the tractor nor the trailer. Hence, it is not tracking the one nor the other, which is a major disadvantage, but still provides the ability to make photographs of the animal transport in a flexible way.
- Scenarios 2 and 3 are collecting geolocation data in devices that are located in the tractor. Hence, they do not focus on the main object of interest in the AWT, being the trailer.
- Scenario 4 proposes a dedicated device and is the only scenario with a sensor that can be installed in the trailer.

As mentioned before, FMS devices offer the possibility to receive trailer data and send them through together with the truck data.

- Trailer connectivity and the rFMS standard

The following conditions need to be fulfilled, to receive data from the trailer:

- For a truck to “see” a trailer, the trailer must have an electronic braking system (EBS) connected via the ISO 11992 CAN-bus through the ISO 7638 plug.
- If present, that EBS broadcasts data
- The truck’s telematics can pick this up and send it to the FMS (from rFMS version 5.0.0 onwards).

This connection is illustrated in the figure below.

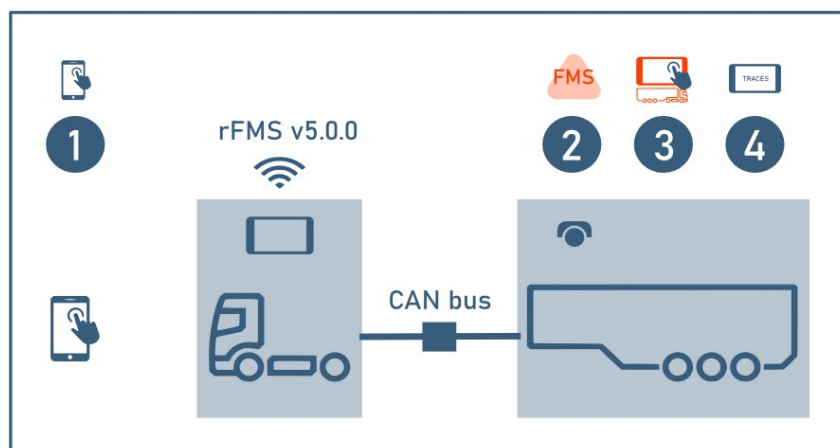


Figure 74 The CAN bus between truck and trailer, to ensure trailer data transmission

Standards about trailer connectivity are in development phase and the most recent rFMS standard version 5.0.0 (V. 25.07.2025) is containing important items for trailer connectivity.

Key items the FMS can receive from the trailer are:

- Triggers: connected/disconnected;
- Identification & composition: trailer VIN, trailer type (e.g., semi-trailer, full trailer, ...);
- Tire data;
- Environment data: ambient air temperature (if exposed) and other vehicle lists standardized in the same response.

- Compatibility of commercialised equipment

Tractor

The tractor needs to work with the most recent rFMS version 5.0.0. As this version is from July 2025, we do not have yet an overview of the truck brand models updated towards this version.

Trailer

The main European trailer builders providing livestock trailers are the following:

- Pezzaioli (Italy)
- Berdex (the Netherlands)
- Cuppers (the Netherlands)
- Menke-Janzen (Germany)

For Pezzaioli and Menke-Jansen builders, references were found to EBS (with the ISO 11992 CAN-bus) to connect the trailer with the tractor in their newest trailers.

We contacted these 4 trailer constructors for more detailed information, but without success.

These 4 brands are not equipping their trailers standard with telematics, to enable communicating data without passing via the tractor. Some main European trailer constructors propose this, but these are not livestock trailers (like Schmitz Cargobull – TrailerConnect, Krone – Krone Telematics, Kögel – Kögel Telematics, Wielton – ZF/Transics-based telematics, Schwarzmüller).

- Conclusion

Obtaining data from the trailer via the tractor's FMS is possible when the trailer has an EBS connecting via the ISO 11992 CAN-bus and when the truck is using the rFMS standard version 5.0.0.

The main European trailer builders providing livestock trailers equipped their newer trailers with this EBS and ISO 11992 CAN-bus.

As a conclusion, the most recent commercialised equipment has the ability to transfer basic trailer data (trailer VIN, trailer type, connected/disconnected, tire data) via the standard FMS channel.

- Intermediate processing

Intermediate processing refers to the aggregation, filtering, and harmonisation of raw geolocation data collected from multiple sources (e.g. FMS, OBUs, apps). The goal is to ensure that only relevant, GDPR-compliant information is forwarded to TRACES, avoiding data overload at TRACES side, while maintaining reliability.

The figure below illustrates this principle of an intermediate processing system on dedicated servers.

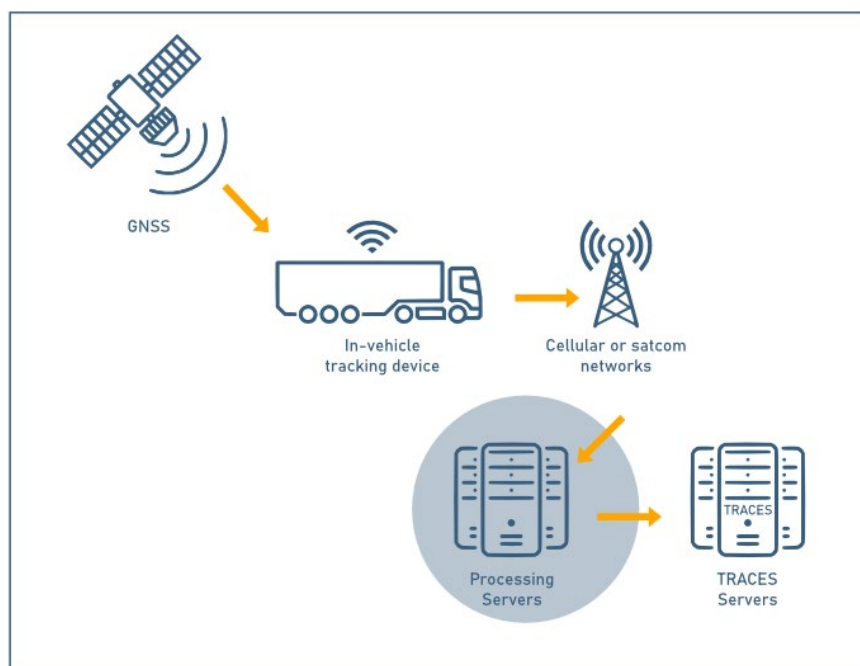


Figure 75 Intermediate processing for the preparation of TRACES-ready data

The advantage of such intermediate processing is that TRACES can receive the data in its specific formats, with its specific frequency and requirements, so no other processing is necessary there. We highly recommend such intermediate processing system, for the following reasons:

- To keep the TRACES hosting infrastructure as much as possible independent from the AWT processes;
- These AWT processes are demanding, as they receive and process data from many different sources around Europe and beyond;
- It is technically and administratively easier to run the databases and services on dedicated ('intermediate processing') hosting environment, rather than include them in the TRACES hosting infrastructure.

This recommendation is valid for all four scenarios of solutions presented above. The figure below presents a high-level conceptual architecture explaining the main aim and added value of such servers performing the intermediate processing. These processing servers will be responsible for receiving and processing the data from the different applications (in scenarios 1, 3 and 4) and from the transport companies' FMS, which is not foreseen inside the TRACES architecture.

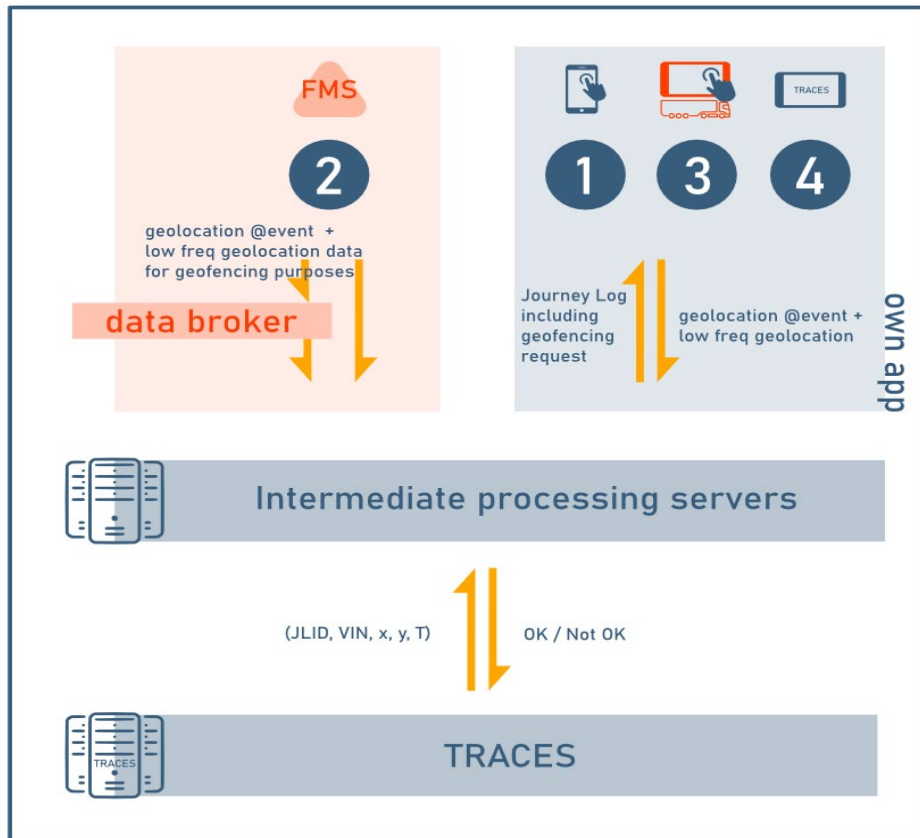


Figure 76 Intermediate processing – high-level conceptual architecture

The figure shows a main difference occurring between scenario 2 (using the geolocation data obtained from the FMS) and the 3 other scenarios:

- Scenarios 1, 3 and 4 all function with an own application managed by the European Commission.
- Scenario 2 receives geolocation data from the FMS and has to process them to distillate the necessary final data.

Event triggered geolocation data

In all four scenarios, receiving geolocation data triggered at a specific event (in particular engine start and stop) is rather simple. These data are requested in any case, they must be sent without exception as they cover the departure, the arrival, as well as the control posts. Moreover, the amount of data is very limited (see previous analysis in paragraph 3.6) and consequently, it is easier to manage and process for TRACES.

Data from geofencing

Geolocation data that should be obtained from geofencing is more complex.

External FMS systems cannot be queried for specific geofences. In other words, it is not possible to send a request with a specific geofence to an external FMS, just asking for the geolocation and

timestamp when the fence is triggered. APIs from external FMS are only transmitting geolocation data, which then need to be collected and processed. Analysing if a geofence was entered needs a collection of geolocation data at a fair resolution (e.g. every 15 min or every 20 km).

Data brokers

Several data brokers already provide such services by aggregating telematics data from multiple FMS vendors and delivering harmonised datasets through APIs. These intermediaries could play a role in ensuring standardised, validated, and TRACES-ready data flows.

In practice, this could involve TRACES connecting to a limited number of certified data brokers instead of maintaining direct connections with many FMS vendors and device manufacturers. This reduces complexity, maintenance costs, and the risk of inconsistencies.

Examples of such data brokers are:

- <https://rio.cloud/en/>
 - RIO is a data broker providing the collected data via standard APIs. Specs of these APIs can be found on <https://rio.cloud/en/apis/telematics-data>
 - RIO can be considered a 'FMS as a service', collecting the data of the transporters, processing and managing them, as well as providing the data via APIs to internal and external systems.
 - Subscribers to RIO services can opt for a full service including the RIO front end, or only the database with its APIs.
 - RIO's offer is dependent on the amount of subscribed vehicles, and independent from the amount of systems receiving the data via the APIs. The intermediate processing server for AWT can be a data receiver, without any impact on cost for the transport company.
- <https://www.s3pweb.com/en/homepage>

Data exchange with TRACES

As stated before, the intermediate processing system is there to keep TRACES as much as possible independent from the AWT processes. Practically,

- TRACES would feed the intermediate processing with the requested points for each journey. This is containing Journey Log ID (JLID), VIN, longitude coordinate (x), latitude coordinate (y), timestamp (T).
- As a response, the processing server would provide TRACES with the information for each point if it was visited or not (by the specific VIN on the specific journey).
 - Cost estimation

The main cost items are listed in the table below. This estimated cost is based on experience with system and software development.

	One-time costs		Recurring costs		Notes
	EC	EO	EC	EO	
Scenario 1 - Geolocation via the mobile App					
	200 k€ - 350 k€	/	50 k€	/	Yearly maintenance cost as a % of one-time costs
Scenario 2 Geolocation via the FMS					
integration cost via a data broker	100 k€ - 250 k€	/	/	50 € / year / vehicle	Assuming a one-time setup cost to connect to their API and then a subscription fee / year. Prices based on RIO pricing policy.
integration cost for all main truck vendors (via APIs)	600 k€ - 1500 k€	/	100 k€	Included in FMS cost	Assuming a single integration for one truck vendor, requires coordination with different vendors.
Scenario 3 Geoloc via the truck's integrated device					
	200 k€	/	50 k€	/	
Scenario 4 - OBU					
	/	100 € / vehicle	/	500 € / year / vehicle	
Intermediate processing server - For all scenarios					
	900 k€ - 1600 k€	/	180 k€ - 300 k€	/	
TRACES adaptation - For all scenarios					
	To be estimated by TRACES team				
Geolocation processing entirely in TRACES - For all scenarios					
	Not recommended				

These main cost items concern:

- For Scenario 1, the estimated cost only comprises the development of the technology (including the coding activities, the documentation, onboarding procedures and a way to publish it as a technical framework) to collect geolocation data via smartphone and transmit them to the server. It does not comprise the setup of a server environment (listed in the item 'Intermediate processing server in the table) and GUI software of the smartphone app. The yearly maintenance cost is calculated as a % of the one-time cost. For this scenario, there is no hardware involved in the cost, only software development, as we rely on the smartphones available at the transport companies (COPE strategy) and/or drivers (BYOD strategy). It is important to note that the current market for mobile phones is dominated by Google Android™ and Apple iOS. We foresee that the technology should support these two platforms natively. A supplement should be foreseen if a wrapper library should be implemented in a hybrid mobile technology.
- For Scenario 2, the cost estimation is separated for two different options:
 - A cost where the API is setup and managed by a broker, assuming a one-time setup cost to connect to the broker's API and then a subscription per year.
 - A cost where the API is setup by the EC with all main truck vendors, assuming a single integration for one truck vendor, to multiply by the number of vendors targeted. However, the EC could enforce the use a standard API format, typically the ones used by the brokers and main truck constructors. This would sensibly reduce the cost at EC side, integrating for different truck vendors.

For scenario 2 as well, the cost is only for software development. No additional hardware is necessary than the existing one at the transport companies (FMS system).

- For Scenario 3, this cost estimation only comprises the development of the technology to collect geolocation data via smartphone and transmit them to the server (as for scenario 1). The part of the data collection between the truck and the truck device is managed by the truck constructors. This cost estimation assumes a standardized software environment, but as Android enables to customize for a specific hardware environment, this assumption may be incorrect. At this level, it is not possible to take the implications of this assumption into account. Specifically, it is expected that the geolocation data to be technically available natively through the Android framework (otherwise it would also need a custom implementation for the truck constructors).
- For Scenario 4, the development of an OBU hardware to be installed in the trucks or trailers for tracking, as well as the software on the OBU to run the device. If this device is managed by market players, they finance the cost and charge the transport companies for its use. As a result, the cost is not located on the side of the EC. However, when we assume that around 30k trailers are to be equipped with an OBU in Europe, this is by far the most expensive solution.
- Hard & software for processing – the setup of a server environment and software for the reception, processing and analysis of the geolocation data in the context of the AWT. It is

important to mention that all other cost items need this intermediate processing servers to function.

- The adaptation of TRACES to receive data from the intermediate processing servers has to be performed by the TRACES team.
- As we do not recommend the reception and processing of geolocation data inside TRACES (but rather in a separate ‘intermediate processing server’), we do not estimate a cost for this. Refer to paragraph 4.6 for a list of arguments about this recommendation.

Cost distribution

Whereas the most cost items are located on the side of the European Commission, the OBU has a cost for the transport companies. They have to buy these devices and install them on the trucks/trailers, whereas all other scenarios 1, 2 and 3 use hardware that is available for the driver and/or inside the truck/trailer.

Apart from the development of the OBU as a physical unit, there is the setup of the logistics for the selling, the distribution, the maintenance and the replacement of the OBU. We do not consider:

- If the OBU development, distribution and maintenance should be managed by the EC or by a third party vendor;
- Whether the cost should be distributed over the EC and the transport companies (e.g. to lower the OBU price/subscription) or only assumed by the transport companies.

Cost due to decommissioning

Truck builders and transport companies have to take decommissioning of telecommunication technologies into account, when striving compliancy with vehicle geolocation data exchange. Devices inside older trucks may be incompatible with the telecommunication technology in the future, while the life cycle of trucks is much longer than the one of GNSS devices.

Cost due to decommissioning are higher for scenarios 2, 3 and 4, as devices linked to a truck are less flexible to replace than a smartphone, functioning independently from the truck and widely available on the market.

- Conclusions
 - Summarized comparison of the scenarios

In the table below, we summarize the pros and cons of the four different scenarios, to provide a clear overview.

	PROS	CONS
1. Smartphone app	cost effective, using the smartphone sensors;	Manual interaction from driver necessary;

	third party independent;	No data recovery when smartphone is off (e.g. battery low); Difficulty to add other IoT truck data (like temperature); No automated collection of trailer data possible.
2. FMS sync	Automated process, without interaction from driver; Possible data recovery (depending on FMS) when truck was out of cellular network reach; No issues with low battery of device; Uses existing FMS system; Possibility to ask for other IoT truck data (like temperature);	Different communication systems necessary with many FMS (via APIs); APIs work intense to set up and maintain; Collection of trailer data only possible under certain conditions.
3. app on integrated device	Independent from other systems, no interoperability necessary. Automated process, without interaction from driver; Possible data recovery (depending on FMS) when truck was out of cellular network reach; Uses existing FMS system; App developed for smartphone is usable;	Only compatible with the latest in build devices on certain brands. Collection of trailer data only possible under certain conditions.
4. TRACES device	Device management and data collection is completely in hands of TRACES; No integration with external systems necessary. The device can focus on collection of trailer data, where AWT matters.	Expensive solution for all parties; includes important logistics for the distribution of the devices; redundancy of onboard (GNSS and other) sensors;

- Complementary scenarios

The above table shows that no solution offers all necessary advantages to clearly distillate a single candidate. Instead, the scenarios are complementary and offer solutions for different situations. Offering different scenarios to the transport companies present the possibility to cope with the main disadvantages of all scenarios.

In all combinations, we advise to propose the possibility to provide FMS collected data, as this is by far the most automated and comfortable solution for transport companies that have invested in an FMS. Moreover, the cost to work with the data coming from the API is representing a relatively low cost, compared to the other scenarios (see previously in paragraph 4.7 on cost estimation).

In the following section, we compare the offering of:

- A combination of the mobile app and the FMS integration;
- A combination of the OBU and the FMS integration.

By offering we mean that the EC would allow the transporters to choose one out of two options in the combination, specifically for the collection of geolocation data.

Offering app and FMS integration

While avoiding the OBU (scenario 4), the more expensive solution for all parties, a combination of a smartphone app (scenario 1) and an API to sync with FMS data, is a robust solution to cover many situations.

The smartphone app for the collection of geolocation data is the best solution for the smaller transport companies that are dedicated to collect their data correctly via the app, while not willing to invest in advanced FMS systems.

The synchronisation with FMS data is the best solution for larger transport companies, who invested already in an FMS and who have large teams of drivers. They do not need the smartphone for the collection of geolocation data. We refer to the advantages of the FMS collection these geolocation data (e.g. less fraud sensitive than smartphone).

Offering OBU and FMS integration

In practice, some authorities that are enforcing the collection of geolocation data today in the context of tolling, are already providing the choice between the OBU and an API to collect data from the FMS.

This solution is more expensive than the one with the smartphone and many transporters are reluctant to add yet another OBU inside their truck/trailer. On the other hand, it has the advantage that a dedicated device can be installed in the trailer, transmitting directly data from the trailer to TRACES systems.

Again, the combination with the FMS is interesting to increase the data collection possibilities at the transport companies.

Conclusion

We conclude that the first combination, offering the app and the FMS integration, is the most efficient way to collect geolocation data from as many transporters as possible.

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6.4 D.03.02. Positioning system design

- Introduction

The business need

Currently, authorities rely on paper Journey Logs and manual reports; however, compliance checks are often delayed and difficult to enforce. In fact, there is no automated mechanism to confirm when a vehicle actually arrived at – or departed from – key points on its route. With millions of animals transported annually, this lack of data leads to delayed interventions and limits the ability of authorities to monitor compliance with animal welfare rules. Therefore, a digital solution is required to capture key journey events automatically and reliably.

Geolocation technologies and possible scenarios

The Market Analysis Report (D03.01) reviewed the state of play for geolocation tracking solutions on the market and concluded that the telematics landscape used by transporters is heterogeneous; therefore, a one-size-fits-all mandate is impractical. The report analysed four main possible scenarios that could leverage existing geolocation data sources-such as smartphones, fleet management systems (FMS), integrated on-vehicle devices, and dedicated On-Board Units (OBUs). The report concluded by recommending a multi-option approach that would support both Fleet Management Systems for larger operators and the mobile application for smaller entities as the source of geolocation data.

The Geolocation Intermediary Service (GIS)

Building directly on these conclusions, this system design proposes an intermediary architecture in the form of a *Geolocation Intermediary Service* (GIS), that would meet the requirements of the "information system" referred to in Article 24(3) of the transport proposal.

The proposed solution ingests location data from the geolocation data sources, detects when a vehicle crosses key points on its route, and forwards only the resulting compliance events to TRACES. Continuous tracks remain in the intermediary platform and are deleted or archived after a legally defined period. This approach explicitly aligns data handling with applicable data-retention policies and anticipates ongoing regulatory developments, clarifying that compliance is enforced through event-based reporting rather than continuous location tracking.

The design also covers journeys that include segments outside the EU (third countries) insofar as location data can be ingested and evaluated by the GIS; any required alignment of TRACES

scope and data model for such journeys remains a policy and implementation topic outside this blueprint.

The GIS does not maintain an independent catalogue of geofences (See Section 4.1.4 for a discussion on geofences). TRACES remains the authoritative source of geofence definitions and publishes versioned, journey-specific geofence sets for read-only evaluation by the GIS, which caches the relevant set to ensure reproducible event detection and auditability.

In operational terms, the GIS enables MSCAs to view a consolidated journey timeline, including departure from origin, arrivals and departures at control posts or border crossings, and final arrival at destination.

The design and associated features is based on the requirements of the Proposed Regulation 2023 and is also further informed by the Consultation Report (D02.01.02), which consolidates stakeholder and authority feedback on key architectural and operational design choices. To ensure consistent interpretation across Member States and system actors, this section also defines key technical and operational terms used throughout the document, including the roles of the GIS, TRACES, and the Animal Journey Log (AJL). In addition, it establishes that the GIS applies pseudonymisation to vehicle and trailer identifiers before any data exchange, limiting downstream processing to compliance-relevant events and thereby reducing personal and commercial data exposure.

High level approach

The core function of the GIS is to act as a **trusted broker**-i.e., an intermediary service that securely ingests location data from existing sources, performs geofencing and event generation, and forwards only the resulting compliance events (not continuous tracks) to TRACES. By extracting and transmitting only the key compliance events derived from the raw GPS data received, the system reduces privacy risks, limits data storage, and avoids overwhelming TRACES.

Furthermore, this approach adheres to the principle of **data minimization**, providing authorities with timely evidence to enforce regulations and protect animals in transit without imposing heavy technical burdens on transporters. In practice, inspectors will see a timeline showing when the vehicle left its origin, arrived and departed at each control post or border crossing, and finally arrived at the destination. However, where a deviation from the planned route is suspected, inspectors can request the relevant supporting location evidence (evidence pack) from the Geolocation Intermediary Service via TRACES, while TRACES continues to store and display only the compliance-event timeline. In doing so, the GIS can ingest location data from multiple underlying sources and normalize it into a consistent set of time-stamped arrival and departure events required for animal-welfare checks. These events represent the only data persisted in TRACES, while the underlying raw location streams remain outside TRACES unless explicitly requested as supporting evidence.

Objectives and scope

The proposed system aims to achieve the following strategic goals:

1. **Automate the capture of compliance events.** The system must record key journey events automatically – without requiring manual input from drivers. This scope includes arrivals and departures at the **place of departure, assembly centres, control posts, border crossings between Member States, exit points, border crossings with third countries, airports, ports,** and the **place of destination**.
2. **Minimise data collected and transmitted.** The architecture employs an intermediary platform to process continuous location data; consequently, it forwards only the minimal information required for regulatory compliance (specifically timestamps, journey identifiers, and checkpoint identifiers).
3. **Support multiple data sources.** In line with the Market Analysis conclusions (D03.01 - Market Analysis report, 2025), the solution will support 2 primary geolocation data-collection options at deployment level: (a) the Smartphone Application and (b) Fleet Management Systems (FMS) integration for larger operators that already have invested in such systems.
4. **Protect privacy and security.** The system must comply with the General Data Protection Regulation by defining clear roles, applying pseudonymisation, encrypting data, and respecting data subject rights.
5. **Scale reliably.** The platform must be capable of handling data from tens of thousands of journeys across the EU and third countries, including operations in areas with poor connectivity.

This blueprint outlines the solution at a high-level architectural and design level.

However, detailed technical specifications for procurement, specific API contracts, and final policy decisions are outside the scope of this study and will have to be developed in subsequent project phases. The GIS-TRACES interface mechanism will be validated against the TRACES Recommendation Report during those phases; any required protocol-level adjustments will be reflected in the Interface Control Document (ICD). Typically, these elements would be detailed at the start of the implementation project and would result in : (a) a Technical Specifications and Architecture dossier ; (b) an Interface Control Document (ICD) for ingestion and TRACES event APIs; (c) a Procurement Technical Annex defining SLAs and acceptance criteria; and (d) a Data Protection Package (DPIA and processor agreements).

- Design principles and boundary with TRACES

We recommend a number of principles as the underlying foundations for the proposed system.

– Standard formats

The system is built on a foundation of standardized data formats to ensure interoperability and clarity. Specifically, it uses **the World Geodetic System 1984 (WGS-84)** as the standard for all map coordinates (latitude and longitude). Furthermore, all timestamps for events sent to TRACES are recorded in Coordinated Universal Time (UTC); this approach prevents any ambiguity arising from different time zones or daylight saving changes.

– Separation of concerns

TRACES will remain the authoritative registry for certificates and official controls; however, it will not ingest or store continuous tracking data. Instead, the proposed Geolocation Intermediary Service (GIS) will handle the ingestion, geofencing, and event generation processes.

– Privacy by design

All detailed location data are processed within the GIS. Consequently, TRACES stores only events – specifically, the arrival and departure times at Journey Log key points; places of departure & destination, control posts, and border control posts. It does not record continuous tracks or the time of leaving the final destination. Moreover, vehicle and trailer identifiers are pseudonymised before leaving the GIS. Detailed responsibilities for data protection will be formally defined in the project's subsequent Data Protection Impact Assessment (DPIA) and related contracts (see Section 8).

– Boundary with TRACES – what is stored and what is not

What TRACES stores

Arrival and departure events at all official journey checkpoints, including: place of departure, assembly centres, control posts, border crossings (intra- and extra-EU), ports, airports, and the place of destination.

What TRACES never stores

Continuous GPS tracks or any geolocation events collected after the truck has reached the destination are not stored in TRACES.

Note : Geolocation events consolidated at the interval level (15 min) may be retained within the Geolocation Intermediary Service (GIS) and imported to TRACES , but only as needed for controlled audit/verification (e.g., to assess deviations between the actual journey and the

	<i>planned journey), and are then deleted or archived according to the legally defined retention period.</i>
	.
<i>Journey or consignment identifiers and vehicle/trailer identifiers.</i>	<i>Raw position fixes (i.e., unprocessed GNSS/GPS location points: timestamp, latitude, longitude) or sensitive sensor data.</i>
<i>Verification status (Confirmed, Estimated or Needs review) and checkpoint names.</i>	<i>Evidence packs (i.e., a small set of location points and metadata immediately before/after a compliance event, retained in the GIS for audit and provided to TRACES only on-demand) and any personal data not required for compliance.</i>

Table 1 Comparison of data stored in TRACES versus excluded data

If a message is sent twice due to network issues, TRACES keeps only one copy. This clear separation reduces privacy risk, keeps TRACES focused on essentials, and – most importantly – supports data minimisation obligations.

- Technical Architecture Overview

To implement the principles outlined previously, the Geolocation Intermediary Service (GIS) is designed as a modular, event-driven system composed of microservices – an architecture that ensures scalability, resilience, and a clear separation of concerns. The diagram below illustrates the high-level components and their interactions.

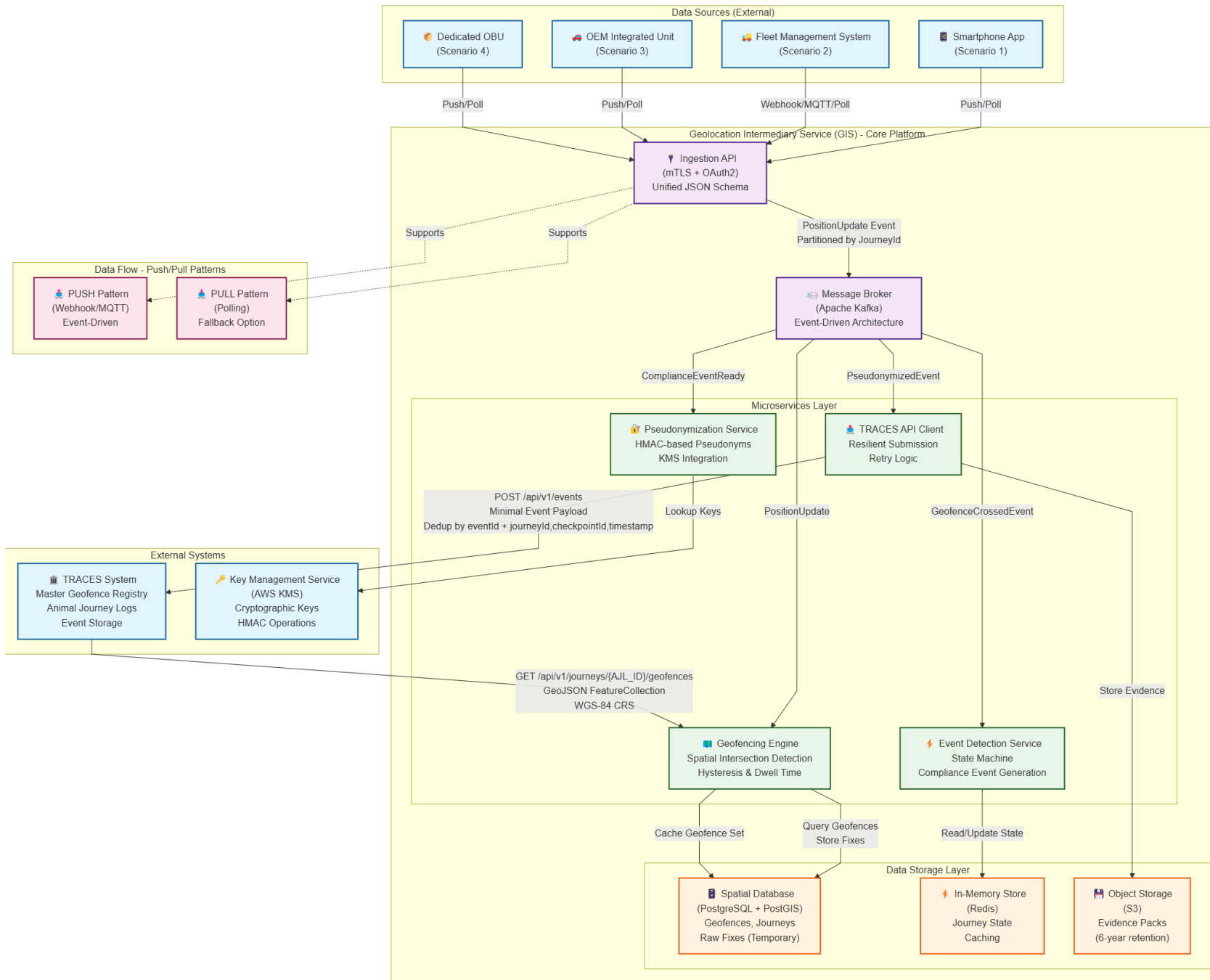


Figure 77
Geolocation
Intermediary
Service (GIS) -
High-Level
Architecture
Diagram

– Key Architectural Concepts

i. Data Aggregation (15-minute intervals)

The system aggregates raw data to ensure consistent processing. The flow proceeds as follows:

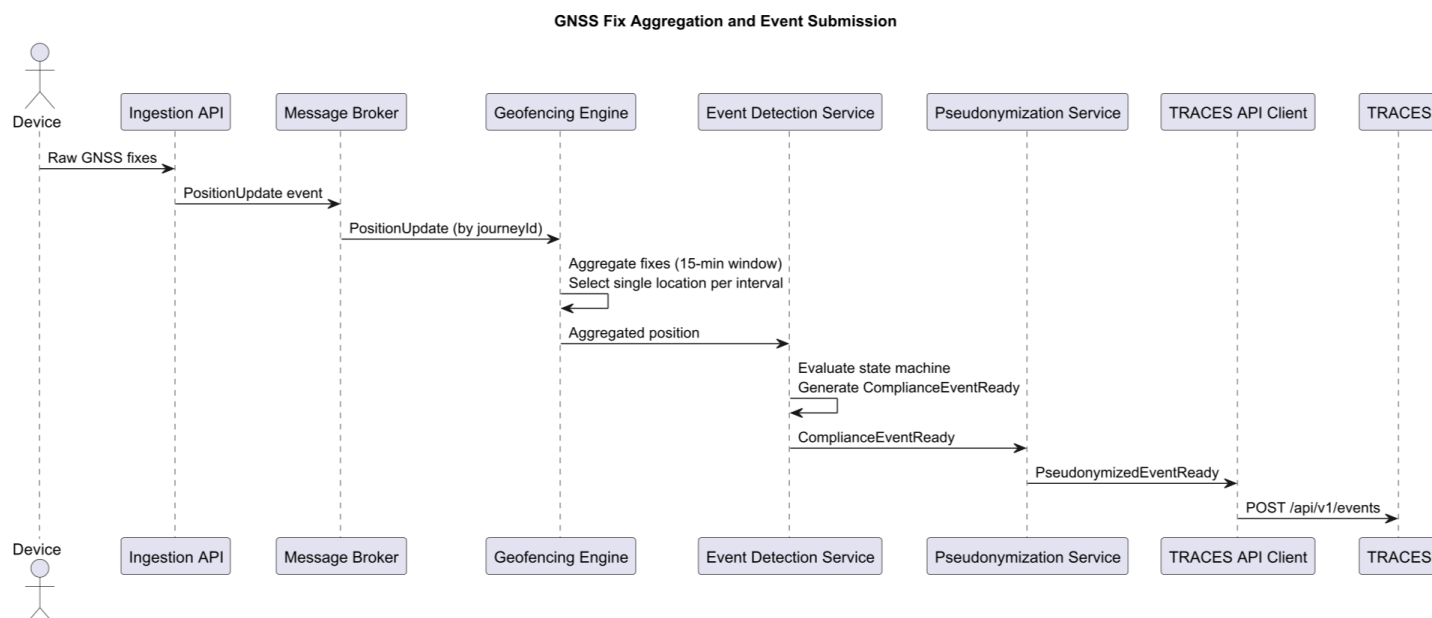


Figure 78 Processing of Raw GNSS Fixes into TRACES Compliance Events

ii. Push vs Pull Model

The architecture supports two distinct communication patterns:

- **PUSH Pattern (Recommended):** This method utilizes Webhooks (HTTPS) – which are stateless, simple, and widely adopted – or messaging protocols like MQTT for high-throughput scenarios with persistent sessions and Access Control Lists (ACLs).
- **PULL Pattern (Fallback):** This method relies on polling at negotiated intervals using caching headers (e.g., `If-Modified-Since`). It enforces idempotency via provider message IDs and applies strict rate-limiting to avoid system overload.

iii. Journal ID Handling

The handling of Journal IDs varies depending on the data source:

- **Data from Smartphone App (Scenario 1):** The App receives the AJL ID directly from TRACES; consequently, fixes are keyed to this AJL ID. Before AJL approval, data is buffered under a provisional token (`AJL-DRAFT-`). Once approved, the buffered fixes are re-keyed to the AJL ID while preserving original timestamps.

- **Data from Data Broker / FMS (Scenario 2):** In this scenario, there is no AJL ID in the incoming data and the Journal ID is absent at ingestion. Therefore, reconciliation happens at the Event Detection stage, where the server matches incoming data against the journey and raises an event back to TRACES with the proper AJL ID.

iv. Geofencing Data Flow

Geofencing is the technique that allows to define a virtual area around a point of interest and generates alerts when a connected device enters or leaves the area. The geofence is defined by a radius around a centre point or by a polygon. Events are generated when a tracked device enters or leaves the area.



Figure 79 Geofenced area

To improve accuracy, two additional concepts are used:

The **Hysteresis band** is a virtual buffer zone around the geofenced perimeter that a vehicle must cross before an event is triggered, to ensure that a vehicle moves definitely into or out of the zone before triggering the alert, rather than shifting slightly due to GPS inaccuracies for instance.

The **Dwell time** is the time spent within the geofenced area: by specifying a minimal dwell time in the area before triggering an event, the system can filter out “passersby” for instance.

The geofencing concepts are defined in detail in the market analysis report (D03.01 - Market Analysis report, 2025).

The geofencing logic follows a strict sequence to ensure accuracy:

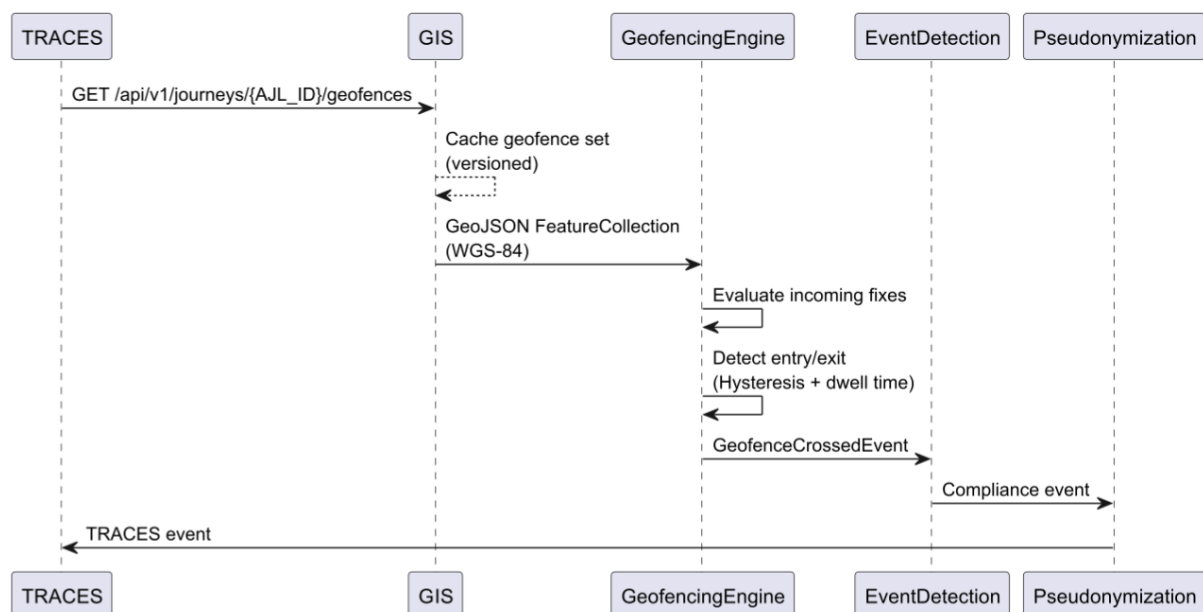


Figure 80 Geofence Evaluation and Compliance Event Flow

To support this flow, **TRACES shall:**

- a) maintain a master geofence registry (control posts, borders, ports, airports) with versioning;
- b) associate a geofence `setId/version` to each Animal Journey Log (AJL);
- c) expose `GET /api/v1/journeys/{AJL\_ID}/geofences` returning a GeoJSON FeatureCollection – a standard format for encoding geographic data – with properties `{checkpointId, type, name, version}` and a defined Coordinate Reference System (CRS=WGS-84);
- d) support standard web caching mechanisms (e.g., ETag/If-None-Match) to reduce unnecessary data transfer;
- e) emit change notifications or allow polling;
- f) store `setId/version` with every received event for audit replay; and
- g) mark retired geofences with a “410 Gone” status to indicate they are permanently removed.

v. Event Submission to TRACES

Events are submitted via `POST /api/v1/events` with a content type of `application/json`. The deduplication mechanism relies on a primary key (`eventId` with a 7-day TTL) and a secondary composite key consisting of `journeyId`, `checkpointId`, and `timestamp`. The response is an HTTP 202 Accepted with a `receiptId`. Authentication is handled via Mutual TLS (mTLS) certificates and OAuth2 client-credentials. Finally, an audit trail is persisted containing event details, processing status, algorithm version, and the provider ID.

vi. Pseudonymization Flow

The pseudonymization process ensures that clear-text identifiers never reach TRACES:

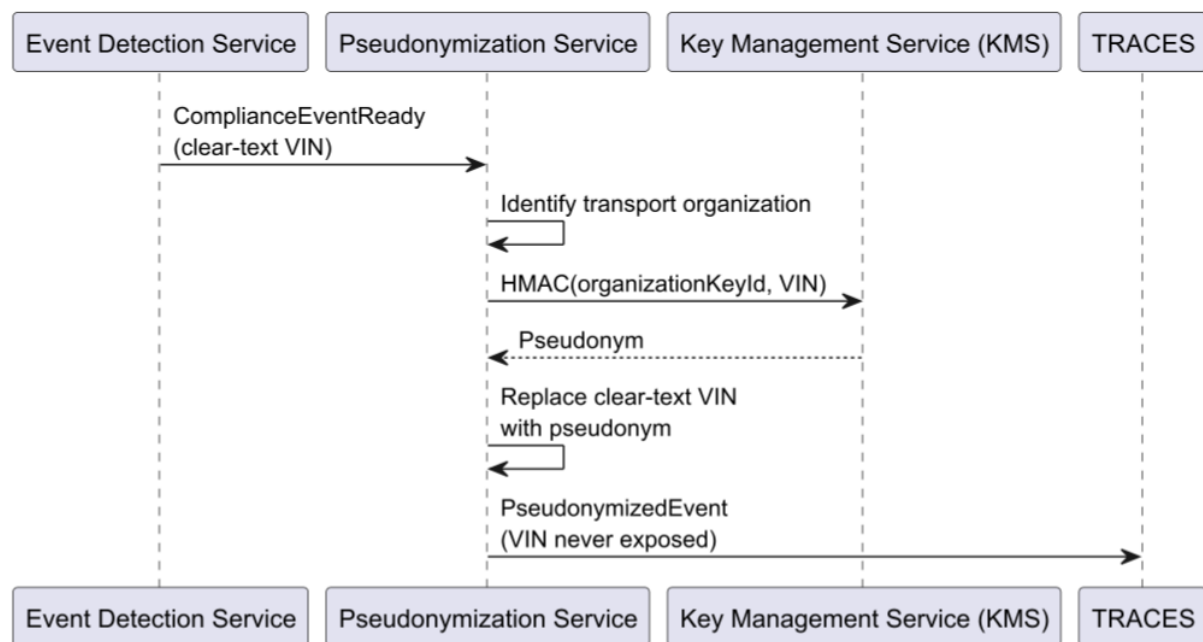


Figure 81 Compliance Event Pseudonymization Flow

– Component Responsibilities

Component	Responsibility	Key Features
Ingestion API	<i>Unified entry point for all data sources</i>	<i>mTLS auth, JSON schema validation, partitioning by JourneyId</i>
Message Broker	<i>Event-driven communication</i>	<i>Kafka topics, in-order processing per journey, decoupled services</i>
Geofencing Engine	<i>Spatial intersection detection</i>	<i>PostGIS queries, hysteresis, dwell time, caching</i>
Event Detection	<i>Compliance event generation</i>	<i>State machine, stateful processing, verification status</i>
Pseudonymization Service	<i>Identity protection</i>	<i>HMAC-based, KMS integration, organization-specific salts</i>
TRACES API Client	<i>External system communication</i>	<i>Resilient submission, retry logic, deduplication</i>
Spatial Database	<i>Geofence and journey storage</i>	<i>PostgreSQL + PostGIS, temporary fix retention</i>
In-Memory Store	<i>State and caching</i>	<i>Redis, journey state machine, performance optimization</i>
Object Storage	<i>Long-term evidence</i>	<i>S3, 6-year retention, audit trail</i>

Table 2 Responsibilities and features of system components

– Data Protection Principles

The architecture adheres to five core principles:

1. **Data Minimization:** Only events are sent to TRACES; raw tracks are never transmitted.
2. **Pseudonymisation:** Vehicle IDs are anonymized before leaving the GIS.
3. **Separation of Concerns:** The GIS handles tracking, while TRACES handles compliance.
4. **Retention:** Raw data is purged after event generation, while evidence packs are retained for 6 years.
5. **Auditability:** Every step is logged with version tracking and evidence packs.

– Scalability & Resilience

To ensure robustness, the system employs several strategies:

- **Independent Scaling:** Each microservice can scale independently based on load.
- **Graceful Failure:** The message broker decouples services, preventing cascading failures.
- **Idempotency:** All operations are designed to be idempotent, meaning that reprocessing the same event or request (e.g., after network retries) does not change the system state beyond the first successful application-this is enforced via unique event identifiers (` eventId`) and deduplication within the defined window.
- **Caching:** Redis caching reduces database load.
- **Partitioning:** Kafka partitioning by ` JourneyId` ensures in-order processing.
- **Target Uptime:** ~99.9% availability.
- **Event Latency:** Events reach TRACES within seconds under standard profiles.

– Data Aggregation and Temporal Resolution

The Geolocation Intermediary Service processes incoming position fixes from multiple sources operating at varying sampling frequencies – whether event-only, low-frequency, or real-time. To ensure consistent geofence detection and compliance event generation, the system implements a data aggregation and filtering strategy aligned with the recommendations in the Market Analysis (D03.01).

i. Temporal Resolution Requirements

Geofence detection requires a minimum temporal resolution to reliably identify when a vehicle enters or leaves a geofenced area. As recommended in the Market Analysis, a 15-minute interval represents a fair resolution for geofence analysis. The geofence areas are defined as either points with a configurable radius or as polygons, using the WGS-84 coordinate system. Geofence parameters (including radius/polygon shape, hysteresis band, and minimum dwell time) are set per checkpoint type and calibrated during pilots, default values are proposed in **Appendix C: Geofencing default settings**, to balance false positives and false negatives.

A 15-minute interval will therefore serve as the baseline sampling rate, as it balances detection accuracy with data volume. Other sampling profiles are defined in the market analysis report for the sake of completeness, (real-time sampling, event-only) and remain of course alternative options if other use cases were to be implemented in the future.

ii. Data Aggregation and Filtering

Raw position fixes from devices are processed by the Geofencing Engine using the following logic:

1. **Buffering:** Incoming position fixes are buffered in the spatial database to enable temporal analysis. Devices may buffer data locally for up to 48 hours during connectivity gaps and resend automatically once a connection is restored.
2. **Redundancy Filtering:** When multiple position fixes are collected in rapid succession – for example, during traffic congestion – the system applies filtering to reduce data volume. Fixes that are spatially very close (e.g., within a few metres) and temporally close are consolidated into a single representative point.
3. **Geofence Detection:** The Geofencing Engine evaluates buffered position fixes against the master geofence catalogue maintained by TRACES. This catalogue is curated and updated by the European Commission, in coordination with Member States, primarily through a manual governance process. Updates to the catalogue are versioned and communicated ahead of enforcement periods, therefore allowing timely refresh by the intermediary system. In cases where the catalogue is incomplete or outdated, the system relies on cached versions for reproducibility and flags potential gaps for review; however, ensuring catalogue completeness remains a key responsibility of the European Commission and Member States. To reduce false positives, the engine applies a minimum dwell time and a hysteresis band to prevent spurious events due to GPS jitter. The authoritative geofencing and event detection logic is defined in Section 7. In the event of discrepancies between local evaluation and documented rules, the Section 7 specification prevails and serves as the normative reference for compliance and auditability.
4. **Event Generation:** Once a valid geofence crossing is detected, the Geofencing Engine publishes a `GeofenceCrossedEvent` to the message broker containing minimal information: journey identifier, checkpoint identifier, event type, timestamp (UTC), and verification status.

The aggregation and filtering strategy ensures that only processed events – not raw position tracks – are sent to TRACES. This achieves multiple objectives: it protects **privacy** by keeping continuous tracking data within the GIS; it improves **efficiency** by reducing the storage burden on TRACES; and it ensures **auditability** by retaining evidence packs for six years to align with legal requirements.

- Data Ingestion Model: Push and Pull Patterns

The Geolocation Intermediary Service supports two complementary data ingestion patterns to accommodate the diverse capabilities of data sources.

Push Model (Recommended):

In the push model, data sources (devices, FMS systems, brokers) actively send position updates to the Geolocation Intermediary Service whenever new data becomes available. This is the preferred approach because it minimizes latency, reduces server load, and supports real-time compliance monitoring. Push delivery can be implemented via Webhooks (HTTPS) – the simplest method – or Messaging Protocols (e.g., MQTT), which are suitable for high-throughput scenarios.

Pull Model (Fallback):

In the pull model, the Geolocation Intermediary Service queries data sources at regular intervals to retrieve position updates. This approach is used as a fallback when data sources do not support push mechanisms. It allows compatibility with legacy FMS systems and supports standard HTTP caching mechanisms. Pull queries are implemented via Polling with Caching Headers (e.g., `If-Modified-Since`) and strict Rate Limiting to prevent overload.

Hybrid Approach:

In practice, the Geolocation Intermediary Service supports both patterns simultaneously. Modern FMS systems typically use push, while legacy systems may fall back to pull. This hybrid approach ensures maximum compatibility while maintaining the system's ability to process data with minimal latency.

This design – particularly the hybrid push-pull model – is architected to ensure seamless integration with TRACES. The implementation of server-side geofencing, idempotent event submission, and evidence-on-demand ensures reliable compliance monitoring. Specifically, TRACES event ingestion via `POST /api/v1/events` accepts `application/json` payloads, deduplicates by `eventId`, and persists critical audit data including the `geofenceSetId` and `providerId`.

- Sourcing geolocation data
 - Data sources

Transporters differ widely in their digital maturity. To accommodate this diversity, the Geolocation Intermediary Service accepts data from several sources, as defined in the Market Analysis (D03.01). The report analysed 4 possible sources of geolocation data, listed below for reference.

The following table summarizes the suitability of each option for different transporter profiles, highlighting the trade-offs between cost, reliability, and data richness.

Data Source	Primary User Profile	Commonality & Coverage	Advantages	Disadvantages
Smartphone App	Small operators, occasional transporters, rental vehicles	Very High. Covers nearly 100% of the market as a baseline.	Low cost, easy to deploy, no hardware installation.	Dependent on driver's phone, no trailer data, potential for signal loss.
FMS Sync	Medium to large professional fleets	High. Most professional hauliers already use FMS.	Automated, reliable data, potential for data recovery, may include vehicle data.	Integration effort required, vendor-dependent, often lacks trailer-specific data.
OEM Integrated Unit	Fleets with modern, high-end trucks	Medium but Growing. Increasingly standard on new vehicles.	Highly reliable, tamper-resistant, no extra hardware.	Limited to specific truck brands/models, not transferable.
Dedicated OBU	High-risk, long-distance, or high-value animal transports	Low but Critical. Used for specific regulatory requirements.	Most reliable and secure, can monitor trailer conditions (e.g., temperature), independent of the tractor.	Highest cost, requires professional installation and maintenance.

Table 3: Comparison of geolocation data source options (Smartphone App, FMS Sync, OEM Integrated Unit, Dedicated OBU)

The Market analysis report compared the pros and cons of the four data sources and recommended for the GIS to support a combination of the first two: the smartphone application for smaller operators and the Fleet Management Systems used by larger transporters. We refer the reader to D03.01 (D03.01 - Market Analysis report, 2025, p. Section 4) for a full discussion of the four scenarios and the resulting recommendation for the GIS to use the first two data sources.

The main implications of the two retained data sources for the design of the GIS are listed below.

- **Smartphone application (Scenario 1).** A cost-effective option where drivers use an official app to start and stop journeys and record location points. The app links to a specific Journey Log and applies simple motion checks to reduce the risk that the phone is outside the vehicle; however, it cannot measure trailer conditions and data cannot be recovered if the phone is off. To ensure reliability and usability across diverse operational conditions, the official smartphone application is designed with the following technical capabilities:
 - **Offline-First Architecture:** The app stores journey data locally and synchronizes with the Geolocation Intermediary Service when connectivity is restored, ensuring no data loss in areas with poor coverage.
 - **Low-Data Mode:** A configurable low-bandwidth mode reduces data transmission for operators with limited or expensive mobile data plans, sending only essential position updates.
 - **eSIM Support:** The app is compatible with eSIM technology, allowing transporters to use dedicated data plans for compliance reporting without affecting their personal mobile service.
 - **AJL Lifecycle Handling:** To accommodate operational needs, the app handles the Animal Journey Log (AJL) lifecycle as follows: Before approval, the app buffers data under a provisional token (` AJL-DRAFT-`) and does not submit to the GIS. AJL approval by the competent authority is a prerequisite to start the journey; therefore, there should be no movement of the animals before the approval is received. On approval, TRACES notifies the app; subsequently, buffered fixes are re-keyed to the AJL ID and forwarded with original timestamps. If the draft is rejected or cancelled, local data auto-purges after 24 hours. If the app collects fixes before approval (e.g., early activation), data are tagged 'UNBOUND' and reconciled when the AJL is issued; unreconciled 'UNBOUND' data purge after 72 hours. If push notification is unavailable, the app polls TRACES for draft status at a bounded interval (e.g., every 15 minutes while in proximity to scheduled departure), then re-keys and submits buffered data upon approval.

- **Fleet Management System (FMS) sync (Scenario 2).** Existing FMS solutions can publish positions and other signals through standard APIs or via certified brokers. This option is automated and may allow recovery of data buffered during connectivity gaps; however, integration depends on vendor cooperation and does not always include trailer data. Event-driven delivery via webhook - a simple method where the FMS sends a notification to the GIS when data is ready - or a messaging protocol (e.g., MQTT) is the recommended integration method. Specifically, the delivery preference is: 1) Webhook (HTTPS) for simplicity, statelessness, and wide broker adoption; 2) Messaging Protocol

(e.g., MQTT) for high-throughput fleets requiring persistent sessions and topic Access Control Lists (ACLs); and 3) Polling as a fallback for brokers without push capabilities. In the polling scenario, the GIS polls at negotiated intervals with standard caching headers (e.g., `If-Modified-Since`), enforces idempotency - the property of an operation that allows it to be applied multiple times without changing the result beyond the initial application - via provider message IDs, and rate-limits to avoid overload. This hybrid push-pull approach preserves compatibility across FMS capabilities-while keeping a consistent security baseline (mTLS and OAuth2 client-credentials) across webhook, MQTT, and polling.

– Sampling profiles

To control data volumes and costs, three possible data sampling profiles were reviewed for the data sources:

- **Event-only** – send a fix only when the driver presses start/stop or when the Geolocation Intermediary Service detects crossing a geofence. This is suitable for low-risk or short journeys.
- **Low frequency** – send a fix every 15 minutes. This profile balances fidelity and efficiency and is expected to be the default.
- **Real time** – send a fix every minute (or faster if required). This profile could be reserved for high-risk journeys.

Based on the use cases considered under the Proposed Regulation 2023, the sampling profile that was retained is the **Low frequency sampling profile** (D03.01 - Market Analysis report, 2025, p. Section 3.6)

It should be noted however, that if other use cases and/or data sources are added later on that might require a different sampling profile, the proposed architecture is designed in such a way that this should be possible to be implemented with very little impact on the system's design.

– Unified Ingestion

Standardized data format. To address the current fragmentation where GPS data are submitted by economic operators to MSCAs in inconsistent formats (Excel, PDF, proprietary formats), the Ingestion API will enforce a single, well-documented JSON schema for all position updates. This schema includes mandatory fields (timestamp, latitude, longitude, journey ID)

and optional fields (altitude, speed, heading, temperature, humidity). Consequently, data providers must transform their native formats into this schema before submission. The Commission will publish a reference implementation and validation tools to assist data providers with this transformation. We recommend to align this reference with the rFMS standard described in the D03.01 Market Analysis Report as it has already been adopted by the main Truck vendors. The rFMS standard is also in the process of being updated to support trailers data in the future so using that format as the reference for the GIS will open up new possibilities in the future.

– Maritime Transport Considerations

For journeys involving maritime segments where road vehicles are transported by ferry or roll-on/roll-off (Ro-Ro) vessels, the system explicitly accounts for operational constraints—most notably temporary loss of cellular connectivity—and supports event detection at ports and ferry crossings. Consequently, the tracking approach focuses on road vehicles while accommodating maritime-related data gaps.

Trucks on Ro-Ro ferries (animals transported in the truck):

During the maritime segment, the truck's GNSS updates may be unavailable while the vehicle is inside the vessel. In this case, the Geolocation Intermediary Service (GIS) relies on buffering, schedule-based estimation, and event inference to flag the journey as “in transit via ferry,” and it marks inferred events as “Estimated.” Where vessel position updates (e.g. via LRIT or other publicly available sources) are available to the GIS, they can be ingested to reduce this gap; however, associating a specific ferry or sailing to an Animal Journey Log (AJL) requires that the ferry/sailing be identified in the AJL, which is a procedural prerequisite outside the scope of this design.

The system does not cover direct tracking of livestock vessels themselves, as geopositioning under the Proposed Regulation Art 24 is limited to means of transport used for transport by road. Maritime data sources are therefore used only to contextualize or bridge gaps in road-based journey tracking.

LRIT Integration:

In addition to standard GNSS, the system can ingest data from Long-Range Identification and Tracking (LRIT) systems, which are mandatory for certain vessel types under international maritime regulations. LRIT provides lower-frequency position updates (typically every six hours) but offers global coverage, including areas where cellular connectivity is unavailable. This is relevant only for maritime legs of live animal transport journeys; therefore, it complements the GIS objective under Article 24(3) by maintaining coverage continuity for event generation when cellular-based data sources are unavailable.

Port and Ferry Integration:

The event detection logic recognizes maritime-specific checkpoints, including ports of loading/unloading and ferry crossings. For ferry segments, the system can handle the temporary loss of cellular connectivity and resume tracking once the vehicle disembarks.

Third-country road leg after port arrival:

Two cases can be distinguished:

1) the same truck continues the onward journey (in the case of a rollon-rolloff vessel) -: geolocation data collection by the GIS continues as before, as there is technically no difference between the EU and non-EU legs of the journey.

2) the consignment gets unloaded from the Livestock Vessel and uploaded to another truck: if those trucks are expected to use the same positioning systems capable of communicating with the Geolocation Intermediary Service (GIS) as described above, monitoring can continue beyond the maritime segment. However, the practical feasibility depends on applicable legal arrangements and cooperation with third-country authorities and transport operators; these aspects will be addressed in subsequent implementation and policy phases. It should also be noted that, just like for EU registered trucks, either the VIN number of those trucks, or the AJL number should be sent along with the geolocation to the GIS server so that the positions can be matched with an AJL (D04.01 TRACES Recommendations report, 2026, p. Section 6.7.2).

Additionally, as potential future work, TRACES could correlate the truck positioning events generated by the GIS with publicly available vessel positioning data for maritime legs, in order to improve reconstruction of the actual itinerary for multi-modal journeys. Detailed functional requirements, data sources, data quality constraints, and integration design for such correlation are explicitly out of scope for this document.

– Data Ingestion and Security

All data sources connect to a single, secure HTTPS endpoint—the Ingestion API. This simplifies integration and provides a consistent security model. Authentication is handled using mutual TLS (mTLS), where both the client (data source) and the server (Geolocation Intermediary Service) present certificates to prove their identity.

Each data provider—for example, a Fleet Management System (FMS) vendor, is issued a unique client certificate upon successful registration. The Ingestion API validates this certificate against a trusted store before accepting any data, ensuring that all incoming data is attributable to a known and approved source.

- Event detection and evidence packs

– Key features

Geofencing and event detection. The Geolocation Intermediary Service maintains a catalogue of control posts and other checkpoints. Each is defined as a point with a radius – or a polygon –

in WGS-84 coordinates. The GIS evaluates incoming location points against this catalogue to detect when a vehicle enters or leaves a zone. To reduce false positives, it applies a minimum dwell time (e.g., two consecutive points within a fence) and a hysteresis band – meaning the vehicle must travel a certain distance outside the fence before a departure is recorded. Map-matching may be used in dense urban or complex border areas to improve accuracy; therefore, this single event detection mechanism ensures consistent results and auditability.

Multi-modal and ferry transport. Journeys often include segments where the vehicle is transported by ferry, and in theory they could also include segments where the vehicle is transported by train. During these segments, the vehicle's GNSS signal may be unavailable – for example, inside a ferry hold or rail car. Consequently, the system detects entry into a ferry terminal or rail loading area and flags the journey as “in transit via ferry/rail.” Upon exit from the terminal, the system resumes normal tracking; however, if the vehicle does not emerge from the terminal within the expected time window (based on published ferry/train schedules), an alert is generated for review by the MSCA. This ensures that multi-modal segments do not create false “device offline” alarms while still maintaining oversight. In practice, journeys today include ferry transport only; rail transport of animals does not currently occur, but the system is designed to accommodate rail segments in the future should they become relevant. Upon exit from the terminal, the system resumes normal tracking; however, if the vehicle does not emerge from the terminal within the expected time window (based on published ferry/train schedules), an alert is generated for review by competent authorities and system operators.

Verification statuses. Each event is labelled by the GIS to guide inspectors:

- Confirmed – clear evidence of arrival or departure.
- Estimated – inferred during signal gaps (e.g., tunnels, ferries) based on neighbouring points and schedules.
- Needs review – ambiguous or suspicious data; inspectors can request the evidence pack from the intermediary system via TRACES. To minimise inspector burden, the GIS applies upstream data quality scoring and filtering so that "Needs review" is reserved for genuinely ambiguous cases and is expected to be rare.

The label (Confirmed, Estimated, Needs review) is included in the event data sent to TRACES and is displayed in TRACES in the per-journey timeline view.

In TRACES, inspectors view a timeline of events for each journey, with the status and checkpoint name.

Evidence packs and retention. For each event, the GIS stores a small collection of location points immediately before and after the crossing, along with signal accuracy and a reference to the geofence version. This concept builds trust among regulators and operators without overwhelming storage. Evidence packs are kept for a period of six years to align with the retention requirements specified in the forthcoming animal welfare legislation and then deleted. Continuous tracks are retained only long enough to compute events and then purged.

- Detailed Data Flow and Technical Implementation

The end-to-end process is orchestrated using the Saga pattern – a sequence of local transactions where each transaction updates data within a single service and publishes an event to trigger the next step – ensuring no single service is a point of failure and that the system is resilient and auditable. The process unfolds across several microservices:

1. **Ingestion:** A device sends a position to the Ingestion API; after authentication and validation, a ``PositionUpdate`` event is published to a message topic, partitioned by ``journeyId`` to guarantee in-order processing for a given journey.
2. **Geofence Detection:** The Geofencing Engine consumes the ``PositionUpdate``. It queries the spatial database for geofences related to the ``journeyId`` and checks for a spatial intersection; if a crossing is detected, it publishes a ``GeofenceCrossedEvent``.
3. **Compliance Event Generation:** The Event Detection Service consumes the ``GeofenceCrossedEvent``. It updates the journey's state machine in the in-memory store (e.g., from ``EN_ROUTE`` to ``AT_CONTROL_POST``). This service determines if a valid compliance event has occurred (e.g., vehicle has been inside the geofence for > 60 seconds) and, if so, publishes a ``ComplianceEventReady`` event.
4. **Pseudonymization and Submission:** The Pseudonymization Service consumes the ``ComplianceEventReady`` event, replaces the vehicle ID with a secure pseudonym using the KMS, and publishes a ``PseudonymizedEventReady`` event; finally, the TRACES Client consumes this event, formats the payload, and sends it to the TRACES API, handling any necessary retries or error logging.

This choreographed saga ensures that each step is an independent, idempotent transaction, making the system highly resilient and auditable.

- Data protection and governance
 - Roles and responsibilities.

The Commission acts as the controller for both the Geolocation Intermediary Service and TRACES. However, data providers – such as brokers, FMS operators, and app developers – may function as processors or independent controllers depending on specific contracts and the Data Protection Impact Assessment (DPIA). While operators are responsible for informing drivers, the GIS publishes a privacy notice and the app provides an in-app equivalent. In fact, this allocation does not shift the legal obligation to provide data away from transporters. This obligation is fulfilled directly in Scenario 1 (smartphone app), Scenario 3 (app on an integrated OEM head unit), and Scenario 4 (dedicated OBU); conversely, in Scenario 2 (FMS sync) or when using a certified broker, the transporter remains responsible for ensuring data reach the

Commission, while the FMS provider or broker acts under contract – either as a processor or, where applicable, an independent controller – with roles finalised in the DPIA and service agreements.

- Pseudonymisation and retention.

Vehicle and trailer identifiers are pseudonymised using per-organisation salts – a cryptographic technique where a unique, secret key (the salt) is assigned to each data provider organization. Furthermore, raw continuous data are retained only as long as is strictly necessary to generate events. How this works in practice:

- **Ingest & buffer:** The intermediary system receives time-stamped fixes and keeps a short rolling buffer solely to compute arrivals, departures, and other checkpoints.
- **Compute events:** The server-side engine evaluates official geofences (radius, dwell, hysteresis) and produces minimal events – specifically type, time in UTC, journey/log references, and vehicle/trailer IDs.
- **Build evidence packs (for audits only):** A small slice of pre/post points and accuracy metadata is packaged per crossing and stored separately for a legally defined period sufficient for audits; importantly, these are not sent to TRACES as part of the standard event flow and are provided only on demand for subsequent audits, subject to the final regulatory retention/deletion rules.
- **Minimise & delete:** Once events and (where applicable) evidence packs are created, raw continuous fixes are reduced to what is strictly necessary for audit or replay and then purged automatically according to the approved policy.
- **TRACES gets events only:** TRACES receives no raw tracks; instead, it receives only the minimal, time-stamped events needed for compliance checks.

- Geofence catalogue governance.

The data governance aspects of the catalogue are discussed in the Traces recommendation report as TRACES will be the source of the data (D04.01 TRACES Recommendations report, 2026, p. 6.7.2). TRACES publishes a versioned set of the relevant static locations to the intermediary system for read-only evaluation; consequently, the intermediary keeps a cached copy of that set (with an ID and version) to ensure reproducible decisions during the journey and in later audits. For initial deployment, a default geofencing radius (e.g., 500 m) is applied around assembly centres and control posts registered in TRACES; this baseline can be adjusted over time by designated keepers through TRACES governance processes. In practice, Member States provide or confirm the coordinates and attributes of their relevant checkpoints in TRACES under a controlled change process, including versioning and effective dates.

- Certification of brokers and data providers.

Certified brokers and data providers must keep data in the EU, pass regular security audits, allow the Commission to review logs, and provide an exit data escrow on termination so that data can be retrieved if a contract ends. These items are certification criteria to be enforced through procurement requirements and service agreements, and will be finalised in the Data Protection Impact Assessment (DPIA) and related contracts; this design document does not assert a standalone legal obligation beyond applicable law. While certifications such as ISO 27001 or SOC 2 are examples, the key requirements remain EU residency, audit rights, and exit clauses.

Ultimately, clear governance and data-protection measures protect individual rights, provide legal clarity, and foster trust among Member States and industry.

– Technical Implementation of Pseudonymization

Pseudonymization. Pseudonymization is a data protection technique in which direct identifiers are replaced with a pseudonym, reducing the risk of re-identification while preserving analytical usefulness. In this design, it supports GDPR and privacy-by-design objectives by ensuring that direct vehicle and trailer identifiers are not exposed outside the Geolocation Intermediary Service (GIS). The pseudonymization process is handled automatically by a dedicated Pseudonymization Service, a microservice operated within the GIS and therefore external to TRACES, with no manual intervention. This microservice consumes compliance events containing clear-text identifiers (e.g., Vehicle Identification Number (VIN)) and applies a keyed-hash message authentication code (HMAC) to generate deterministic pseudonyms. Cryptographic keys are managed by a Key Management Service (KMS) (e.g., AWS KMS), which centrally stores and controls access to keys. A unique, non-exportable symmetric HMAC key is maintained per transport organization, ensuring that the same VIN always yields the same pseudonym within one organization but different pseudonyms across organizations, thereby preventing cross-fleet correlation. Clear-text identifiers are processed exclusively within the GIS; only pseudonymized identifiers are propagated downstream.

The process is as follows:

1. The Pseudonymization Service receives a compliance event.
2. It identifies the transport organization associated with the journey.
3. The service calls the KMS, providing the organization's key ID and the clear-text identifier.
4. The KMS performs the HMAC operation internally and returns only the resulting pseudonym.
5. Finally, the service replaces the clear-text identifier in the event with the pseudonym.

This approach ensures that clear-text identifiers never leave the secure boundary of the Geolocation Intermediary Service and that cryptographic keys are never exposed to the application code.

- Reliability and coverage targets

The system is designed to be reliable and practical for enforcement - without binding technical contracts at this stage. Therefore, the following qualitative targets guide the design and procurement:

- The intermediary platform should achieve approximately 99.9% uptime (availability target).
- Events should typically appear in TRACES within seconds under standard sampling profiles (end-to-end target in the order of seconds, e.g., < 5 seconds).
- Devices must store at least 48 hours of data during connectivity gaps and resend automatically once a connection is restored.
- Alerts should be raised if a device stops sending data: within 5 minutes for real-time profiles and within 30 minutes for low-frequency profiles. Furthermore, silent-device alerts are routed to operators and competent authorities for follow-up.
- The geofence engine should correctly detect crossings at least 95% of the time in pilot corridors.

These targets remain non-binding at this stage and are supported by the resilience mechanisms described in Section 9.1 (idempotency, retries, and failure isolation).

– Technical Implementation of Reliability

This subsection describes reliability for the GIS - TRACES event-submission path - implemented in the GIS TRACES API Client microservice (e.g., Resilience4j) - and does not cover device/broker - GIS ingestion. Reliability is achieved through a combination of architectural patterns and specific technologies:

- **Circuit Breaker:** To prevent cascading failures when the external TRACES API is slow or unavailable, a circuit breaker is implemented. If the failure rate exceeds a threshold (e.g., 50% over 10 requests), the circuit opens for a configured duration (e.g., 30 seconds), causing subsequent calls to fail fast without attempting a network request; this allows the TRACES system time to recover.

- **Retry with Exponential Backoff:** For transient network errors or temporary service unavailability (e.g., HTTP 503), the client will automatically retry the request. The delay between retries increases exponentially (e.g., 1 s, 2 s, 4 s...) up to a maximum number of attempts (e.g., 10). Consequently, this avoids overwhelming the downstream system with rapid-fire retries.
 - **Dead Letter Queue (DLQ):** If a message cannot be sent to TRACES after all retry attempts have failed – or if the circuit breaker is open – the message is not discarded. Instead, it is published to a dedicated message topic known as a Dead Letter Queue, a holding queue for messages that cannot be delivered to their destination. This ensures no data is lost and allows for manual inspection, reprocessing, or alerting.
 - **Idempotency:** Every event sent to TRACES includes a unique event identifier. This allows TRACES to safely discard duplicate messages that might result from network retries, ensuring that each event is processed exactly once.
-
- Risk considerations and mitigations

Connectivity gaps. Vehicles often travel through areas with poor cellular coverage; therefore, devices must buffer location data for at least 48 hours-and potentially longer, depending on operational conditions-and resend it automatically once a connection is restored. The Geolocation Intermediary Service estimates events in tunnels, ferries, or trains using adjacent points and schedules. Where available, the system may integrate external data sources - such as weather forecasts and satellite navigation (SAT NAV) route data - to improve the accuracy of these estimates. For example, if a vehicle is known to be traveling through a mountain tunnel with a published length, the system can calculate the expected re-emergence time and suppress false alerts during that period. Consequently, these events are flagged as "Estimated" for inspectors. For remote areas with limited connectivity, the system relies on buffering and offline processing rather than satellite connectivity. The exact buffering duration will be refined during implementation and pilot phases.

Heterogeneous devices and data quality. Transporters use different hardware and software; as a result, data from these sources will vary in quality and format. To ensure data can be processed consistently, the Geolocation Intermediary Service will normalise all incoming data to a common schema. Furthermore, a data quality score will be assigned to each data point, and data that does not meet a minimum threshold will be rejected. This ensures that the event detection logic operates on a consistent and reliable dataset.

Vendor lock-in. Relying on a single broker could create dependency; therefore, a **multi-broker strategy** will be employed to mitigate this risk. Multi-broker governance includes: onboarding

≥2 EU-resident certified brokers meeting (i) Remote Fleet Management Standard (rFMS) v5 parity incl. trailer IDs; (ii) 99.5% monthly delivery Service Level Objective (SLO) for push/poll feeds; (iii) escrow readiness (see §7); and (iv) Web Application Firewall (WAF)/Distributed Denial-of-Service (DDoS) protection and ISO 27001/SOC 2. Furthermore, the strategy requires providing a conformance test suite (schema, idempotency, late data, replay), defining active-active ingestion with `sourceId` tagging and deduplication by `providerId`, `deviceId`, and `timestamp` (±jitter), and maintaining an EC-operated contingency broker – a thin adapter – to mitigate market gaps.

Misuse of smartphone apps. By linking the app to a specific Journey Log and applying simple motion checks, the system reduces the risk that the phone remains outside the vehicle. Alerts are generated if the device stops sending data within 30 minutes (low-frequency sampling profile). These thresholds follow the reliability and coverage targets in Section 8, and alerts are routed to operators and competent authorities for follow-up.

GPS jamming and spoofing. The system assumes a degree of trust in the data sources; however, while some measures can be taken – such as cross-referencing with cell tower data – determined fraud is difficult to prevent entirely at the technical level. The system will flag suspicious patterns (e.g., sudden jumps in location) for review, but the primary mitigation remains at the procedural level, with penalties for non-compliance.

Scalability and cost. The system must be able to handle a high volume of data from thousands of vehicles; consequently, the use of an event-driven microservices architecture allows the system to scale automatically to meet demand. Costs are managed by using a low-frequency sampling profile by default and only increasing the frequency when necessary.

Ultimately, addressing risks early and transparently allows for appropriate safeguards and builds confidence among Member States, operators, and the public.

- Detailed Technical Implementation

This section provides a deeper dive into the specific technologies and architectural patterns used to meet the system’s requirements for data storage, security, scalability, and observability.

- Data Storage (Polyglot Persistence)

This section describes the data storage architecture within the Geolocation Intermediary Service (GIS), not TRACES. TRACES remains the authoritative store for minimal compliance events only (timestamps + identifiers) and does not ingest continuous tracking data.

The GIS uses a polyglot persistence approach - selecting the best storage technology for each specific data type and access pattern - because it must support (i) short-lived buffering of position fixes for event computation (including delayed delivery after connectivity gaps) and (ii) longer-lived storage of Evidence Packs for audit. Raw continuous positioning data are retained only as long as required to generate compliance events (and, where applicable, Evidence Packs) and are then purged according to the approved retention policy.

- **Relational Database with Spatial Extension** (e.g., PostgreSQL with PostGIS): This is the primary relational database and the system's source of truth for structured business data; specifically, it stores journey details, user information, and the master catalogue of all geofences (control posts, borders, etc.). Furthermore, the spatial extension provides powerful and indexed spatial query capabilities - such as finding all geofences within 5 km of a point - which is essential for the Geofencing Engine to operate efficiently.
- **In-Memory Data Store** (e.g., a Redis Cluster): A distributed in-memory key-value store used for high-throughput, low-latency caching and state management. It stores the real-time state of each journey's state machine (e.g., `EN\_ROUTE`, `AT\_CONTROL\_POST`) and the more granular state of each vehicle-geofence interaction (INSIDE, OUTSIDE). Consequently, this allows the event detection services to make rapid, stateful decisions without querying the main database for every incoming position.
- **Object Storage** (e.g., Amazon S3): Used for storing large, immutable binary objects - specifically the Evidence Packs. When a compliance event is generated, the associated raw GPS data snippet is packaged into a JSON file and archived in the object store; this is a cost-effective, durable, and highly available solution for storing audit data that is infrequently accessed.

– Security (Defense-in-Depth)

The Geolocation Intermediary Service (GIS) is designed to be secured using a defense-in-depth model, with multiple independent layers of security controls:

- **Network Security:** All endpoints are protected by a Web Application Firewall (WAF) and DDoS mitigation services. Moreover, communication between microservices occurs within a private network – such as a Virtual Private Cloud (VPC) – and is not exposed to the public internet.
- **Authentication & Authorization:**
 - **mTLS:** As described in Section 5.1, all data sources must authenticate using mutual TLS client certificates, ensuring only registered and trusted devices can submit data.

- **JWT Tokens:** Internal service-to-service communication is secured using JSON Web Tokens (JWTs) for fine-grained authorization, ensuring services can only access the resources they are permitted to.
- **Data Encryption:**
 - **In Transit:** All data is encrypted in transit using TLS 1.2 or higher.
 - **At Rest:** All data stored in databases and object storage is encrypted at rest using industry-standard AES-256 encryption.
- **Key Management:** The **Key Management Service (KMS)** is used for managing all cryptographic keys, including those used for data encryption and the HMAC keys used for pseudonymization. Keys are automatically rotated, and access is strictly controlled by access control policies (e.g., IAM policies) – ensuring that no single service or user has direct access to the raw key material.

– Scalability (Horizontal Scalability)

The proposed design, the Geolocation Intermediary Service (GIS) should be designed for high availability and horizontal scalability, allowing it to handle traffic from millions of devices without performance degradation:

- **Microservices Architecture:** The system is decomposed into small, independent services; consequently, each service can be scaled horizontally (by adding more instances) independently of the others based on its specific load. For example, if data ingestion becomes a bottleneck, more instances of the Ingestion API can be deployed without affecting the Event Detection Service.
- **Asynchronous Communication:** The message broker acts as a scalable, durable buffer between services. This decouples the services and allows them to operate at their own pace; therefore, if a downstream service (like the TRACES Client) slows down, the message broker absorbs the backlog of messages, preventing data loss and allowing the upstream services to continue operating normally.
- **Containerization and Orchestration:** All microservices are packaged as software containers (e.g., Docker) and deployed on a container orchestration platform (e.g., Kubernetes). The platform automatically handles service discovery, load balancing, and auto-scaling – adding or removing container instances based on real-time CPU and memory usage.

– Monitoring and Observability

The system is designed for comprehensive observability to ensure operational transparency and rapid troubleshooting:

- **Structured Logging:** All services generate structured logs (e.g., in JSON format) containing a **correlation ID** – a unique identifier that is passed through a chain of requests across different services. This allows operators to trace a single request as it flows through the entire system, making it easy to debug complex interactions; logs are aggregated in a central logging platform (e.g., OpenSearch or Splunk).
 - **Metrics:** Each microservice exposes a wide range of metrics (e.g., request latency, error rates, queue depths) in a standard format (e.g., Prometheus). These metrics are collected and stored in a time-series database; subsequently, a visualization tool (e.g., Grafana) is used to build dashboards that provide a real-time overview of the system's health and performance.
 - **Distributed Tracing:** The system uses distributed tracing (using standards like OpenTelemetry) to provide a detailed, **flame-graph visualization** – a way of showing the call stack of a program to identify performance bottlenecks – of individual requests. This allows developers to identify performance bottlenecks within and between services with a high degree of precision.
 - **Alerting:** Alerts are configured based on the collected metrics. If a key metric crosses a predefined threshold (e.g., API error rate > 1% for 5 minutes, or message queue consumer lag exceeds 1,000 messages), an alert is automatically sent to the on-call engineering team via services like PagerDuty or Opsgenie, enabling a rapid response to production issues.
-
- Key policy choices and next actions

This section summarises the main policy decisions that must be finalised before implementation:

- **Retention period for detailed routes and evidence packs.** The Commission proposal foresees a six-year retention period for compliance data stored in TRACES. The Geolocation Intermediary Service aligns with this by retaining evidence packs for six years, while raw continuous tracks are purged immediately after event generation to minimize privacy risks. Any anonymisation or other post-retention handling of data stored in TRACES (including whether and how it is automated) is a TRACES responsibility and is discussed in the TRACES Recommendation report (D04.01 Section 6.7.3).
- **Geofence parameters by location type.** Member States' competent authorities responsible for animal transport controls must set radii, minimum dwell times, and hysteresis thresholds for geofenced locations. A data governance recommendation was

put forward in the TRACES Recommendation report whereby 1) sensible default values would initially be used for all locations 2) MSCAs would have the possibility to finetune those parameters on a per location basis. (D04.01 TRACES Recommendations report, 2026, p. Section 6.7.2). This report does not prescribe fixed numeric values at this stage; instead, the tentative recommendation is to calibrate parameters via pilots at representative sites (urban, rural, border, port), collect ground truth data, and perform Receiver Operating Characteristic (ROC) analysis. Indicative values are provided for default settings in **Appendix C: Geofencing default settings** but these will need finetuning based on the recommended ROC analysis. .

- **Trailer-first threshold.** Receiving events from the trailer rather than the truck itself has many advantages but also technical limitations which are discussed at length in the Market Analysis Report (D03.01, Sections 4.5 and 4.6). The important point from the perspective of this technical design is that the proposed architecture, by recommending the rFMS protocol as its ingestion format, is taking into account the ongoing developments in rFMS V5 that will support trailer data in the future (D03.01, Section 4.5.1).
- **Broker governance and liability.** The Commission must establish clear requirements for data brokers and providers, including:
 - EU residency requirements: data storage and processing within the EU;
 - audit rights: the Commission and Member States can audit the broker/provider and access relevant records;
 - log retention: retention of delivery and processing logs for a legally defined period; and
 - termination clauses: orderly data handover or deletion upon contract termination. These measures reduce vendor lock-in and increase data portability and audit readiness - even though they may come with higher integration costs.

- Implications of design choices (for the Commission)

This blueprint includes architectural and design choices that have direct implications for procurement, operational readiness, and governance-therefore, they should be treated as choices with downstream commitments, not only as implementation details.

- **Event-driven microservices architecture:** Supports scalability and resilience for heterogeneous inputs; however, it implies stronger needs for orchestration, monitoring, and incident handling capabilities during operations.
- **Data minimisation and privacy by design:** Sending only compliance events to TRACES and pseudonymising identifiers reduces privacy exposure and aligns with GDPR; nevertheless, it implies robust key management and auditability within the GIS.

- **Multi-source data integration (smartphone app, FMS, OEM device, dedicated OBU):** Maximises operator coverage; however, it increases integration and governance effort across multiple providers.
- **Push vs pull model:** Push reduces latency and avoids central polling load; the pull fallback (and evidence-on-demand) increases overall system complexity and implies clear SLAs with data providers.
- **Geofence versioning and verification statuses:** Versioned geofence sets and statuses (Confirmed, Estimated, Needs review) improve traceability and regulatory defensibility; however, they imply ongoing coordination with TRACES and Member States for geofence lifecycle management.
- **Reliability and alerting targets:** The stated uptime/latency and silent-device alert targets can be used as procurement baselines; consequently, they imply proportionate monitoring, alerting, and on-call arrangements.
- **Evidence pack retention (6 years):** Aligns with audit/legal requirements stated in this blueprint; however, it has predictable consequences for storage sizing, access control, and deletion enforcement at end of retention.
- **Broker governance and multi-broker strategy:** Reduces vendor lock-in and availability risk; at the same time, it introduces contractual, certification, and operational overheads that must be planned and budgeted.

These implications should be considered in subsequent phases-procurement preparation, policy finalisation, and operational planning-to ensure the selected design remains implementable and sustainable under Commission constraints.

- Estimates

The table below provides a high-level estimate of the required development effort for the GIS solution as described in this document.

Avg Manday cost	PM	1.000 €
	ARCH	1.000 €
	INT	850 €
	TEST	650 €

Feature	Reg 2023	Level	Mandays		The feature covers :
Architecture & design	Required	ARCH	250	250.000 €	Detailed technical requirements, regulatory analysis , system architecture, datamodel design , security
Core backend development	Required	INT	440	374.000 €	Data ingestion layer, message broker , data aggregation & pseudonymisation, journey correlation, TRACES API client , error handling, logging, security & authentication
Geofencing subsystem	Required	ARCH	120	120.000 €	Geofence management API, Catalogue synchronisation, Spatial logic , event engine & streaming
Database & data infrastructure	Required	INT	150	127.500 €	data architecture, object storage system, geospatial storage, Redis cache, Backup & disaster recovery
API Platform integration	Required	INT	150	127.500 €	REST API development, openAPI documentation , integration testing
Monitoring, observability & DevOps	Required	INT	100	85.000 €	Container deployment, CI/CD pipelines, dashboards, logging & alerting
Testing & Quality assurance	Required	TEST	150	97.500 €	API testing, geospatial validation, performance & load testing, security testing , TRACES interop testing
Deployment & production setup	Required	INT	80	68.000 €	load balancing, security hardening, infra provisioning , production rollout
Project Management	Required	PM	250	250.000 €	
Additional TRACES API	Optional	INT	50	42.500 €	Additional service for full geolocation display of an itinerary in TRACES in case of deviation from plan

Total Required Features Only **1.499.500 €**

Total Optional Features Only **42.500 €**

Hardware & Software licensing costs are not included as these would depend very much on the EC purchasing & sourcing policies. It should be noted however that the proposed design is largely based on open source software (Apache Kafka, PostGreSQL, PostGIS, Redis).

Annual maintenance costs are typically estimated as a percentage of the one-time implementation costs, usually 15-20%

- Conclusions

The transport of live animals across the EU demands a robust, efficient, and privacy-conscious positioning system, as mandated by Article 24 of the Proposed Regulation 2023. This document presents the Geolocation Intermediary Service (GIS) as a scalable, event-driven platform that integrates diverse data sources to automatically detect key journey events and relay only essential information to TRACES.

Architecturally, the study strongly advocates for the GIS to be operated as a system separate from TRACES: TRACES remains the authoritative registry for certificates and official controls and does not ingest or retain continuous tracking data, whereas the GIS handles multi-source ingestion, data aggregation in 15 minute sampling intervals, geofencing, event detection, pseudonymisation, and forwards only compliance events and compact evidence packs to TRACES. Collapsing these functions into TRACES would eliminate this separation of concerns and require TRACES to process continuous location data, which would have a huge impact on TRACES processing bandwidth.

By adhering to principles of privacy by design, data minimisation, and separation of concerns, the GIS empowers MSCAs with timely, reliable evidence while safeguarding personal data. Clear governance frameworks-including defined roles, data protection impact assessments, and contractual arrangements with certified brokers-underpin the system's trustworthiness. The use of evidence packs ensures auditability without compromising data volume or privacy.

Reliability targets and alerting mechanisms further enhance system robustness.

The multi-source approach accommodates the geolocation data collection scenarios recommended in the Market Analysis report, more specifically the use of both the mobile application and fleet management systems as complementary sources of positioning data.

Sensible defaults are proposed for key geofencing parameters, balancing the need for accuracy with the need to minimise data sets size. The study recommends validating the assumptions behind those default values through pilots & field testing and allowing MSCAs to override default values if specific locations need customisation.

Recommendations around the architecture, formats and protocols are designed to ensure the GIS can evolve over time and accommodate new policy requirements or technical evolutions. Position data sources can be added to the design, such as trailers through the upcoming rFMS protocol revision, or Data Sampling profiles can be added if a particular use case requires a higher frequency data sampling profile.

Moving forward, key policy decisions remain regarding data retention periods, geofence configurations, trailer device mandates, broker governance, and handling of remote areas.

Finally, the study presented a high-level estimate of implementation and maintenance costs of such a system.

In conclusion, implementing the GIS as outlined will modernise animal transport monitoring across the EU, improving welfare outcomes, reducing administrative burdens, and upholding privacy standards.

Appendix A: TRACES Animal Journey Log Data Model

This appendix provides a high-level overview of the key data fields in the TRACES Animal Journey Log (AJL) that the Geolocation Intermediary Service must populate or reference. The complete data model is defined in the official TRACES NT user guides.

6.5 Planning

Field	Description	GIS Relevance
I.1.1 Organiser	Name and address of the journey organiser	Referenced in journey metadata
I.1.2 Person in charge	Name and contact details of the person responsible for the journey	May be linked to driver contact in mobile app
I.2 Total expected duration	Expected journey duration in days and hours	Used to validate actual journey duration
I.3.1 Place of departure	Address and geo-coordinates of departure point	Primary geofence for journey start event
I.3.2 Departure time	Planned departure date and time	Compared against actual departure detected by GIS
I.4.1 Place of destination	Address and geo-coordinates of destination	Primary geofence for journey end event
I.4.2 Destination arrival time	Planned arrival date and time	Compared against actual arrival detected by GIS
I.5.1 Species	Animal species being transported	Not used by GIS
I.5.2 Number of animals	Total count of animals	Not used by GIS
I.5.3 Veterinary certificates	References to health certificates	Not used by GIS

I.6 List of scheduled resting, transfer or exit points	<i>Planned control posts, assembly centres, border crossings</i>	<i>Critical geofences for compliance events</i>

Table 4 TRACES Planning Fields

6.6 Place of Departure

Field	Description	GIS Relevance
<i>II.3 Date of loading</i>	<i>Actual date and time animals were loaded</i>	<i>May be compared against GIS-detected departure</i>
<i>II.5 Means of transport</i>	<i>Vehicle registration, trailer ID</i>	<i>Pseudonymized identifiers sent to TRACES by GIS</i>

Table 5 TRACES Departure Fields

6.7 Place of Destination

Field	Description	GIS Relevance
<i>III.3 Date and time of check</i>	<i>Actual arrival time at destination</i>	<i>Primary compliance event generated by GIS</i>
<i>III.4.5 Journey Log records and journey time limits</i>	<i>Verification that journey time limits were respected</i>	<i>GIS provides evidence for this verification</i>

Table 6 TRACES Destination Fields

6.8 GIS-to-TRACES Event Mapping

The Geolocation Intermediary Service generates the following event types, which are sent to TRACES and associated with the relevant Journey Log:

Note : at the time of writing, not all locations are available in the TRACES catalogue of locations to be tracked. See the TRACES Recommendation report for details. From the perspective of the GIS design, this does not matter. If more locations are made available in the future, they will be managed by the GIS in the same manner as existing ones.

<i>Event Type</i>	<i>TRACES Field</i>	<i>Description</i>

<i>DEPARTURE</i>	<i>I.3.2 (actual)</i>	<i>Vehicle departed from place of departure</i>
<i>CONTROL_POST_ARRIVAL</i>	<i>I.6 (actual arrival)</i>	<i>Vehicle arrived at a planned control post</i>
<i>CONTROL_POST_DEPARTURE</i>	<i>I.6 (actual departure)</i>	<i>Vehicle departed from a control post</i>
<i>BORDER_CROSSING</i>	<i>I.6 (actual crossing)</i>	<i>Vehicle crossed an EU internal or external border</i>
<i>DESTINATION_ARRIVAL</i>	<i>III.3 (actual)</i>	<i>Vehicle arrived at place of destination</i>
<i>ASSEMBLY_CENTRE_ARRIVAL</i>	<i>I.6 (actual arrival)</i>	<i>Vehicle arrived at an assembly centre</i>
<i>ASSEMBLY_CENTRE_DEPARTURE</i>	<i>I.6 (actual departure)</i>	<i>Vehicle departed from an assembly centre</i>
<i>EXIT_POINT_CROSSING</i>	<i>I.6 (actual crossing)</i>	<i>Vehicle crossed an exit point</i>
<i>PORT_ARRIVAL</i>	<i>I.6 (actual arrival)</i>	<i>Vehicle arrived at a port</i>
<i>PORT_DEPARTURE</i>	<i>I.6 (actual departure)</i>	<i>Vehicle departed from a port</i>
<i>AIRPORT_ARRIVAL</i>	<i>I.6 (actual arrival)</i>	<i>Vehicle arrived at an airport</i>
<i>AIRPORT_DEPARTURE</i>	<i>I.6 (actual departure)</i>	<i>Vehicle departed from an airport</i>

Table 7: Event Mapping

Each event includes:

- *Timestamp (UTC)*
- *Journey Log ID* (links to the AJL in TRACES)
- *Pseudonymized Vehicle/Trailer ID*
- *Checkpoint ID* (references the geofence in the TRACES catalogue)
- *Verification Status* (Confirmed, Estimated, Needs Review)

Appendix B: GIS-TRACES data exchange protocol

This appendix outlines the functional and technical requirements for the interface between the Geolocation Intermediary Service (GIS) and TRACES; specifically, it serves as a high-level definition of the data exchange protocol.

Requirement	GIS Implementation
Event Types	<i>The GIS generates and transmits the following event types: `DEPARTURE`, `CONTROL_POST_ARRIVAL`, `CONTROL_POST_DEPARTURE`, `BORDER_CROSSING`, and `DESTINATION_ARRIVAL`.</i>
Required Fields	<i>Each event payload includes: `eventId` (UUIDv4), `journeyId` (AJL Reference), `checkpointId` (from the TRACES catalogue), `timestamp` (UTC), `status` (Confirmed, Estimated, or NeedsReview), and `pseudonymizedVehicleId` / `trailerId`.</i>
Transport & Security	<i>Events are sent to TRACES via HTTPS POST to `/api/v1/events` – using Mutual TLS (mTLS) for device authentication and OAuth2 client credentials for authorization.</i>
Evidence Retrieval	<i>To support audits without overloading TRACES, evidence packs – consisting of raw data snippets – are not pushed automatically; instead, they are retrieved on-demand via `GET /api/v1/evidence/{eventId}`.</i>
Idempotency	<i>To ensure data integrity during network retries, TRACES discards duplicate messages based on the unique `eventId`.</i>
Data Minimization	<i>The GIS does not send continuous track data to TRACES by default; rather, only compliance events are transmitted, adhering to the principle of data minimization and privacy by design.</i>

Table 8: Functional and technical requirements for GIS-TRACES interface

- Appendix C: Geofencing default settings

There is very little quantitative research on how to set radius, hysteresis and dwell parameters for geofencing, reinforcing our recommendation in Section 13 for 1) a pilot environment for further finetuning and 2) the ability for MSCAs to modify parameters on a case-by-case basis through the TRACES catalogue (See TRACES Recommendation report section 6.7.2).

Some Fleet Management Systems vendors propose default values usually in the ranges listed below : ¹¹

<i>Radius</i>	<i>150-200m</i>
<i>Hysteresis band</i>	<i>20-50m</i>
<i>Dwell time</i>	<i>60-180 sec</i>

However, the AJL use case for geofencing is subject to more specific constraints than typical geofencing applications:

- Greater variation in area to cover for the same type of location. For instance:
 - Sampling using the list of establishments published by the EC shows that the ground surface of establishments can vary greatly, ranging for instance from less than 100m for a small, privately owned assembly centre to 300m-500m for a very large facility.
 - Some Border control posts are known for their long waiting times. If parking spaces are insufficient, queues can form on the road, leading to a larger area to cover.
- The average dwell time in a given key location will usually be much larger (loading/unloading time, 24hr mandatory rest, queueing at a border control post...)

A better approach would then be to minimise the number of false negatives by increasing the radius, since the resulting increase of false positives could be compensated by a higher dwell time:

<i>Radius</i>	<i>500m</i>
<i>Hysteresis band</i>	<i>100m</i>
<i>Dwell time</i>	<i>1800 sec</i>

¹¹ GPS accuracy is normally much more granular but the recommendations usually take into account variations in accuracy of GPS signals depending on location (urban canyons, tunnels, mountain terrain etc)

The fact that the geofences to be tracked in the context of the Proposed Regulation have a long average dwell time is an important assumption that allows us to increase the radius without incurring too many false positives.

EU internal Border Crossing points are a notable exception, as a truck would probably just drive through those points, but the internal crossing points are not available in the TRACES location catalogue anyway and will therefore not be included in the geofencing mechanism foreseen in this study (D04.01 TRACES Recommendations report, 2026, p. Section 6.7.2). If they are to be included in the future, specific defaults will need to be defined for those location types.

6.9 D.04.01. TRACES improvements recommendations

- Management Summary

This study examines how the Trade Control and Expert System (TRACES) can support the implementation and enforcement of the proposed Regulation on the protection of animals during transport (European Commission, 2023). It identifies the main digital solutions foreseen in the legislative proposal, assesses how these can be operationalised within TRACES, and formulates recommendations to maximise automation, reduce administrative burden, and strengthen compliance across the EU.

- Main digital solutions assessed

The proposed Regulation introduces a more data-driven and digitally supported framework for planning, monitoring, and controlling animal transport. The study assessed the following core digital solutions and their feasibility within TRACES:

- Digital journey planning and approval
 - Electronic submission and validation of journey logs.
 - Structured planning data, including routes, timing, rest points, and contingency measures.
- Digital verification of transport authorisations and certificates
 - Centralised storage and verification of transporter approvals, vehicle authorisations, and certificates of competence.
- Monitoring and recording of transport conditions
 - Recording of environmental and journey parameters (e.g. duration and other compliance indicators).
- Animal fitness and eligibility verification
 - Standardised data to support checks on fitness for transport and species-specific requirements.

- Risk-based official controls
- Data availability to support targeted inspections and compliance monitoring by competent authorities.
 - Information sharing and traceability
- Cross-border data exchange enabling all authorities involved in a transport operation to access the same validated information.
 - Digital documentation and reporting
- Harmonised electronic records of transport operations, inspections, and outcomes.

Together, these elements establish TRACES as the central digital backbone for planning, authorising, monitoring, and controlling animal transport movements within and across Member States.

- Implementation in TRACES and resulting automation of tasks

The integration of these digital solutions into TRACES will automate or streamline multiple processes for different stakeholder groups. The system will act as a **single source of truth**, reducing duplication of data entry, improving data reliability, and enabling faster and more consistent official controls.

- Overview of automated or streamlined functions by stakeholder

Stakeholder	TRACES Functionality	Resulting benefit
Organisers	Digital journey log preparation and submission	Automated validation of required fields and parameters reduces manual checking and re-submission cycles.
	Centralised access to regulatory requirements	Reduced time spent verifying compliance conditions across Member States.
	Space calculator	Facilitates planning by checking up front that the transport meets the minimal space requirements
	Integration with Geo-routing and Weather forecast interfaces	Facilitates planning and documentation by accessing itinerary calculation and weather forecast features directly in the AJL.

Drivers / attendants & keepers	Digital storage of authorisations and vehicle approvals	Eliminates repeated submission of documents for each transport.
	Automatic linkage of transport data (actors records, consignment, certificates, ...) to journey records	Reduces duplicate data entry and documentation handling.
	Widgets that assist operators in determining whether animals are fit for transport,	Provides easier access to digital resources, help and guidelines
	Digitalisation of AJL forms, prefilled with transport data.	Greatly simplifies the creation and signing of AJL Sections
	Mobile access to AJL data through a new mobile application	Real time access to key AJL data throughout the transport, include offline access to some resources.
MSCAs	Single source of truth for certificates and authorisations	Faster verification during official controls and reduced administrative workload.
	Automated validation checks and alerts	Enables risk-based inspections and reduces manual screening of transport plans.
	Shared cross-border data access	Eliminates information requests between authorities and accelerates decision-making.
	Direct access to journey and compliance data	Faster inspection procedures and more consistent enforcement.
	Automatic import of geolocation data at the end of a journey	MSCAs no longer need to chase operators for transport geolocation data, deal with various formats and data types, etc.
EU-level oversight	Aggregated data and reporting	Improved monitoring of compliance trends and policy evaluation.

- Additional TRACES enhancements identified in the study

Beyond the digital solutions explicitly foreseen in the legislative proposal, the study examined additional TRACES developments that could further reduce the administrative burden of operators and enhance the user experience.

Notable examples include:

Task-based Workflows

Features that facilitate online collaboration between actors of the process by automating the creation and (re)assignment of process tasks required at various steps of the process.

Business Rule Engine

A configurable rule-based validation system allowing competent authorities to apply harmonised or national control rules automatically. This would support consistent enforcement and reduce manual decision-making effort.

Automated alerts and compliance triggers

Real-time notifications when journey parameters approach regulatory limits or when documentation is incomplete.

Advanced risk analysis and targeting tools

Data-driven inspection prioritisation based on compliance history and transport characteristics.

These enhancements are not strictly required by the proposed Regulation but would substantially increase TRACES' effectiveness as an enforcement and compliance support tool.

- Main recommendations

The study identifies a set of strategic and operational recommendations to ensure TRACES can effectively support the new regulatory framework. To do so, the present study builds upon the capabilities identified in the Task 2 Traces Report (D02.01.01 TRACES Report). We refer the reader to that document for a definition and in-depth discussion of the capabilities.

Capability	Recommendation
Document & Record Mgt	• Link documents (certificates and authorisations) to the relevant user records, to facilitate compliance checks and inspections • Add document/record events mgt to improve the notification and task management flows (renewals, etc...) • Introduce retention, archiving and disposal policies in line with the new requirements

Workflow Mgt	• Introduce a process engine to decouple document management and task management to enhance flexibility • Use a rule-based engine to facilitate business rules checks in the application and provide visual support in the interface for underlying rules & checks applied
Compliance Mgt	• Enhance the display of non-compliances in the software interface and guide the user towards resolution • Enhance the ability of authorities to detect, inspect and solve non-compliant behaviours
Data integration	• Integrate weather forecast APIs to provide in-app information to stakeholders and facilitate planning / compliance checks • Integrate geo-routing APIs to facilitate the planning phase by allowing itinerary and duration calculations for the organiser. • Automate the integration of geolocation data into TRACES through a combination of scenarios as described in (D03.01 - Market Analysis Report, 2025)
Access Mgt	• Introduce more fine grained Role-based access management to support roles for individual economic operators that will operate in TRACES (desktop or mobile) • Introduce the concept of a “Case Team” to link individuals (both MSCAs and Operators) to a single Journey Log so as to support real time communication between actors during a journey
Reporting	• Include the reporting dimension into the design of the new flows so that all required data points and measures are readily available to QlikSense

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- Overall conclusion

The proposed Regulation places digital tools at the centre of compliance and enforcement for animal welfare during transport. TRACES is well positioned to serve as the core implementation platform, enabling harmonised data management, automated compliance verification, and efficient official controls across the EU.

While the functionalities required by the proposal already deliver substantial efficiency gains—particularly through centralised information and automated validation—additional enhancements such as automated fitness calculations and rule-based enforcement mechanisms could significantly amplify these benefits.

Implementing the recommendations of this study will allow TRACES not only to support regulatory compliance but also to transform administrative processes, improve enforcement consistency, and strengthen animal welfare protection across the Union.

- Introduction

The present TRACES Recommendation Report forms an integral part of the broader study of the modalities of Animal Welfare during Transport, commissioned under the EU4Health and Single Market Programme and managed by the European Health and Digital Executive Agency (HaDEA).

More specifically, the report builds upon the insights collected during previous phases of the study to address objectives three and five of the commissioned study:

- “Objective 3: To explore needed developments of TRACES to meet the requirements of the proposal and potential improvements of user’s experience of TRACES by adding functionalities to assist users in their work (...)”
- “Objective 5: To examine the potential for communication of TRACES with other IT systems, thus providing information needed for improved operability of digital solutions. (...)”

(Technical Annex - Annex 1 to Specific contract N° BEACON/HADEA/SANTE/Study on modalities AW during transport - BEACON-000167, 2024, p. 5)

The figure below highlights the logical links between the various reports that constitute the study on modalities of Animal Welfare during Transport. In order to provide recommendations on the required changes to support end-to-end digitalisation of the AWT process, the report consolidates insights gathered in the consultation phase (Task 2) and the analysis of the options offered by modern geolocation systems (Task 3).

The improvement of TRACES accessibility by means of a mobile application is studied in another Task 4 report, the Mobile Application Outline report, to which this report will frequently refer.

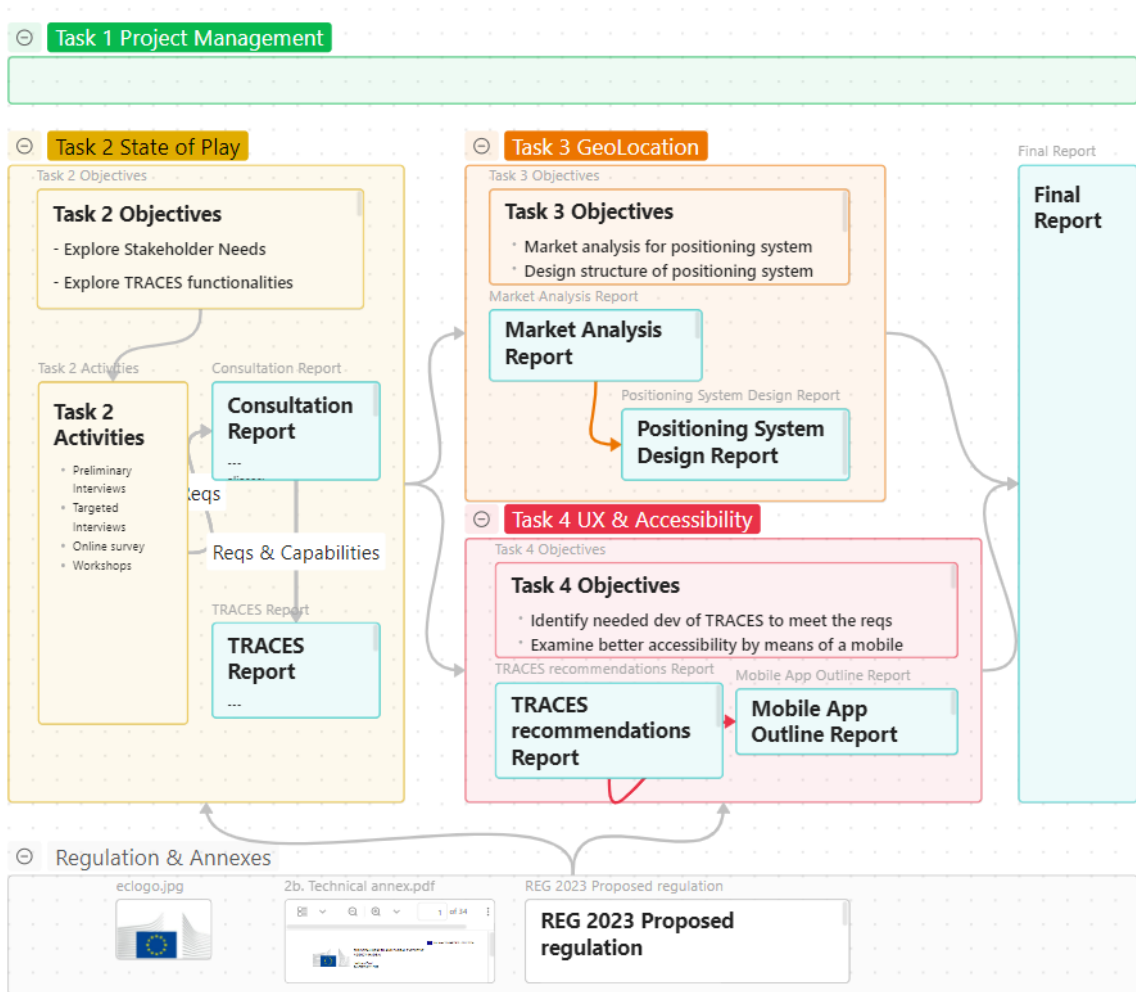


Figure 82 Overview of the study deliverables

The present report formulates recommendations along two main dimensions: the **entitlement process** that enables operators to gain the necessary certificates and authorisations required to carry out live animal transport activities on the one hand, and the **animal journey log process** that defines the new framework under which the transport activities will take place.

For each process, the various capabilities defined in the Task 2 TRACES Report (D02.01.01 TRACES Report) are reviewed and used to propose extensions and improvements of the current solution. A last section will cover reporting capabilities as these are transversal to the business processes.

To improve readability, we will follow the chronological order of activities undertaken by the stakeholders in the respective processes.

- Entitlements management

The entitlement management capability covers all activities required to manage the authorisations and certificates required for Economic Operators to carry out live animal transport activities.

Within the larger context of our study, the capability

- Supports the first phase of the AWT value chain “Obtain entitlements”
- Focuses on the Authorisation process
- Relies on other capabilities like Case, Record & Document management, Workflow management, Business rules management, Compliance management and Access Management.
- Impacts primarily the Desktop Application

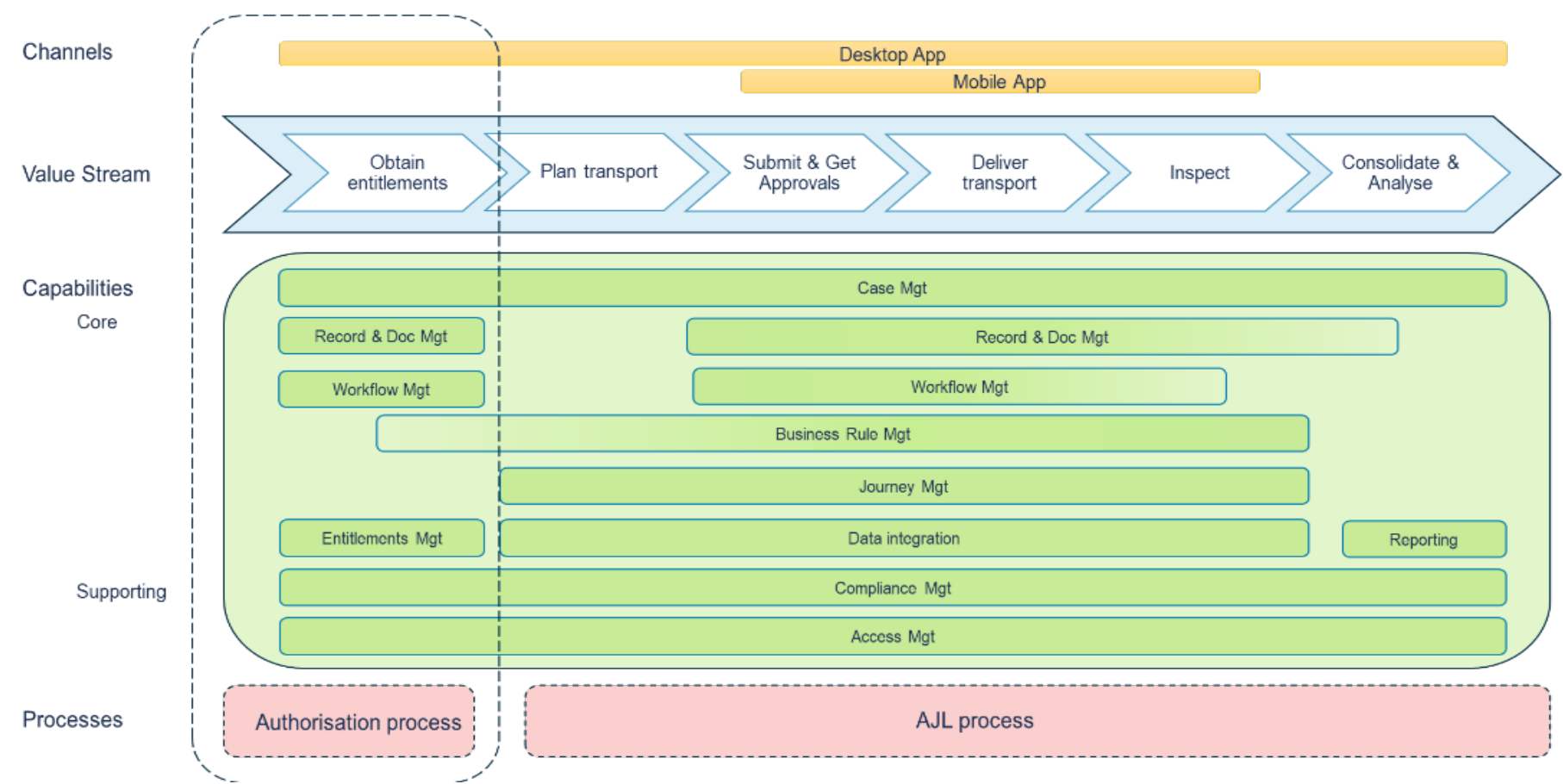


Figure 83 Entitlements within the AWT Value Stream

- Summary of requirements

The requirements pertaining to the capability have been analysed in previous deliverables of the current study; we provide a brief summary below with references to the corresponding documents for further details.

The overall objective is to enable an end-to-end digitalisation of the entitlement capability, allowing Operators and MSCAs to manage the entire authorisation and certification processes in a digital manner.

- Process flows

The Traces report described two main high level entitlement processes (D02.01.01 TRACES Report, p. 22) allowing Organisers and Transporters to obtain or renew the required authorisations. Both processes are largely similar in terms of activities and differ mainly in terms of documentation to be submitted.

Next to the authorisation processes, an ancillary process was described that allows for the suspension/withdrawal of authorisations.

One process was left out of the studied scope, namely the interactions between a Transporter and certification bodies. Those interactions allow a Transporter to obtain Driver certificates of competence after taking a course and the associated exam.

- Certificates and authorisations

Regarding the process artifacts, the Traces report identified two types of documents exchanged in the processes namely authorisations and certificates (D02.01.01 TRACES Report, p. 4.1.3 Documents).

- Stakeholder scenarios:

Lastly, the Consultation report (D02.01.02 Consultation Report, 2025, pp. 6.2.1.1 End-to-End Digitalisation) described two main scenarios among Member State Competent Authorities (MSCAs), with a group of countries favouring the option of managing entitlements from within TRACES (“TRACES-centric” scenario) while other countries that have already invested in their national application to manage these processes would rather take the path of integrating their national application further with TRACES to support the processes (“National application” scenario).

- Required features

From the requirements identified in the previous section, we can derive the following list of features for the entitlement management capability.

Process-specific features

- Ability to manage Economic Operator records in TRACES
 - create an Economic Operator record in TRACES
- Ability to manage Activities for an EO record
 - Ability to add an activity to my EO record
 - Ability to approve activities on the EO record
 - Ability to suspend/withdraw an activity under the EO record
 - Ability to re-activate a suspended activity under the EO record
- Ability to manage users for the EO
 - Ability to create a user login: manual – EU Login required
 - Ability to create a driver / attendant record
 - Ability to assign user to the EO record
- Ability to manage means of transport records for the EO
 - Ability to create a means of transport record
- Ability to manage Certificate or Authorisation records
 - Ability to submit request for authorisation with accompanying documentation
 - Ability to check for pre-existing authorisation rejections
 - Ability to approve/reject request for authorisation
 - Ability to link submitted document to EO/Driver/Mean of Transport records
 - Ability to seal authorisations

Generic process engine features:

- Ability to manage tasks
 - Ability to create tasks for each new request and assign them to the correct user group
 - Ability to view incoming tasks for one's group and to pick them up
 - Ability to manage the lifecycle of the task and associated task status per type of task

- Ability to action requests assigned to self
- Ability to capture or generate process events (renewal, ...) and create corresponding task

The features listed above are technology-agnostic and therefore applicable to both scenarios under consideration but will need to be implemented differently depending on the case.

It should also be noted that TRACES already supports a large number of the required features, either directly as an existing function in TRACES / webservice or indirectly as a function that is available for a similar process and could be extended to support the entitlement processes.

Where applicable, we will indicate whether a required feature already exists in a ready-to-use manner or could be implemented using a similar feature.

- Illustration: the transporter authorisation flow in a federal/regional setting

As a concrete use case for the process under study, we provide a sample instantiation of the transporter authorisation flow in an environment where the responsibilities are divided between a National and a regional Competent authority. The example is taken from the Belgian situation but applies to several federal member states contacted during the study. It can also serve as an illustration for both the “National application” scenario and the “TRACES-centric” scenario mentioned above.

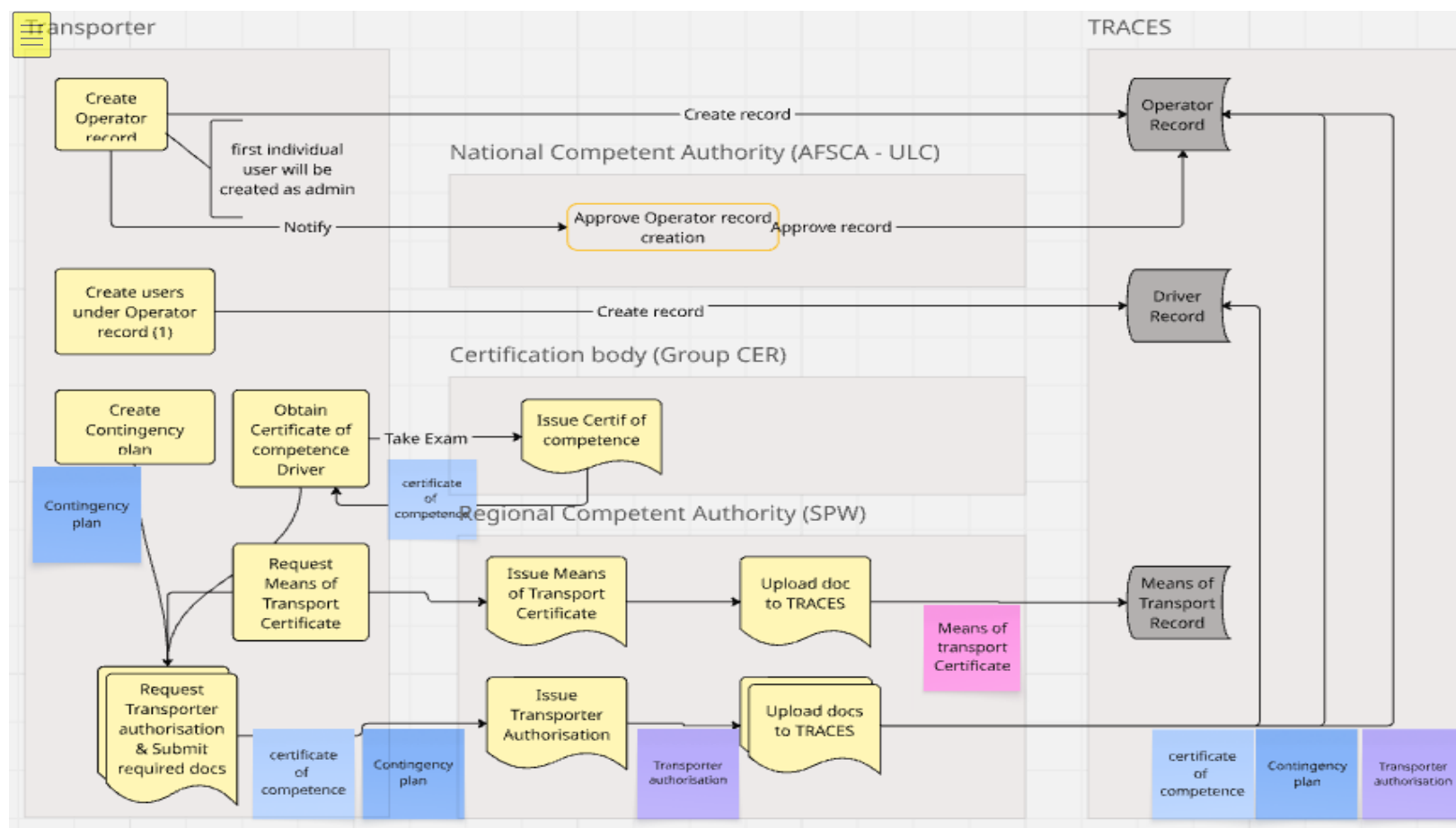
The Transporter will first need to have an Operator created in Traces and have the relevant TRACES activity(ies) assigned to it. The validation of the record creation is done by the national authority in TRACES.

 The Transporter then turns to a Certification Body to obtain a Driver certificate of competence. This implies the driver taking a course and an exam at the Certification Body’s premises and receiving a certificate.

The Transporter then reaches out to the regional authority to obtain a Means of Transport certificate. This implies an inspection of the means of transport by the authority and results in a Certificate being delivered by the authority to the Transporter, and a record being created in TRACES for that means of Transport, with an associated certificate validity status and expiry date.

Finally, the Transporter submits a request for a new Transporter authorisation from the regional authority, submitting the required documents, including the driver Certificate of Competence obtained in step two. This results in a Transporter authorisation being issued to the Transporter and recorded in TRACES by the Regional Competent authority.

The drawing below shows the interactions with the various bodies involved, the flow of documentation and the resulting updates to TRACES records.



(1) Including the driver as a user of the transporter operator is a recommendation, which is further discussed in section 5.4.1 p25

Figure 84 Authorisation flow - an example

In the next sections, we will use this sample flow to illustrate the differences between a TRACES-centric implementation and a National application implementation.

One key assumption taken is that the interaction between the Transporter and the Certification Body is taking place out-of-band and does not involve the MSCA. The Transporter contacts the Certification Delegated Body, takes the exam and receives a certificate that he/she then uses in later steps of the process with the MSCA. However, if integrating that interaction into the TRACES-Centric and National Application scenarios became necessary at some point, it would need to be implemented following the example of the means of transport certificate step.

- Integration Scenarios
 - TRACES-centric scenario

In this scenario, a MSCA chooses to use TRACES as the main business application to support its interactions with national operators to manage the entitlements process.

The templates that are intended to support the process are provided in Annex V of the proposed Regulation 2023, Sections 1 to 6. During the consultation phase, the MSCAs did not express any specific concerns or requirements about the format and the content/fields of the templates (D02.01.02 Consultation Report, 2025). The main concern for the MSCAs was that some countries have already implemented the certification process in their own workflow / national application, a requirement which led to the definition of the “National application scenario” described in **section 5.4.2 National Application scenario**

To assess the impact of the requirements on TRACES, we will analyse the following capabilities in more detail in the following sections:

- Document & Record management will be central as entitlements are essentially records that will be materialised as documents.
- Workflow management will ensure that the various flows foreseen by the Proposed Regulation (approval, suspension, renewals ...) can be implemented
- Business rules management
- Access management: the various actors will need specific access rights to implement the roles assigned to them in the various process flows.

Document & Record management

The Document and Record Management capability analysis carried out in the Task 2 Traces report (D02.01.01 TRACES Report, p. Sections 7.5 and 7.6) showed that TRACES NT supports a wide range of functionalities around records in TRACES.

The records relevant to the Entitlement process (Transporter, Driver, Means of Transport and the associated authorisations and certificates) can be managed in TRACES by the authorities with the required access rights.

It should also be noted that TRACES supports the ability to electronically seal authorisations, for MSCAs.

Means of Transport

Figure 85 Means of Transport record

Means of transport records are supported in TRACES and are linked to Transporter and Certificate records (see below), as would be expected.

One missing attribute worth noting is the Vehicle Identification Number (VIN) that will be used to match up geolocation records to a given vehicle and from there to the relevant Journey Log. It is however foreseen in the template of the Certificate of Approval of Means of Transport foreseen in the Proposed

Regulation 2023 (European Commission, 2023, pp. Annex V - Section 5).

See the Market Analysis report for details on obtaining and matching geolocation records to journey logs (D03.01 - Market Analysis Report, 2025)

Certificate of approval of Means of Transport

Certificates of approval of Means of transport records can be created in TRACES, can be associated with a specific vehicle, a Transporter and possess the attributes required to support the Entitlement process needs:

- Issuing authority
- Issue date
- Expiration date
- Status: Valid / Suspended / Deleted.

A competent authority with the appropriate rights can create/update/delete the records and can manage the status of the record as valid/suspended/deleted.

Figure 86 Certificate of approval of MoT

Transporter & Transporter authorisation

The Transporter authorisation is represented in the Transporter record as an activity record, that carries the validity (from, to) attributes, the status and the possible actions for the authority: validate, suspend, delete.

Figure 87 Transporter Authorisation

Driver

Users can be added to an operator, Transporter in our case. However, there is no way to specify that a user added to a Transporter carries the role of Driver, attendant or welfare officer. As such, there is no immediate way of assigning a specific Certificate of Competence to that user record.

Driver user records can be created in another section of the application but are used mainly to give driver users access to a weblink for the driver declaration web page.

Enhancements

One feature that is missing in the current setup is the ability to upload the actual certificate and authorisation documents to the corresponding record in a pdf format. This would be a useful enhancement if the documents are to be made available in the mobile application, for a driver to display to authorities during inspections. While strictly speaking, the certificate record in TRACES can be displayed and is the digitally valid version of the certificate, being able to store it as a pdf would allow users to print them out easily, display them or forward them as the need may arise.

A second enhancement would be the ability to generate events when a certificate nears its expiration date so that the relevant tasks can be autogenerated and assigned to TRACES users to start renewal activities.

Thirdly, it will be needed to further expand the ability to assign individual users to an operator with a given role, including drivers, so that the required certificates can be assigned to their records and made available in the mobile application.

The same enhancements could be foreseen for users accessing TRACES through their own national application, the “National application” scenario, see *section 5.4.2*.

Workflow management

Task concepts

In the illustration below, we present a view of what a user task list could look like in TRACES for the authorisation process. The task list is meant here as an illustration for the discussion of features that follows, not as a realistic screen design of the to-be solution.

Task List

Search		Transports*							
Process	Task Id	Task Type	Associated party	Created on	Target date	Created by	AssignedTo	Status	Available actions
Authorisation	1	Transporter authorisation Renewal	Transports ABC	10-10-25	13-10-25	System		New	Claim
Authorisation	2	Transporter authorisation Request	Transports ABC	15-10-25	18-10-25	Operator	Me	Assigned	Start, Requeue
Authorisation	3	Driver Competence Certificate Request	Transports ABC	14-10-25	24-10-25	Operator	Me	In Progress	Approve, Reject, Pause, Cancel
Authorisation	4	Transporter authorisation Review	Transports XYZ	14-10-25	17-10-25	MSCA	Me	In Progress	Suspend, Withdraw, Cancel
Authorisation	5	Transporter authorisation Request	Transports DEF	15-10-25	18-10-25	Operator	Requestor	Rejected	--
Authorisation	6	Transporter authorisation Request	Transports GHI	15-10-25	18-10-25	Operator	--	Completed	Reopen
Authorisation	7	Transporter authorisation Cross Check Request	Transports GHI	12-10-25	13-10-25	MSCA FR	--	New	Claim

Filter Requests based on the process :
Authorisation vs AIL

Associated party : entity about which the req was created. Does not have to be the requester

Request creator.

- System : reqs can be automatically created based on certain events
- MSCA FR : reqs can be exchanged between MSCAs

Status : defined by the lifecycle of a request.

Available actions : what a user can do with the task. The action will trigger a change of Status. Which actions are available depends on the Current task status AND on the task Type

Figure 88 Task List

Task

With the Proposed regulation 2023, a TRACES user will be confronted with a number of new process tasks that relate to the documents that need to be processed. The concept of task is a key mechanism that will trigger the interaction between the various actors as one task will travel from one actor to the other as defined in each (sub) process.

Task type

A second important element is that the system will need to support different types of tasks: in the example above, we list sample tasks that are

- Requests from operators to obtain an authorisation
- System-generated tasks that are triggered when an event occurs (authorisation up for renewal)
- Transporter authorisation review, generated by a MSCA that wants to start an investigation that can result in suspending or withdrawing an authorisation
- MSCA to MSCA communication task

Other types of tasks can be defined as needed but the critical element is that the task type can have its own lifecycle and actions.

Task lifecycle

The task lifecycle determines the various states in which a task can find itself as a result of user actions. This is typically represented by the task's status. A task can move from the state "new" to the state "in progress" because of an action from the user picking up the task and assigning it to him/herself.

Task actions

The task actions are actions that a user can perform on a given task that will trigger a change of state for the task. The actions available to a user are determined by his/her roles and by the type of task. The latter is clear from the illustration above: a request for authorisation from an Operator will have actions associated with it such as "approve" and "reject" while an authorisation review task will have actions such as "suspend" or "withdraw" for instance.

From a Document-oriented to a Task-oriented workflow

As detailed in the TRACES Report (D02.01.01 TRACES Report, pp. pp80-82), the TRACES solution already supports a number of functions such as lifecycle and actions around certificate documents.

A first option would be to extend those functions to new documents, such as Certificates and Authorisations, to allow them to support lifecycle / status changes and basic lifecycle management. This would come with a certain number of limitations however, and not all functionalities described above would be available as the lifecycle management features are tightly coupled to a given document.

A second option would be to evolve TRACES to a task-based approach, as the proposed Regulation introduces use cases that will require a more fine-grained mechanism for work assignment and user interaction. A task may be associated with several documents while conversely a single document will require several types of tasks to be processed.

While the features can be implemented as an extension of the current workflow capabilities of TRACES, the contractor recommends adding a full-blown workflow management / engine to the TRACES roadmap.

Most modern workflow solutions implement the BPMN standard (Object Management Group (OMG), 2014). BPMN stands for Business Process Model & Notation and is the de facto standard for process management software solutions. It offers the following benefits that would make a lot of sense in the TRACES context.

- Business process logic is visible to everyone as human-readable BPMN flows instead of embedded in application code, which greatly facilitates communication between business and development teams
- BPMN workflow engines include decision/rule-based capabilities out of the box, using the DMN standard. Decision tables can be added as a step in a BPMN process, enabling a graphical representation of business rules applied within the process logic
- Workflows can be used to provide webservice orchestration such as the sequences of webservice calls illustrated in the two sequence diagrams presented in section 5.4.2. Orchestration can also be extended to human tasks, allowing workflows to combine automation through web services with human validation tasks. This brings tremendous flexibility to processes as a level of automation can gradually be brought into a manual process.
- Most BPMN solutions available on the market can be implemented in various types of architectures (monolith, modular, micro-services, Software as a Service), limiting the impact on legacy applications.
- Vendor supported solutions often provide out of the box components for Process dashboarding and analytics.
- It should also be noted that BPMN based workflow engines are a very mature technology, and solutions offer a large choice between vendor-supported & open-source solutions.

Business rules management

Contrary to the Journey management, the business rules capability requirements will be rather light weight in the entitlement process. The Proposed Regulation does specify a number of business rules that will govern the creation, suspension, cancellation or renewal of the entitlements, such as

- durations (authorisations are valid for 5 years, the renewal process should kick in one month before expiry, a cancellation should occur three months after the suspension of an authorisation if no remediation has been taken, etc ...)
- presence of specific documents in the request for authorisation

Such business rules are easily implemented in a process engine as described in the previous section and should not present any specific difficulty.

Access management

The current implementation of access management in TRACES has been studied in the Task TRACES report. Insights gathered in that section apply to the Entitlement process as well.

One specific point raised in that report is particularly relevant to the entitlement process. Roles (“Activities”) are assigned at the level of an operator, not individual contributors. This could become a problem in terms of managing employee records and uploading individual certificates of competence as there is currently no way to distinguish roles between users assigned to a single operator.

Summary

The analysis of the TRACES-centric scenario did not reveal any major risks or issues for an implementation in TRACES:

- Those MSCAs that do not have a national application/workflow to support the entitlement process welcomed the idea of using TRACES to streamline operations. The templates proposed by the Commission did not raise concerns or specific requests.
- The main records and mechanisms that are needed to support the process in TRACES are already present in the application.
- The contractor further recommended enhancements to the features around 4 business capabilities :
 - Document & Record management: enhancements are recommended that will allow to access certificates as pdfs, generate events (expiration date nearing...) and role-based checks.
 - Workflow management: we recommended the implementation of a workflow engine in TRACES to support a Task-oriented workflow for increased flexibility
 - Business rules management: the business rules at play in the entitlement process are not complicated and can be implemented either in the TRACES code, or directly in the workflows if a Task-oriented workflow is implemented.
 - Access management: enhancements will be needed to allow TRACES to link certificates to individual user records based on their role, for further use in the downstream journey log process (approvals of journeys, inspections, etc).
- National Application scenario

The second integration scenario, the National Application scenario, entails that MSCAs interact with their national operators through a national application. This means that:

- The Entitlement workflow process is managed in the national application; it is up to the national application to maintain the state of the process flow. In other words, the process engine is on the member state side.
- The TRACES database is the source of truth for records entitlements, meaning that a National Application will need to query the TRACES database to check that the

same applicant has not already applied unsuccessfully somewhere else, before it allows the creation of the entitlement in its own database.

- Once this is verified, the National Application processes the application, which results in an approval or rejection. The outcome, positive or negative, of the process is pushed to TRACES through webservices, ready to be consulted by other MSCAs for future application requests, or other use cases.

Overview of TRACES webservices

See Traces Report for technical assessment of service-oriented architecture (D02.01.01 TRACES Report, p. 6.1 Interoperability assessment)

Webservice	Sample Methods	Status
Reference Data WS V1	• getClassificationSections (incl a list of operator activity types linked to the sections)	Use as is
Operator Directory WS V1	• findOperator, • getOperator, getOperatorByActivity, • addAddress, update...etc • createOperator, deleteOperator, ... • addOperatorActivity, deleteOperatorActivity, validateOperatorActivity, suspendOperatorActivity	Use as is
CHED WS V01	• createDraft, createAndSubmitForDecision, • validate CreateAndSubmitDecisionAsInProgress, • delete, cancel	Create new based on the logic used
Certificate Attachment WS	• submitCertificateAttachmentRequest	Use as is

Directory web services

TRACES NT already provides a set of fully functional directory services, among which the operator directory services. Most features described above around the management of operators and activities are already supported. The sequence diagram below presents a simplified view of how existing webservice methods could be reused (green arrows) , and complemented by other methods to be created (red arrows).

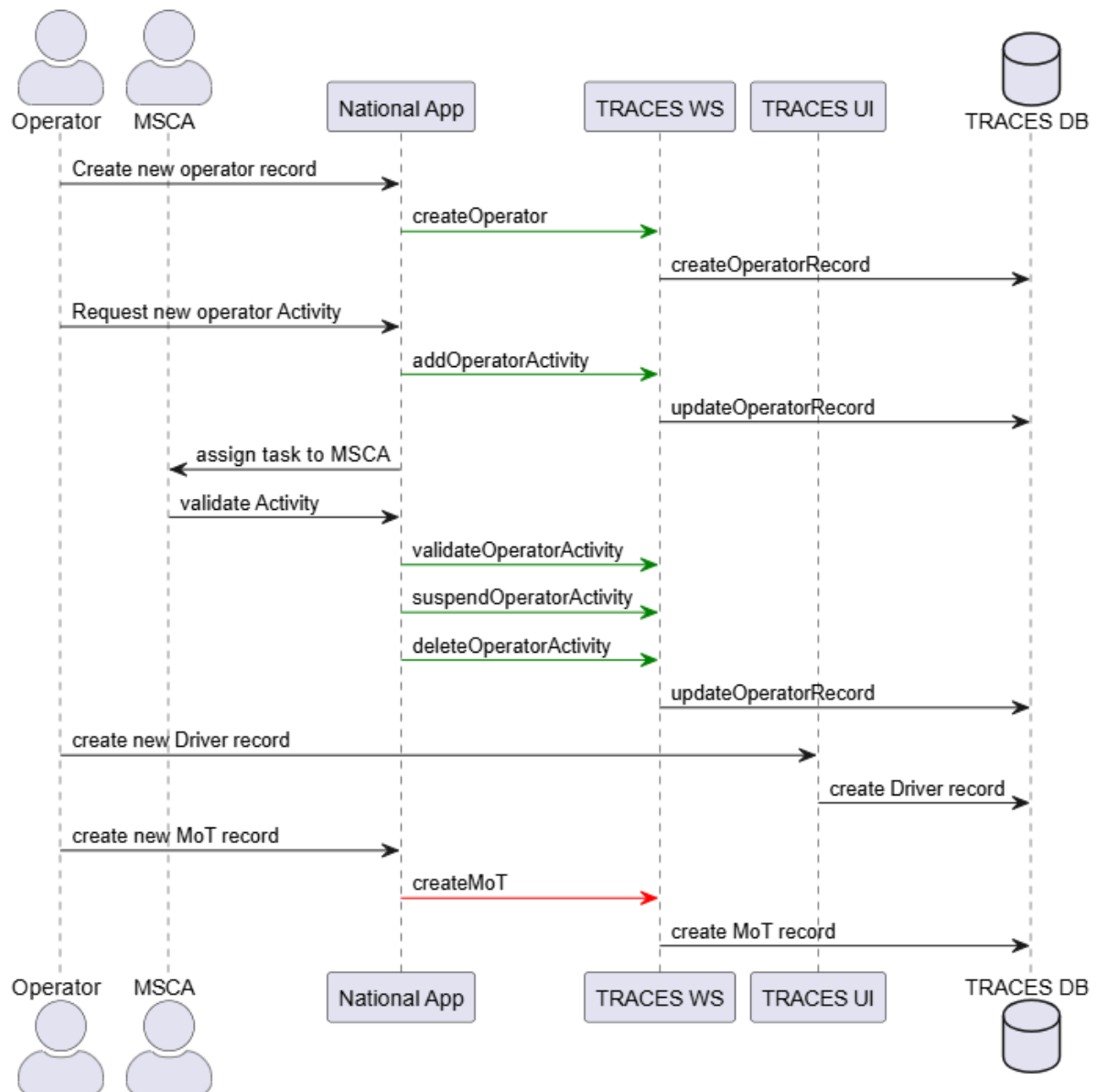


Figure 89 Sequence diagram - record creation

SPS Certificates vs Entitlement Authorisation/Certificate

The various Certificate webservices implemented in TRACES NT follow the UN/CEFACT standard (Trade Facilitation and E-business(UN/CEFACT), s.d.). As mentioned earlier in the document, the “Certificates” that TRACES NT Web Services support are certificates in the sanitary sense of the word, like INTRA-EU health certificates etc. They do not cover the other types of certificates that are relevant for the present study, namely the Driver Competence Certificate or the Means of Transport Certificate.

On the other hand, two elements must be noted that should facilitate the implementation of new web services to support the submission and lifecycle management of the Authorisations and Certificates exchanged in the entitlement process:

- The current webservices already support the management of a certificate (in the sanitary sense) lifecycle. This logic would also apply to an authorisation / certificate in the entitlement process (submit, approve, ...)
- The UN/CEFACT standard also defines objects that are similar to the concepts of authorisation and certificate in the entitlement process (“Government registration”, “Government accreditation”, “Transport agent”, etc.). This should make it possible to extend the current set of TRACES NT Webservices while staying within the scope of the UN/CEFACT standard.

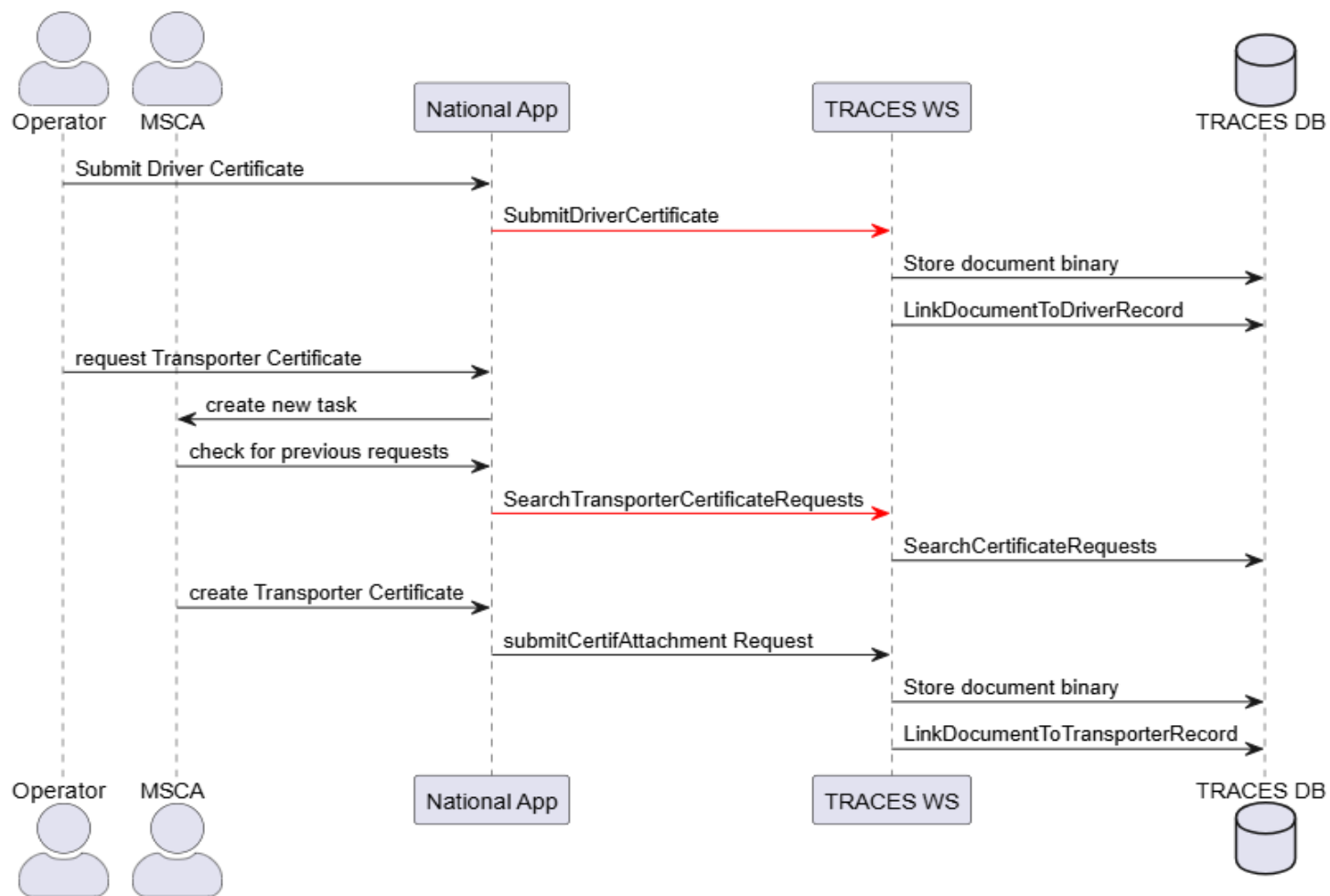


Figure 90- Sequence diagram - Certificates & Authorisations

Takeaway

The analysis of the TRACES NT Webservices shows that it should be possible to leverage the existing Operator Directory services to check for entity existence, apply updates etc. (first sequence diagram).

On the other hand, the current set of certificate services could be extended by leveraging the logic implemented in the certificate services (for instance the CHED WS V1.0) and port it to a new set of UN/CEFACT objects that will represent the certificates and authorisations required by the entitlement process.

- Implementing both scenarios

If TRACES NT is to support simultaneously the two scenarios required by MSCAs for the entitlement process, it will have to manage a certain level of asymmetry:

In the “TRACES-centric” scenario, the process engine within TRACES NT is in charge of handling the process instances, maintaining state, raising and catching events, storing data ...

In the “National application” scenario, the business logic of the process state is handled by the national application which then calls webservices to synchronise the output of the process with TRACES.

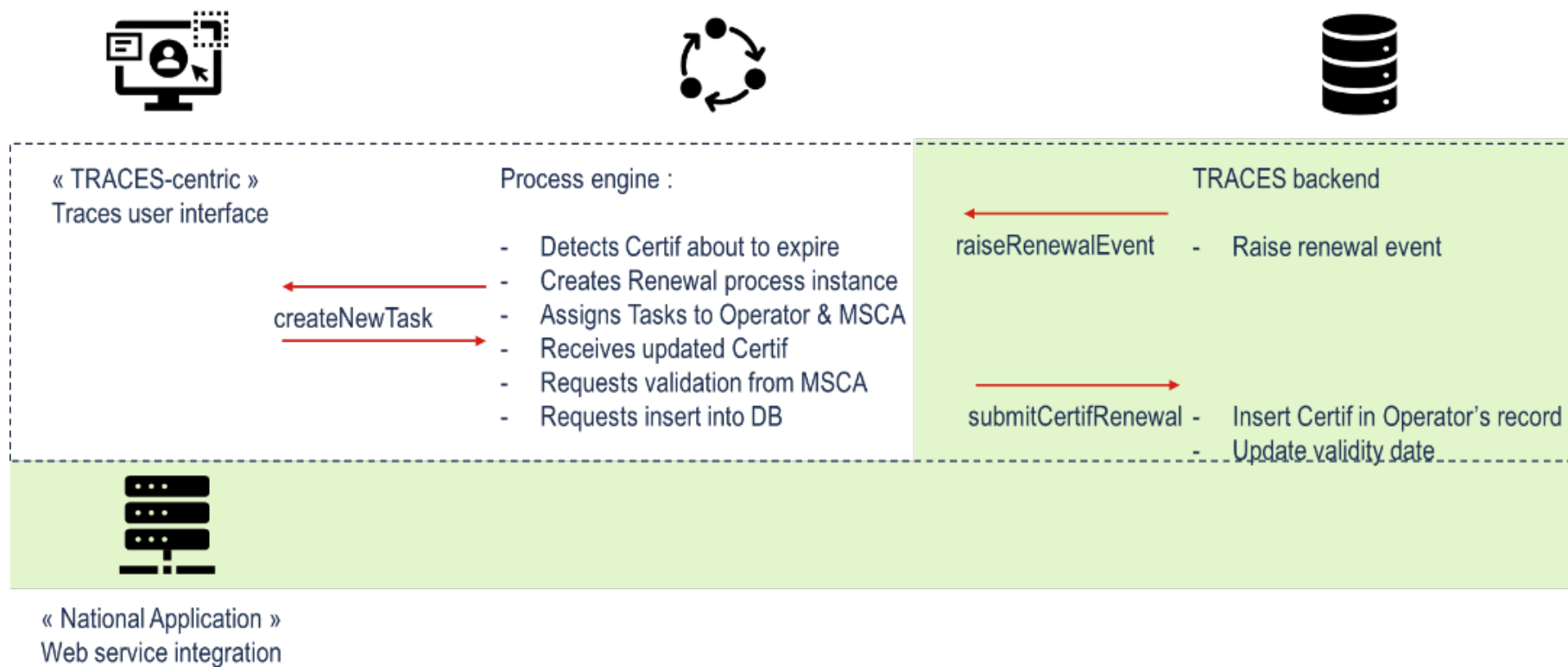


Figure 91 Integration styles

It is rather common for large applications to support simultaneously two channels to interact with its functionality: a user-to-system interface (through a graphical interface as in the TRACES centric scenario) and a system-to-system interface (usually through web services, as in the national application scenario).

This means that a common API will be shared by both the user-to-system and system to system interfaces

In the example provided above, both consumers share a common API that allows them to submit a Certificate for Renewal for instance when an event is generated that signals the upcoming end of validity of an active certificate. The Backend will implement validation logic (for instance to ensure that a suspended certificate cannot be renewed)

However, the business logic that governs the various steps to be taken, approvals to be received etc ... to obtain a renewal is best implemented in the TRACES process engine for the TRACES centric / user-to-system scenario and in the national application for the National application / system-to-system scenario.

In other words, the responsibility to enforce a given business process for renewals shifts from TRACES NT to the national application in the National application scenario.

- Journey Management

The journey management capability covers all activities required to carry out the actual transport activities.

Within the larger context of our study, the capability

- Supports the core phases of the AWT value chain; “Plan transport”, “Submit and get Approvals”, “Deliver transport” and “Inspect”
- Focuses on the AJL process
- Relies on supporting capabilities Case, Record & Document management, Workflow management, Business rules management, Compliance management and Access Management.
- Impacts both the Desktop Application and the to-be created mobile application.

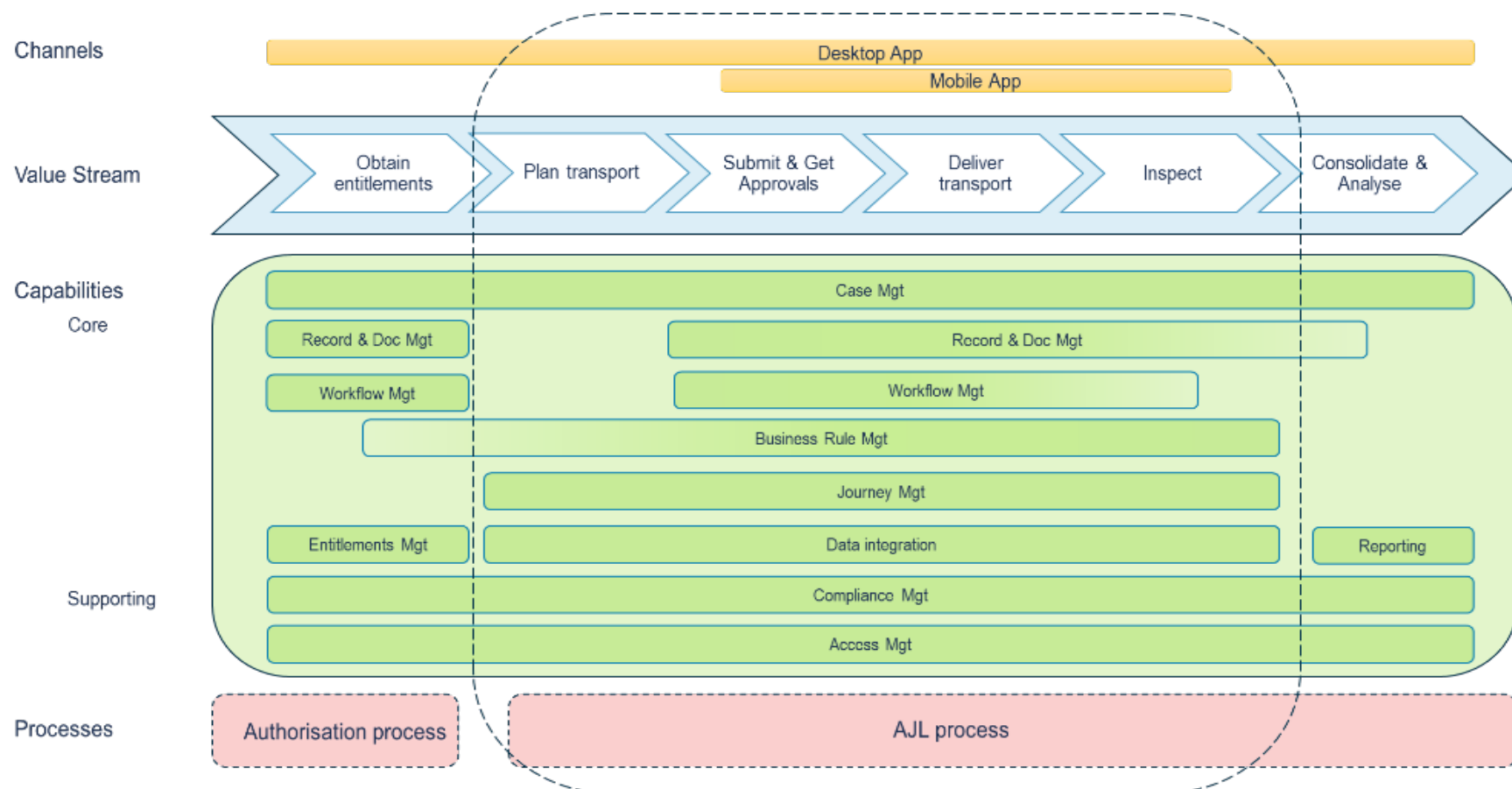


Figure 92 Journey Management within the AWT Value Stream

In the following sections, we will be defining recommendations for the preparation of a roadmap towards a truly end-to-end digital animal journey log in TRACES. We will be following the logical sequence of a journey, from the planning to the closing phase, reviewing the required features in that order and proposing recommendations.

- Planning the AJL

As discussed in D02.01.01 TRACES Report, the current implementation of TRACES includes a module that allows for the creation of a route, with the ability to define start, intermediary and end points and to calculate overall journey duration.

However, the Proposed Regulation introduces a whole new array of travel time calculations and associated rules and requirements, which will require enhancements to the current TRACES module.

- The planning steps

We refer the reader to the report (D02.01.01 TRACES Report) for a discussion of the journey process but we propose here a more technical view on the planning phase of the AJL process as it shows the level of integration and automation that is being proposed in the following sections.

The creation phase shows the steps taken to create a brand new AJL, either as a copy of a previous log or as a creation from scratch, with the possibility to select a predefined itinerary.

The configuration phase brings a host of new features to the AJL, where journey segment durations, temperature forecasts and compliance calculations/checks are automated wherever possible.

The approval phase introduces a formal approval step for the AJL itself, which allows for baselining of the log that will serve as a reference for future analysis.

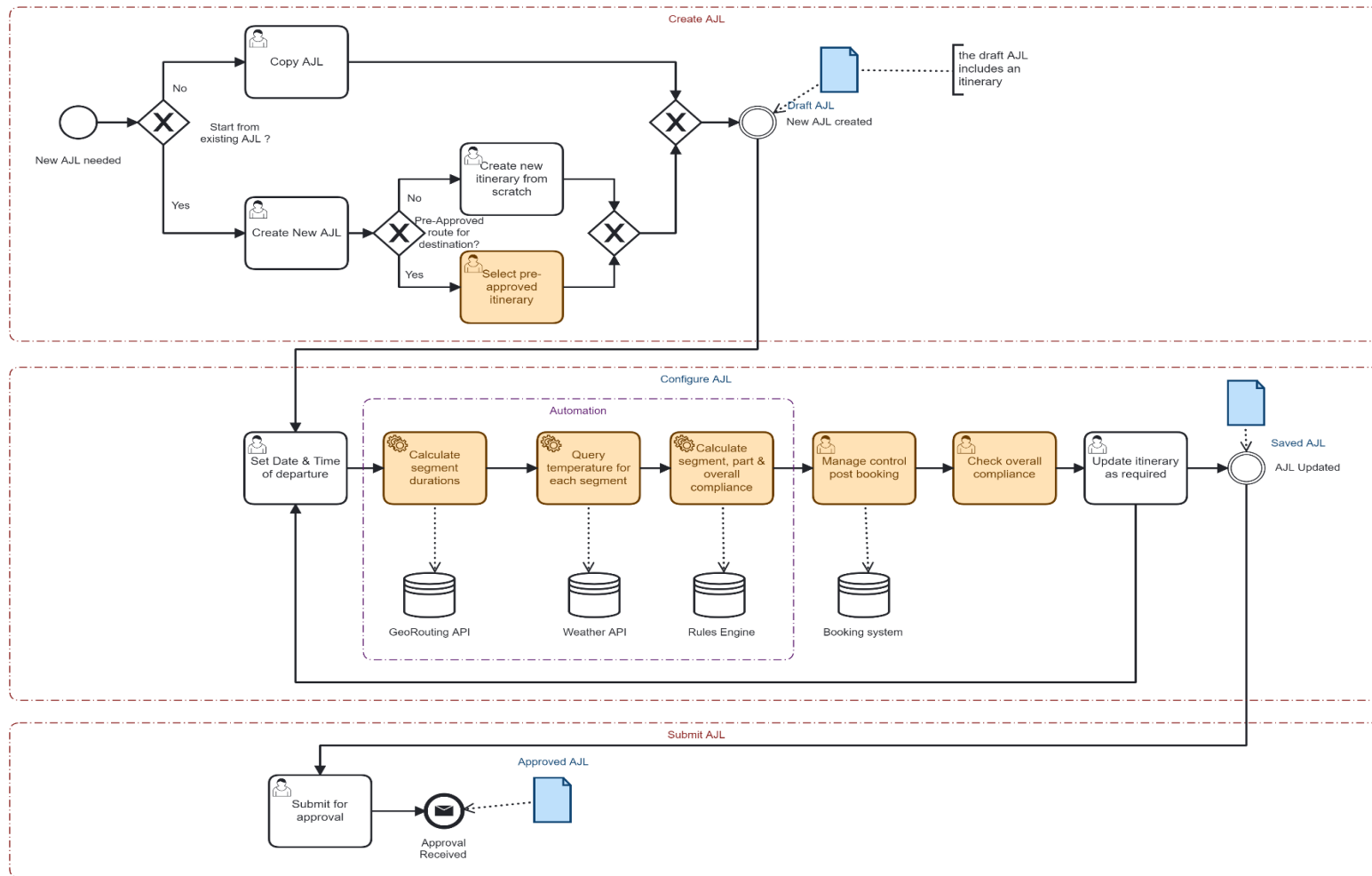


Figure 93 AJL Submission phase - process view

- Creating the Journey Log

The AJL could be created in one of two ways;

- Choosing a destination and selecting a pre-approved route for that destination, following the best practice from Member States identified during the consultation. See (D02.01.01 TRACES Report, p. 66). The pre-approved route should be seen as a predefined list of segments to reach the selected destination.
- Creating a route from scratch by adding the desired Place of Departure, Place of Destination and any number of intermediary locations.

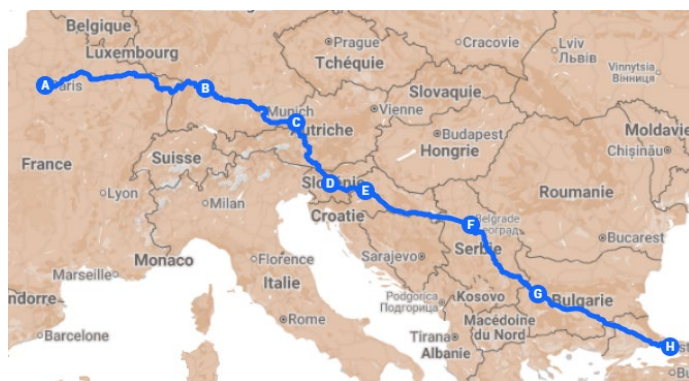


Figure 94 Long Journey - Sample itinerary with Segments

The journey log first needs to break down the two parts of the Journey, to ensure a 24 hour stop gets included between the two parts. In our example, Part 1 starts at the Place of Departure Paris and ends at a fictional Control Post in Ljubljana. Part 2 covers the rest of the journey until the Place of Destination in Istanbul.

In the first Part of the journey, we only create two segments, representing the fact that a journey Leg within a journey Part can last for maximum 10 hours before a one-hour stop is observed. The second segment represents a 10hour route that ends at the control post with a rest of 24 hours. In the second Part however, we chose to define 4 segments to provide additional detail. The journey log could therefore contain as many segments within a journey part as needed, provided the segments are consecutive, i.e. the start location of one segment is the end location of the preceding segment.

In order to facilitate data entry, it is suggested that

- 1) Wherever possible, a pre-approved route is selected, auto filling predefined journey parts/segments

- 2) the user enters the following pieces of information (blue fields):
 - Date and time of departure
 - Planned rest time at Control Post
- 3) For each segment:
 - a. TRACES calculates each segment's journey time using an external geo-routing service / API. (purple fields)
 - b. TRACES calculates the arrival time for the segment by adding the journey time to the segment's Start date/time.
 - c. TRACES uses the calculated segment duration to determine the start date/time of the next segment
- 4) TRACES calculates the overall journey time and journey duration fields

Planned AJL							
Part	Segment	Place of Dep	Place of Dest	Start at	Journey time (hrs)	Arrive at	Rest time (hrs)
Part 1	1	Paris	Stuttgart	02-09-25 08:00	10	02-09-25 18:00	
Part 1	2	Stuttgart	Ljubljana	02-09-25 18:00	10	03-09-25 04:00	24
Part 2	3	Ljubljana	Zagreb	04-09-25 04:00	5	04-09-25 09:00	
Part 2	4	Zagreb	Belgrade	04-09-25 09:00	8	04-09-25 17:00	
Part 2	5	Belgrade	Sofia	04-09-25 17:00	3	04-09-25 20:00	
Part 2	6	Sofia	Istanbul	04-09-25 20:00	3	04-09-25 23:00	
				Journey time =	39	hours	
				Journey duration =	63:00	hours	

Figure 95 Long Journey - User entered vs system calculated data

▪ Integrating Geo-routing data

TRACES already uses the OpenStreetMap API for limited geo-routing calculations as described in the Task 2 TRACES report (D02.01.01 TRACES Report, p. Section 7.11.4). Georouting allows to calculate the duration of an itinerary by providing date and time of departure and destination.

We are proposing to extend this mechanism in order to facilitate data entry by the organiser: instead of manually entering the date and time of arrival at the various points of the journey defined in Section I – Planning, the organiser would define time and date of departure and TRACES would obtain the durations of the various journey segments from the geo-routing API as described in the example above.

On top of reducing data entry by the organiser, importing durations of the various journey segments from a georouting API would also standardise the way journey durations are calculated across all AJLs, making assessment of the AJL easier for MSCAs.

Implementing geo-routing for the creation of a planned journey as described above would require the following functionalities in the selected geo-routing API:

- ability to set departure date/time in the future
- ability to calculate real durations based on traffic, using the departure date/time provided with the segment.
- ability to choose the transport type (truck) for more precise duration calculations
- ability to calculate durations by segment.
- Note that TRACES will need to add the 24h rest time to the calculated journey time if applicable

There are several well-established geo-routing APIs on the market, some open source like OpenStreetMap and others commercial like Google Maps.

For instance, the Google Maps API;

- does not support vehicle type = truck and
- does not allow to calculate a route duration that would include rest times at intermediary waypoints. Stopovers can be defined, but no specific duration can be assigned to them. This means that the journey duration will have to be calculated segment by segment as proposed in the algorithm described above.

On the other hand, the OpenStreetMap API does not allow to take the actual departure time and real traffic conditions into consideration.

- Integrating Weather forecast data

Summary of requirements

Key assumptions of the proposed regulation

The legislative revision foresees that:

When planning the journey, the organiser takes account of the weather forecast ONLY for designated points on the journey, at the time the animals are expected to be at those places,

- Member States competent authorities will assess the journey log also based on the weather forecast at designated points on the journey. For this purpose, Member States competent authorities will provide to the COM the temperature forecast body that shall be used as a point of reference by TRACES.
- Temperature readings to be collected are the forecasted temperatures valid for the date and time the transporter is expected to be at the designated point(s).

Additional input from stakeholders

During the consultation phase of the present study, MSCAs provided detailed input as to their needs around temperature data collection, to be able to more easily verify if a submitted AJL complies with temperature requirements.

The requirements around weather forecast data expressed by the MSCAs can be summarized as follows:

- A need for clear visualisation of temperature forecasts along the proposed route.
- A need to obtain specific temperature forecasts for route waypoints in addition to the places defined by the Proposed Regulation.
- A need to be able to baseline the temperature information along with other planned AJL data when the log is submitted, to allow for future comparison with actual data.
- A need for some Member States to complement the weather forecast data they obtain from the European Centre for Medium Range Weather Forecast ¹² service (<https://www.ecmwf.int/en/about>, s.d.), with forecast data specific for alpine countries.
- A need for a single source of truth on forecast data across Europe to avoid discussions between MSCAs and transporters on discrepancies between forecasts provided by various weather services.

Challenges

Multiple sources for weather forecast

The proposed Regulation foresees that each MSCA will provide to the Commission the weather forecast service they want to use for the assessment of temperatures.

From a technical perspective, this solution is problematic as it would entail that TRACES would have to connect to potentially many different weather forecast interfaces, depending on the country where the AJL is being submitted.

This means concretely that for each interface requested by a MSCA, TRACES would have to:

1 – create a specific connector for the service tailored to the protocol used by the service in question (Rest, Soap, ...), the methods supported by that specific service, the data model and schema validation rules defined.

¹² ECMWF is both a research institute and a 24/7 operational service, producing and disseminating numerical weather predictions to its Member States. Some MSCAs use the ECMWF service as a source of weather forecast data for AJL validation.

2 – ensure that the data received from the specific service is translated back to a single schema, that is understood by the Animal Journey Log component, for display of the temperatures.

This would also greatly impact TRACES maintenance as a change in a remote service will very likely imply a change in the corresponding TRACES connector. Multiplying the interfaces would inevitably increase the load on TRACES maintenance teams and the risks associated with connector updates being rolled out in production.

We do not recommend that approach and advise to select one single source of data for that functionality.

Data granularity

The Proposed Regulation foresees that Temperature forecast must be obtained for the place of Departure, Place of Destination, and where applicable, the Control Post and exit point/Border Control post. It should be noted that this granularity may not always be sufficient to achieve the intended objective.

In the fictive Animal Journey illustrated below, the forecasted maximum temperature at the three designated points (Place of Departure, Control Post and Place of Destination), is always below 30C, ***at the time the transporter is expected to be at those places***. However, significant segments of the journey take place in conditions exceeding 30C. These could go undetected on longer journeys if temperature readings are only obtained for the designated journey points defined by the Regulation.

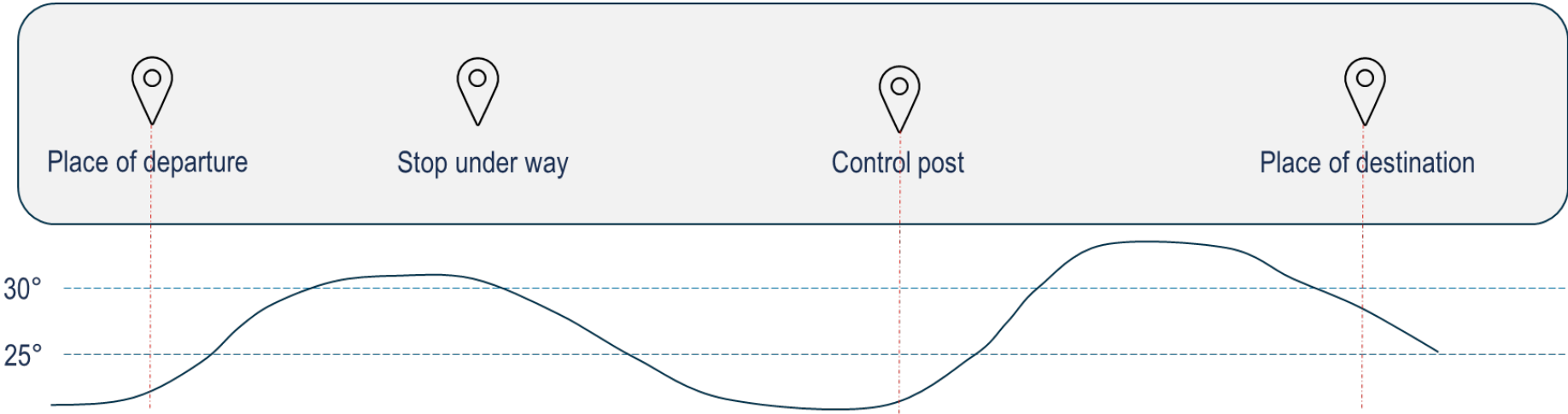


Figure 96 Data granularity on Temperature forecasts

Dynamic character of forecast and itinerary

Another challenge is the dynamic nature of both the forecast and the journey: temperature readings must be taken for the key locations of the journey at the creation of the journey by the organiser, and again when the MSCA assesses the AJL. The readings, however, must be taken for the date / time the transport will reach a given key location.

The challenges listed are addressed with the following recommendations.

Recommendations

Data structures and visualisation

A first option to visualise forecasted temperature on a planned journey is to use heat maps of the area to be crossed by the proposed transport.



Figure 97 Heat map

The proposed itinerary could be superposed to the heat map for improved readability. While this option is visually appealing, it does not meet the requirement to see the temperature at the moment the transporter will reach a designated location.

A second option is to use coloured itinerary segments:



Figure Segment map

This is a preferred option because:

- It allows to see the segments that will be non-compliant **at the time the transport will reach those** versus a heat map which shows the entire trip at a given point in time.
- Stops at a control post or sea crossings on RO/RO vessels could be added as separate segments where T° readings are not applicable.

Weather forecast APIs typically provide forecasted temperatures based on coordinates and a timestamp. Temperature for a segment between two way-points could be taken as the temperature forecasted at the time the transport is expected to leave the starting point. The more intermediary way points are added, the more granularity and precision will be obtained.

In the table below, we present sample segments applied to the fictitious journey from Paris to Istanbul displayed above. For each segment, the following steps are applied in order:

1. the start date/time of the segment is derived from the overall journey duration calculated earlier.
2. A forecasted temperature is then obtained for each point, at the date/time the transport is expected to be at that point.
3. A compliant / not compliant value is determined, and a specific colour can then be applied to the entire segment.

Place of Dep	Place of Dest	Start at	Journey time (hrs)	Arrive at	Rest time (hrs)	Forecasted T°	Colour code
Paris	Stuttgart	02-09-25 08:00	10	02-09-25 18:00		18°	green
Stuttgart	Ljubljana	02-09-25 18:00	10	03-09-25 04:00	24	23°	green
Ljubljana	Zagreb	04-09-25 04:00	5	04-09-25 09:00		27°	orange
Zagreb	Belgrade	04-09-25 09:00	8	04-09-25 17:00		29°	orange
Belgrade	Sofia	04-09-25 17:00	3	04-09-25 20:00		28°	orange
Sofia	Istanbul	04-09-25 20:00	3	04-09-25 23:00		24°	green
Journey time =			39	hours			
Journey duration =			63:00	hours			

Re-calculations:

If changes are brought to the AJL during planning, the system needs to recalculate segment durations and start times and then re-query the weather API for the temperature at the waypoints for the new date/time.

The same applies if a segment is added to the journey. For instance, a segment could be added to the journey representing a control post stop, postponing arrival date/time at the subsequent segments by 24 hours and leading to a recalculation of the forecasted temperature at those subsequent segments.

Additional waypoints on pre-approved routes

Following the best practice from some Member States of selecting one of several pre-approved routes for a given destination, we recommend including the ability to have additional waypoints added in advance to the pre-approved routes. Once a given route is selected by the user, TRACES automatically queries the weather API for all the included waypoints. This would allow the user to have a better granularity on the journey temperatures without having to manually encode too many additional way points on the journey log.

Thing to note:

The openWeather API for instance provides in a single answer 96 hourly temperature values (Hourly forecast for the next 4 days) for a given set of coordinates. This could be used to cache the data and avoid re-queries if a recalculation of the itinerary is needed.

On the other hand, the API requires a separate call for each location/set of coordinates, which could prove costly if users start to define a lot of waypoints on a single AJL.

Sample API request response

Obtaining temperature data is in itself rather straightforward : a sample request/response to the forecast API of openWeather is provided at the link

<https://docs.openweather.co.uk/api/hourly-forecast#limit> for illustration purposes

A call to the service below returns readings for the provided latitude and longitude for the next 96 hours (4 days):

<https://pro.openweathermap.org/data/2.5/forecast/hourly?lat={lat}&lon={lon}&appid={API key}>

API Assessment

Many opensource and commercial services are available. We carried out an assessment of four major APIs as an illustration of how the criteria / requirements listed above can be checked against market offerings.

Evaluation criteria	Weight	Range	OpenWeatherAPI Weighted	ECMW API Weighted	Meteo Blue API Weighted	Google Weather API Weighted	Notes				
Sovereign	3	0 or 1	1	3	1	3	0	0	Offered by a EU company / institution		
Public/Private	2	0 or 1	0	0	1	2	0	0	0	Public institutions are preferred as more stable	
Pricing	1	0 or 1	0	0	1	1	0	0	0	Custom pricing for enterprise level, to be requested by DG SANTE.	
Functional										We only indicate if commercial(0) or free to use (1)	
Hourly forecast for next 4 days	1	1 to 2	1	1	1	1	2	2	2	2	Ability to request hourly forecasts for 4 or more days (<=4days => 1, >4 days => 2)
Lat/long as input	0,5	0 or 1	1	0,5	1	0,5	1	0,5	1	0,5	Available by default in all APIs
Geocoding	0,5	0 or 1	0	0	0	0	0	0	1	0,5	Ability to request T° by submitting location name directly
Multi point request	0,5	0 or 1	0	0	0	0	0	0	0	0	Ability to request T° for several locations in a single API call
Elevation	0,5	0 or 1	0	0	0	0	1	0,5	0	0	Ability to specify an altitude for a given location => increase precision in Alpine countries
Technical											
Protocol	1	1 to 2	2	2	1	1	2	2	2	2	ECMW API is Python library , not used by TRACES today
Total	10			6,5	8,5		8		5		

Figure 98 Weather API Assessment

Meteo Blue : <https://content.meteoblue.com/fr/solutions-commerciales/api-meteo>

OpenWeather : https://openweathermap.org/api/one-call-3?collection=one_call_api_3.0

Google Weather : <https://developers.google.com/maps/documentation/weather/hourly-forecast?hl=fr7>

ECMWF : <https://www.ecmwf.int/en/forecasts/accessing-forecasts>

- Integrating Control Post Booking data

Summary of features

A booking system is a platform that allows transporters and drivers to reserve the required control posts during their journey. It may function as an integral module within TRACES or as a standalone system, but in either case, it should remain fully integrated with TRACES. Integration should allow authorised organisers and transporters to access control post availability, make bookings, manage waiting lists, attach booking confirmations, and cancel. All booking data—including confirmations, waiting list updates, cancellations, must be automatically linked to the corresponding AJL segments, ensuring accurate journey records.

The following functional requirements were identified in the consultation phase of the project: see (D02.01.01 TRACES Report) and (D02.01.02 Consultation Report, 2025) for additional details.

User access and security- Only authorised organisers and transporters should be able to view, book, attach, and cancel Control Post bookings. It should be a secure login via TRACES desktop or mobile.

Control Post Search & Availability- The booking system should allow Transporters and Organisers to search for control posts using a range of filters such as radius/location, type of animal, species, capacity, food availability, duration of stay, resources, and dates. This functionality helps them for suitable options that meet their journey and compliance needs. In addition, the system must display the real-time availability status of control posts, indicating whether they are available, full, or have a waiting list.

Booking Process- The booking system should enable users to reserve space in selected control posts after applying relevant filters, making it possible to secure rest stops as part of the overall journey planning process. To finalise a booking, users must complete key details such as origin, destination, animal type or species, number of animals, specific resources needed, and planned arrival and departure times. All this information can be extracted from the journey log directly, avoiding duplication of data entry.

Once the booking request is submitted, the system must generate either a booking confirmation or a waiting list notification, which is shared with both the organiser or transporter and the control post. To ensure efficiency and transparency, notifications should be sent automatically whenever a booking is confirmed, rejected, or placed on a waiting list, keeping all stakeholders updated in real time.

Attaching booking confirmation- The booking system should enable users to upload a digital booking confirmation, such as a PDF, JSON file, to the Animal Journey Log, serving as regulatory proof that rest stop arrangements have been properly planned.

Cancellation of booking- The booking system should allow authorised users to cancel confirmed bookings via TRACES, providing the flexibility needed to adapt to changes in journey planning, such as weather disruptions, traffic delays, or animal welfare considerations. The system should display the “Cancel” button only after a booking has been successfully confirmed. Upon cancellation, automatic notifications must be sent to the control post, drivers, and organisers. Cancellations should only be permitted before the scheduled arrival time, for example 30 minutes prior, unless manually overridden to accommodate exceptional circumstances. Additionally, there should be possibility of manual cancellation as well like phone or email in case the system is unavailable.

Notifications & Communication- The booking system must ensure that notifications are delivered in real time or within defined time limits

Illustration

In the adjacent figure, a journey organiser views the various Control Posts that are situated in a given radius around a proposed stop in the journey. The user can click on a Control Post and view availability and could possibly proceed to booking the CP from there.

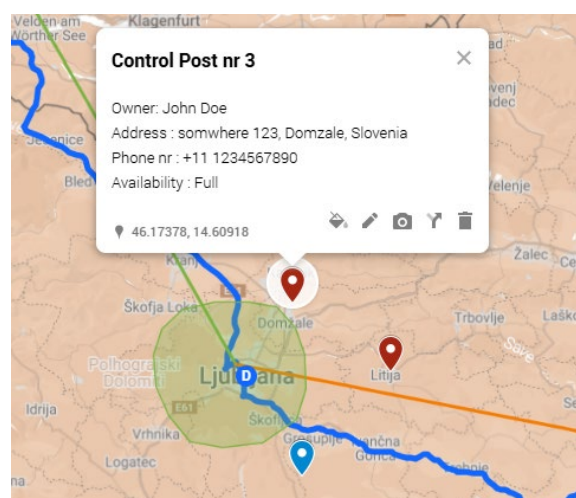


Figure 998 Viewing Control Post availability along the route

Additional requirements can be derived from the above:

- Multi-tenant: each control post owner manages the configuration and bookings of his/her own Control Post(s). This means that the booking solution is designed in such a way that each Control Post administrator has exclusive access to his/her own environment where they can customise the attributes of their own Control Post and manage booking requests.
- Access control: a Control Post owner has admin rights to his own tenant but no access to other Control Posts
- Multi-attribute booking: some Control Posts have a limited number of slots for specific requirements (calves, feeding system, etc...). The booking system should support configurable selection attributes for a given facility, on top of the standard species / number of animals / arrival & departure dates selection criteria. For instance, the

Control Post Owner can add specific attributes to one or more facilities such as Species type, feeding equipment, etc.

- Multi language support
- Dedicated interface for Control Post admins to manage their Control Post availability , specific criteria, and handle booking requests

Other requirements considered:

- Ability to place one's request on a waiting list if the Control Post is full and be notified if the booking is accepted
- Ability to pay for the booking in the same interaction

It is worth considering that these two requirements were not mentioned by the stakeholders during the interviews and may significantly increase implementation complexity.



Different options

From a technical perspective, two main options can be considered:

- Option 1 : Add a new booking module to TRACES allowing to manage Control Post bookings directly within TRACES
- Option 2 : Use a third-party application to manage CP bookings and connect it to TRACES through webservices.

Option 2 can be further defined into 2 specific scenarios :

Option 2a : use the TRACES desktop/mobile interfaces for both the booking requests/responses exchanges and the Control Post calendar management activities by the keeper. In that scenario, TRACES implements all booking functionalities and uses the third-party application as a backend that manages the booking business logic. This is the underlying assumption that was used to develop the mobile application customer journeys (D04.02 - Mobile Application Outline Report, 2025).

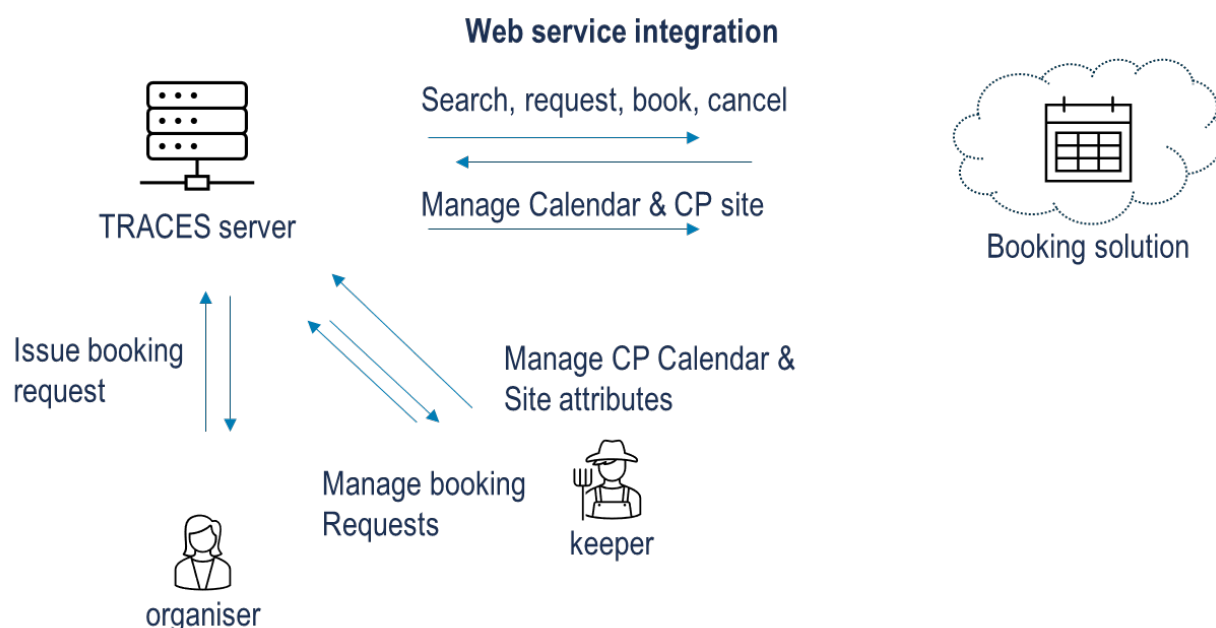


Figure 100 Control Post Booking scenario 2a

Option 2b goes further and separates the functionalities required by organisers and keepers and use the TRACES desktop/mobile interfaces for the booking requests from the organiser and have the keeper use the 3rd party application interface to handle incoming booking requests and manage their CP site attributes and calendar.

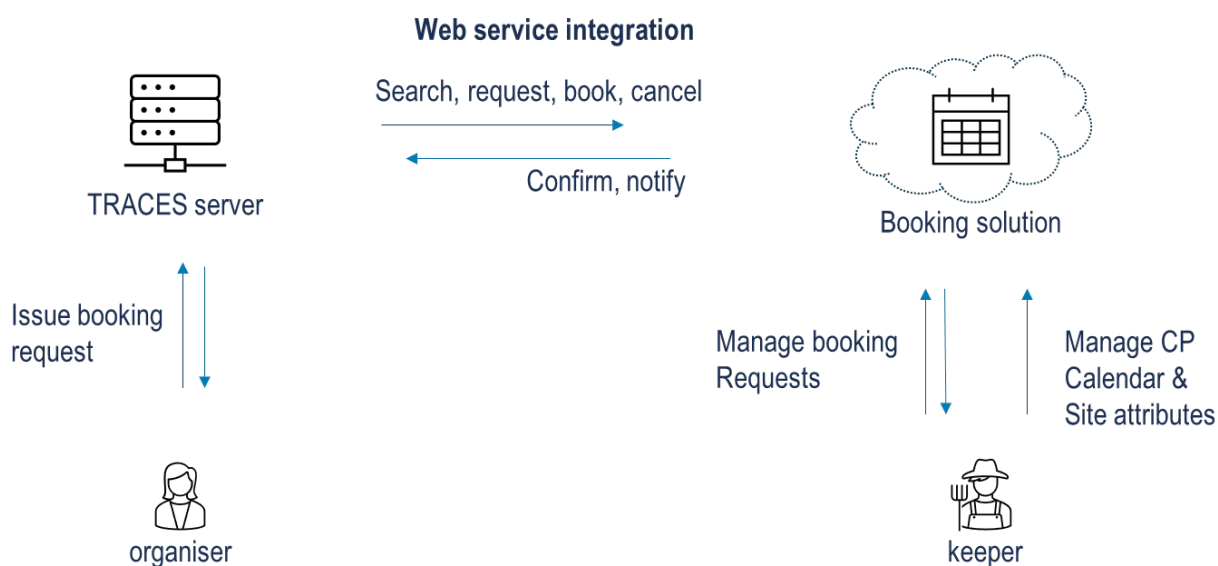


Figure 101 Control Post Booking scenario 2b

Pros	Cons

TRACES module	Leverage the existing list of control posts in TRACES, with their attributes Use the access control mechanism in place	No similar module in existence within TRACES, so new development to be foreseen
Third party application	Leverage an existing application, only integrate the AJL by means of services	Issue tender, maintenance contract ...
Scenario 2a	The keeper can manage the CP and the incoming booking requests from the mobile app	Significantly more complex than scenario 2b as the set of features to be implemented in TRACES / mobile app is larger
Scenario 2b	The keeper still sees the bookings in the mobile app but manages them in the 3 rd party app. Easier to implement	Additional interface for the keeper to manage

Note : In all scenarios, if the control post already operates their own facility management system, they will have to maintain booking schedules in their own system AND in TRACES or third-party application. It will result in duplication of data entries.

Recommendation :

We believe the Third party application – scenario 2b is the better option for DG SANTE.

Technically this is a much simpler option for TRACES as the third-party application will:

- Manage the Control Post owner interactions directly through their own web interface (defining the specific attributes of their CP, keeping the calendar up to date, managing requests, etc). This means that all features required by CP owners, including multi-tenant management and access control are leveraging out of the box features from the vendor instead of being developed in TRACES.
- Expose the required functionality for organisers working in TRACES through webservices.

What still needs to be done in TRACES is develop the graphical interface in the AJL that allows an organiser to search for a Control Post (by Id, by location etc) , manage the booking request cycle and attach the booking request confirmation to the AJL and implement the vendor's web services that support those features.

As a second-best option, we recommend the Third-party integration scenario 2a - with all end user features in the TRACES / mobile app. This means adding a set of features to be supported by the Desktop and Mobile application, but with all the backend business logic around managing sites and bookings still implemented in the third-party application.

It is for the TRACES team to estimate the complexity/cost of implementation of those options on TRACES. However, we believe that even when taking the operational costs involved in the third-party application scenario (vendor selection process, licence costs, maintenance contract), the third-party application – scenario 2b will remain cheaper by a factor two or three than a full TRACES implementation.

As an illustration, we provide the reference of such a third-party application / API that meets the requirements listed above: <https://www.planyo.com/api.php> .

- Checking planned AJL Compliance

The ability to verify compliance of a planned AJL is a key factor to improve the user experience and support operators and MSCAs alike in adopting the new rules defined in the Proposed Regulation. It is essential that issues are captured and fixed before an AJL is submitted and a well-defined compliance check mechanism could drastically reduce the number of rejections by MSCAs, thereby streamlining the entire approval process and reduce overall process cycle time.

To achieve this objective, the system will need to

- Visually inform the Operator of any non-compliance in the planned journey
- Help the user understand and fix the issue
- Recalculate compliance after the issue has been fixed and prior to submitting to the MSCA

- Submitting the AJL for approval

The system should prevent the organiser from submitting an incomplete AJL.

Once the various compliance checks have been applied to the planned AJL, the organiser can then submit for approval, kicking off the AJL approval sub process.

We recommend using the same task-based workflow approach as the one described in the Entitlements management Section – Workflow management, in order to support the AJL approval flow. Such workflows bring a number of important benefits from an implementation perspective:

- They allow for the definition of the flow to be followed by the process in a graphical manner that is both readable by non-technical resources and executable by the system
- Business rules can be associated to the workflow and tasks automatically created for the actors involved
- Specific operational reporting can be created to measure the effectiveness of a given sub-process (see 7.2 KPI definition).

- Baselining the AJL

Once approved by the MSCA, the AJL's Planning Section should be baselined and become read-only. If changes are required, they should result in a new AJL submission, so that the MSCA can evaluate the impact and ensure the AJL remains compliant.

As organisers mentioned that the names of the driver/attendant are often not known during the planning phase, it should be allowed for organisers to add drivers/attendants to the AJL after the approval by the MSCA. See following section for details on adding users to the AJL.

- Accessing the AJL

The Access Management capability has been described in a previous report, see Task 2 report (D02.01.01 TRACES Report). However, new use cases have been identified that will require further enhancements to the capability, namely the need to link individual participants to a specific AJL, and not just the economic operator to which they belong.

In other words, a user will gain access to an AJL

- If he/she belongs to an operator that has the required role and has been correctly associated with the AJL
- AND if he/she is part of the AJL Case Team (see further)

The following examples illustrate the need for a more granular assignment:

- The need to limit the number of journeys that an individual working for an economic operator (driver, attendant, welfare officer) will see in his/her Journey list within the mobile application. The access policy must ensure he/she only views the journeys he/she has been assigned to.

- The need for in-app real time chat messaging. If contact resources are to be displayed in the chat module, they must be individually linked to the AJL. This module is further defined in the mobile outline report (D04.02 - Mobile Application Outline Report, 2025).
- The need for an official veterinarian to select and self-assign individual AJLs for inspections and see them in the mobile app.
 - This can be on a geographical area basis, where the official veterinarian selects in advance in the Desktop App the journeys that are relevant for the area he/she is covering, using current TRACES rules
 - or during unplanned, on-the-spot inspections by searching in the mobile app for a specific journey, using a licence plate or AJL number for instance.

 Our recommendation is to introduce the concept of a Case / AJL Team, where all individual actors that need to interact with a specific journey are nominatively listed. Alternatively, this could also be addressed by having certified drivers/attendants be their own kind of “operators” in TRACES (this would also imply they have their own profiles, and their own boxes in the AJL template). A single user and email address (that of the driver/attendant) would be linked to this nominative operator

For operators, the assignment can be done during the planning phase by the organiser. We suggest that this should drive operators access to the application: an individual driver, attendant, or CP operator would only have access to the AJLs he/she has been nominatively assigned to.

For MSCAs/Vets, the assignment will need to be more flexible. A MSCA / Vet should still be able to see and consult the AJLs he/she is interested in using the rules currently defined in TRACES. On top of that, they would have the option of assigning themselves to the AJL, which would result in the AJL being directly visible in the “My journeys” section of their mobile application and also make them appear as contacts for the in-App real time chat module.

GDPR-wise, linking individuals’ records to an AJL would probably require an addition to the TRACES DPIA but this should not be a major change as some individual records can already be linked to the AJL today, see field I.1.2 “Person in charge of the Journey” in Section I – Planning , which allows to define the contact person acting as Organiser and displays the name, telephone number and email address.

- Space calculator & Fitness assessment tool

The TRACES platform is foreseen to be used across the EU to record, validate, and monitor animal transport journeys. While some of the features to manage documentation and traceability are already in place today, it does not actively assist organisers in making welfare-related decisions.

By integrating smart calculators & tools directly into TRACES, its capabilities can be expanded to further support users in their decision making.

The tools recommended in the following sections are to be conceived of as individual modules with their own interface features. In the present document, we outline the requirements and general features as well as benefits (the “what” and the “why”). Implementation guidelines and usability recommendations for the modules (the “how”) will be presented in the mobile outline report (D04.02 - Mobile Application Outline Report, 2025).

- Space Requirement Calculator for Journeys

Space allocation is a critical element of journey planning, as requirements differ depending on species, animal weight, and vehicle size. Digital calculators provide a standardized way to consistently apply regulatory requirements and scientific guidance, ensuring animal welfare while maintaining practical transport operations.

It can also assist authorities/operators with automatic identification of non-compliant scenarios and propose necessary adjustments to ensure adherence to welfare standards as defined in the Annexes of the proposed regulation.

The space calculator will be used first and foremost to calculate the number of animals that can be loaded in a given truck. The user provides the truck’s available floor area and height, and the calculator determines the maximum number of animals that can be safely loaded based on standard space and height requirements.

The reverse calculation, from the number of animals to the size required will also be possible, see further in this section.

The following section has been drafted considering the values of Annex I Chapters III and VII of the [commission proposal for a regulation on the protection of animals during transport](#). It is important to note that the principles described will remain the same regardless of whether specific values and thresholds for space allowances are modified during trilogue negotiations.

Input parameters

- Species and category/sub-type (e.g., bovine, ovine, pigs, poultry, Equidae)
- Average live weight per animal
- Number of animals to be transported

- Truck/Container dimensions (length × width × height)
- Height or wither height if the tallest animal to be transported, depending on the species

Calculation outputs

Area required per animal

Integration space calculator tool will allow transporters and organisers to calculate the area required per animal using the k values (as per Annex I, Chapter VII), which helps determine the maximum number of animals that can be safely loaded on a truck.

Truck load capacity:

Number of animals that can be legally and safely transported, considering floor area and partitioning requirements.

Height clearance check

The height of the truck compartment is just as important as floor space because insufficient vertical clearance can cause stress, injury, and poor ventilation.

As per Annex I, Chapter III, Minimum vertical height requirement each species has a predefined height requirement, and the calculator could help revalidate it. For example, in case of transportation of cattle, the user can enter wither Height of the tallest cow and the calculator would compare the truck's internal height with the minimum required clearance for the tallest animal in the consignment, by using the formula $H = W \times 1.17 + 20$, and tell the user if the height requirement is sufficient or otherwise.

If truck height is insufficient, the system can inform the consignor about the compliance status of the foreseen journey, and suggest corrective measures (e.g., fewer animals per consignment or suggest use of a larger container/vehicle).

Validation message

To simplify interpretation, TRACES would generate a **clear status output** after each calculation step:

- **“Compliant”** → All requirements (floor area, height clearance, ventilation assumptions) are satisfied, the journey plan can proceed.
- **“Risk of non-compliance”** → One or more thresholds are not met. The system specifies why (e.g., “Insufficient deck height for tallest cattle,” “Truck surface only fits 175 sheep, not 200”)

The calculator should support space calculations in two directions, from the number of animals to the space required, and vice versa.

For example, the below table is a sample *simulation* designed to evaluate the feasibility of loading and transporting animals based on truck dimensions and species-specific space

requirements. It considers both floor area and height clearance to ensure that animals can be safely and comfortably transported without overcrowding or underutilizing the vehicle. The simulation below demonstrates how the calculator works using a truck with a 30 m² floor area and a 2.0 m internal height.

Space calculator - Simulation to check feasibility for loading animals

Truck area (in m ²)	30
Height of truck (in m)	2

Species	k Value	Sample Weight (per animal in Kg)	Area Required (in m ²)	Animals per truck	Area needed (in m ²)	Wither Height (in m)	Min Height of Truck need to load the animal (in m)	Max number of animals that can be loaded on the truck
Pigs	0.027	150	0.76	20	15.24	0.6	1.0	39
Cattle	0.034	200	1.16	0	0.00	0	1.0	25
Horses/Donkeys	0.029	200	0.99	0	0.00	0	1.0	30
Sheep/Goats	0.037	50	0.50	0	0.00	0	1.0	59

Truck Area needed (in m ²)	15.24	to load animals	1.0

Result:	Feasible	Truck sufficient?	Feasible

The calculator helps the user in the following scenarios

Case A: Organiser enters the number of animals → system checks if truck space suffices

In this scenario, the user specifies the number and type of animals to be transported, and the calculator determines whether the truck's available space is sufficient. For example, in the table, the organiser intends to transport 20 pigs, each weighing approximately 150 kg. Based on a k-value of 0.027, the area required per pig is 0.76 m², resulting in a total required floor area of 15.24 m². The pigs have an average wither height of 0.6 m, and the minimum truck height required to load them safely is 1.0 m. Since the truck in this simulation has a floor area of 30 m² and a height of 2.0 m, the calculator concludes that the transport setup is feasible, and the truck height is sufficient. This indicates that the truck can comfortably accommodate all 20 pigs with adequate remaining space, ensuring efficient and safe transport.

Case B: Organiser truck size → system calculates maximum permissible number of animals

In this case, the user provides the truck's available floor area and height, and the calculator determines the maximum number of animals that can be safely loaded based on standard space and height requirements. Using the same truck parameters (30 m² area and 2.0 m height) and pig space data (0.76 m² per animal, 1.0 m minimum loading height), the calculator estimates that the truck can carry up to 39 pigs..

▪ Fitness Check tool

The fitness of animals for transport is one of the most critical checks under the Proposed Regulation 2023 (Annex I, Chapter I).  Currently, it relies on assessments by the driver/attendant and keepers. This creates variability, risks of misinterpretation, and inconsistent enforcement.

By embedding a Fitness Check tool in TRACES, the system could provide a structured environment to assist fitness-for-transport assessments by AJL actors. This would help:

- Simplify and standardize fitness determinations.
- Reduce subjectivity by making the interpretation of the rules easier and referencing the rules themselves.
- Create a transparent, traceable record of every fitness decision made.

The Fitness-for-Transport tool could assist AJL actors in this determination in several ways:

- Provide a quick and easily accessed summary of Fitness-for-Transport rules and definitions as defined in Annex I of the Proposed Regulation 2023, as they apply to
 - 1) all species / types (e.g. “injured or ill”)
 - 2) the specific species/type involved in the transport in question (e.g. “calves less than 5 weeks of age”)
- Point to online resources that might be consulted in specific situations or the contingency plan if fitness for transport can no longer be guaranteed during the journey
- Allow the actor to use the picture/video module to record the incident and share it with the MSCA if needed (see **section 6.5 Managing pictures and videos**)
- Link to the Anomaly report module so that the actor can easily report the incident that might have led him/her to conduct the fitness assessment.
 - Integrating calculators into TRACES

The Space Requirement Calculator and Fitness Check tool offer different advantages to actors involved in different stages of the Animal Journey Log (AJL).

Journey Planning (Organiser):

When an organiser enters journey details into the AJL, the Space Requirement Calculator would help verify the number of animals, their average weights, and the available vehicle/container space. Real-time validation ensures that the journey plan complies with EU standards before it is submitted for approval. The system also flags non-compliance early and suggests corrective actions, avoiding unnecessary delays in authorization.

At Loading (Keeper/Driver):

The Fitness Check tool supports those responsible for the fitness assessment with resources they can refer to in case of doubt about whether each animal is fit for transport. In cases of borderline conditions, drivers can upload photos or videos for MSCA review.

During Transport (Driver/Transporter):

Both tools continue to support decision-making throughout the journey. If incidents occur, such as an animal showing signs of illness or injury, the system provides structured assistance on next steps and clearly indicates when veterinary escalation is required. Upload options allow drivers to submit evidence in real time, enabling authorities to make quick, informed decisions.

After Arrival (Authority/Keeper):

At the place of destination, be it in a third country or in a Member State, competent authorities or keepers can review fitness and compliance data captured during the planning and transport phases. Competent authorities can access structured reports on space allowance validation, animal fitness outcomes and anomaly reports filled by respective actors.

Benefits of Integrating calculators

Integrating these tools into TRACES and the AJL provides the following benefits:

- **Standardization Across the EU:** Automatic application of formulas and decision rules ensures uniform compliance with regulatory requirements across all Member States, decreasing ambiguity and variations in interpretation.
- **Error Reduction and Efficiency:** Digital calculations minimize the risk of human error in applying technical annexes. Organisers can plan journeys faster, while authorities can review submissions more efficiently.
- **Strengthened Animal Welfare:** Real-time verification of space allowances and structured fitness assessments ensures that animals are transported in safe, compliant conditions, reducing stress, injury, or suffering. 
- **Practical Support for Stakeholders:** Organisers, drivers, and authorities are guided step-by-step, reducing reliance on specialist interpretation and ensuring that compliance checks are straightforward and accessible.
- **Evidence-Based Enforcement:** The ability to upload photos, videos, and structured reports strengthens enforcement by providing verifiable data to authorities and veterinarians.

▪ Conclusion

Integrating the Space Requirement Calculator and Fitness Check tool into TRACES will enhance its ability to support AJL actors in making the best decisions for animal welfare. With real-time checks, clear welfare assessments, and digital records built into the Animal Journey Log, the EU can ensure consistent compliance, fewer errors, and better protection for animals during transport.

This upgrade modernises enforcement while reducing paperwork for stakeholders, creating a balanced solution that supports organisers, authorities, and above all, the animals being transported.

- Managing documents and records
 - Summary of requirements

The document and records management capabilities were studied at length in the Task 2 TRACES report (D02.01.01 TRACES Report). The report assessed TRACES capabilities around typical document and record management functionalities; create/update/delete (CRUD), sign, exchange, retrieve, dispose, upload, template & tag.

In *section 5 Entitlements management* of the present report, we proposed specific recommendations around event generation, pdf generation and role-based assignment of documents to user profiles.

We now focus on recommendations for the capabilities from the perspective of the actors during the journey execution.

- Required features

Managing Journey log forms/sections

Filling in the 5 forms defined by the Proposed Regulation 2023 is probably the most important documentation requirement that is placed on journey stakeholders by the new regulation.

The forms are a key component to allow MSCAs to better track and enforce animal welfare measures and to identify deviations from the rules and/or disagreements between actors.

The latter is a key element: forms must be countersigned and allow for differences in interpretation to be expressed by two actors countersigning the form. For instance, a driver/attendant and a keeper must countersign the Place of Destination form but may disagree on the state of some animals. Such a disagreement must also lead to an Anomaly Report being filled by one of the actors.

Form status

The forms will need to support a typical lifecycle with the appropriate status changes: Draft > Saved > Signed > Countersigned.

Form exchange

The system will allow the forms to be generated as pdf files, that can be displayed as such in the (mobile) application or send to external recipients from the application.

Multi-user updates

The proposal foresees that Section III of a given journey can be filled by two actors and should allow for contradictory input as it needs to capture diverging interpretations of a given situation. This has implications for the form's status cycle and for the mobile application conflict-handling strategy.

In the update cycle, we recommend distinguishing between two types of form entries:

- Form input that is auto filled from other sections of the AJL. (Information relating to the actors' profile, places of departure & destination, etc...). Those information fields should be corrected in the AJL itself if need be and should not lead to separate interpretations from the two actors signing the form.
- Form input that represents an actor's appreciation of the AJL situation: those fields should be stored separately, representing the actor's own input. See *Figure 21 Sample AJL Form section*. This would allow a trace of conflicts of interpretation to be safeguarded while having a single document that is signed off by the two actors. This approach also prevents synchronisation problems that could arise from one of the two mobile applications going offline.

5. CHECKS PERFORMED ^{(5),(6)}		
Checks	Outcome of checks	
	Compliance	Non-compliance
Transporter Authorisation number		
Driver		
Number of the certificate of competence		
Means of transport Identification		
Space allowances Average space/animal in m ²		
Journey log records and journey time limits		

Figure 102 Sample AJL Form section

Signature

The form should have a status showing that it is ready for signature and can no longer be changed, allowing both actors to proceed to signing.

Both actors will need to sign the form in a digital manner. It should be noted that a qualified signature was deemed too complex to handle in this matter. The seal functionality currently implemented in TRACES for MSCAs will not be extended to economic actors in the mobile application. The signature will be based on the user's EU-Login authentication, with a TRACES-generated timestamp.

Inspecting certificates and authorisations

The other main type of documents & records required during the journey are the certificates & authorisations required for transport activities and defined in *section 5 Entitlements management*. The critical element from a journey management perspective is the ability for an actor to be able to retrieve and display the records and associated documents during an inspection.

Referring to supporting documents

The last type of documents that can be used during the journey will be supporting documentation such as the contingency plan. Those documents are the simplest to handle from an application perspective as they simply require to be easy to access and consult during the journey.

- Managing pictures and videos
 - Summary of requirements

The ability to upload pictures or videos taken by AJL actors on the field to a TRACES AJL is not a requirement of the Proposed Regulation 2023.

However, the topic was raised several times, both by operators and MSCAs, during the consultation phase of the present study, as a very effective and beneficial way of documenting the state of animals at various stages of the journey (D02.01.02 Consultation Report, 2025).

The component is therefore explored in the following section as an optional addition to the core requirements.

- Features

The component would provide two main groups of functionalities:

Capture & upload

The ability to record and upload photos / videos of key moments of a transport (loading/unloading) to TRACES, as a way to document animal state during the journey. The capture and upload feature would be exclusively done from the mobile application.

The feature would be made available to drivers/attendants, keepers and official veterinarians from within a given AJL.

Recording and uploading could take place at any moment during the journey, but most probably either during loading/unloading to document the state of the animals, or as a way to document an anomaly / incident that has occurred.

The driver/attendant should be able to review the picture/video before sending it.

Streaming

Once uploaded, the ability to view the captured photos and videos would be restricted to the TRACES Desktop application only and made available only to MSCA users.

- Integrating into TRACES

Managing upload and streaming of video files is a mature functionality that is widely used in many large-scale applications, relies on secure and stable technologies and remains very affordable thanks to the continuous drop in storage pricing.

Recommended set up

The recommended architecture is to separate the storage of pictures and videos from the TRACES infrastructure and use object storage technology. Object storage is a highly scalable, durable cloud storage system that stores data as objects in flat structures called buckets, accessed via unique keys and metadata through APIs, ideal for unstructured data like pictures and videos.

European Object Storage cloud vendors could be leveraged, ensuring pictures and videos remain in the European Union. Support for GDPR requirements is the de facto standard for such providers¹³. Object Storage providers also typically provide support for the Content Delivery Network (CDN) technology mentioned below.

The role of the TRACES backend would be limited to the generation of URLs and the enforcement of access control. The mobile application would upload the video directly to the object storage database and the TRACES desktop would stream the video directly from the same storage, without impacting the backend's performance.

Storage sizing

We provide separately a simple calculator to estimate storage sizing to be foreseen based on a number of adjustable parameters. Using the calculator, it is rather straightforward to estimate hosting costs from various object storage providers for different usage scenarios.

Bandwidth and processing requirements

- On the TRACES server: very limited on the upload side as the role of the TRACES backend is to
 - generate a signed upload url pointing to the object storage, to be sent to the mobile client that needs to upload a file
 - generate a read url that will be stored in the corresponding AJL and used by the TRACES desktop client to stream the uploaded video.

¹³ See for instance [European Object Storage | Secure & Scalable S3 Providers](#) , or also [European alternatives to Amazon S3 | European Alternatives](#)

- On the TRACES desktop client: network bandwidth between the desktop client and the Object Storage that contains the video can be optimized using CDN technology¹⁴ which will cache files to a location closer to the user.
- On the mobile client, uploading the video to the object storage server could also leverage CDN technology to optimise the upload. Files can be compressed, and video size can be limited within the mobile app to further limit file sizes and upload time.

Security

Access control is used to protect content in two ways:

- Only drivers/attendants/keepers/official veterinarians associated with a given AJL can upload files to that AJL.
- Only MSCAs can stream the files for the AJLs they have access to, using the TRACES desktop application.

Videos can be encrypted, at rest in the object storage server and in motion during upload and download.

Retention

Since the Proposed Resolution 2023 does not include videos and pictures in its requirements, it can safely be assumed that the 6-year retention period defined in the regulation does not apply to multimedia artefacts. A shorter duration can then be defined to limit storage space. Retention length is a parameter in the sizing tool provided separately to DG SANTE.

- Engaging other AJL stakeholders

An important dimension that would bring added value to AJL users concerns the ability to engage in real time with other actors and facilitate in-journey communication.

Two main aspects discussed in the present study aim at easing internal communication:

- Real time messaging app & automated translation

This set of functionalities would allow MSCAs and economic actors to chat in real time with each other through the mobile application, with automatic language translation to support cases where the language barrier needs to be overcome.

The module is further defined in the mobile application outline report. (D04.02 - Mobile Application Outline Report, 2025).

An important implication of this feature on access management is also highlighted in *section 6.2 Accessing the AJL*

¹⁴ See for instance https://en.wikipedia.org/wiki/Content_delivery_network for a discussion of CDN technology.

- Case Tasks and notifications

Another important element to facilitate internal AJL communication is the use of workflow tasks and notifications proposed in section *Workflow management*, on page 278.

Case tasks and notifications can be generated automatically as a result of a specific event occurring in the AJL. For instance, the creation of an anomaly report can generate a notification to a MSCA, allowing them to review the situation and engage the transporter if required.

Tasks can also be generated directly by an AJL actor wishing to request information or specific actions from another actor in the process. Modern workflow engines allow actors to generate ad hoc tasks on the fly, separately from predefined process tasks, when they see the need to engage another actor. These tasks effectively become another means of communication within the AJL context, complementing the real time chat functionality with a more asynchronous communication means.

- Completing the journey

- Process closure

From a workflow and process management perspective, it is important to define an explicit stage in the journey log process where pending activities are completed and the case is formally closed off, marking the AJL status as completed.

This is not happening today as the process is not carried out end-to-end in TRACES but is recommended once a fully digital AJL is put in place. Having a formal close off step brings a number of benefits:

- It ensures consistency for process cycle time measurements, allowing to measure process duration in a consistent manner and analyse deviations.
- The data remains available for consultation, analysis, etc but operators can no longer use the AJL for any transportation activities.
- It could also serve as a trigger for automated archiving of data after a predefined retention period has elapsed.

The completion of the AJL does not necessarily have to coincide with the end date of the journey itself. While a lot of the manual tasks that happen today after the end of the journey would be automated with the proposed solution (for instance, collecting and uploading GPS data, signed forms etc...), it is still advisable to let the competent authority review the journey log and decide if the log can be marked as completed.

This recommendation is also consistent with the recommendation for a dedicated BPMN workflow engine as formulated in *section 5 Entitlements management*. Workflow engines will

typically manage the entire lifecycle of each and every process instance, from creation of the case to the formal completion. Analytics are also provided based on that lifecycle. The workflow engine would also typically trigger a task for a MSCA to review the journey log at the time the destination is reached.

- Geolocation data import and analysis

The completion of the journey is also important as it will trigger the import of collected Geolocation data. The Proposed Regulation states that the import will happen after the project's completion and will concern the journey's key locations : Place of departure, Control posts, exit points/Border crossings and Place of destination (European Commission, 2023, p. Art 24). In the rest of this section, we will use the phrase "key location" to refer to any one of those places.

We refer the reader to the report (D03.02 Positioning System Design, 2026) for technical details on how the geolocation data will be collected during the journey and imported into TRACES at the completion of the AJL. In short, geolocation events will be generated and collected at regular intervals during the journey and matched against predefined "geofences", i.e. areas around a point of interest such as the key locations cited above. When the system collects a geolocation event that appears to enter an area / geofence of interest, it records the date and time of entry into the geofence, and likewise when the geofence is exited.

This means that at the end of the journey, the AJL will receive date/timestamps indicating when the transport entered and left the Place of Departure, Control Post, EU exit points and Place of Destination.

The data points will allow the MSCA to verify the following elements of the AJL as it really took place (as it might differ from the planned journey).

Journey durations:

- Total journey duration from the moment the transport exited the Place of Departure until the moment the transport entered the Place of Destination.
- Journey durations between the various key locations listed above
- Duration of the actual stop at the Control Post, measured as the difference between entry and exit into/from the geofence area of the Control Post

Itinerary:

- Whether the transport actually went through the predefined geofence areas or not. If a deviation happened during the journey and the transport stopped at another control post than planned, the geofence event would be that of the actual control post visited, making the deviation of itinerary apparent for the MSCA.

Location catalogue in TRACES

The geofencing mechanism described above relies on the availability of a catalogue of locations to be geofenced, with accurate addresses and the associated geographical coordinates (Latitude/longitude).

- At the time of writing, such a catalogue is available in TRACES for a number of key locations: Place of departure, place of destination, Control Posts and border control posts. Ports and airports are instances of border control posts and therefore included as well.
- Some types of locations are missing.
 - either completely (crossing points between member states)
 - or partially :
 - exit points , even if in practice they are mostly Border Control Posts and included as such
 - Places of departure, destination and assembly centres that do not trade with other EU countries. In practice, this would only affect AJLs for long journeys within a single member state.
- The catalogue contains postal addresses but not geographical location (latitude/longitude).
- Article 45 of the IMSOC Regulation provides a legal framework for this catalogue and its maintenance by the MSCAs. The data governance process for the catalogue is in place today and being effectively used by MSCAs whenever additions or updates of location data is required.
- The catalogue is used today in the TRACES application as it lets AJL users select locations/addresses for the various locations of the AJL.

Tracking AJL deviations

Since the number of geolocation points collected at the end of the journey will be limited to the key geofenced locations, it will not be possible to see the actual route that a transport followed **between** two key locations of the journey, only the key locations that were visited.

If more granularity is required to analyse the deviations from the planned journey, it is possible from a technical point of view to import the full list of geolocation events collected during the trip (at 15-minute intervals) into TRACES and display it on the map.

There is currently no formal definition of what constitutes such a deviation. It could be defined as the delta between the actual time the transport reached a geofenced location and the time it was expected to reach it according to the plan.  Once these parameters are defined, rules for automatic imports of the data set upon deviation can be implemented. Alternatively, the simplest way would be to implement the mechanism as a manual action available for a MSCA

user, to request the full list of geolocations if they need it to audit the journey. A third option would be to implement both mechanisms, automatic import upon deviation of the journey and an available import option for competent authorities.

The implications for TRACES would be the following:

- TRACES would need to call a second webservice, next to the service used to collect the geofenced key locations in the normal scenario. This other web service will return the full list of locations collected during the journey and will be implemented in the Geographical Intermediary Service (GIS).
- The button to call the service would be available only to MSCA users and only on AJLs that have been marked as completed.
- The format of the returned data is an implementation decision. There are a number of well-established formats for displaying itineraries on a map, such as GeoJson or KML. The format should be the same as the one used for the list of geofenced areas to simplify the implementation in TRACES.

Nota Bene: This additional import mechanism is only mentioned here as a possible enhancement as it is not currently foreseen by article 24 of the proposed Regulation. It would also require detailed GPS data to be retained longer than is currently foreseen by the Regulation.

Geographical coordinates

As mentioned above, the catalogue of locations will need to contain the exact geographical coordinates of the location (longitude/latitude). This can be easily derived from the postal address of the location, using a geocoding web service¹⁵ that takes an address as input and returns coordinates as output.

Two options can be considered by the Commission to implement this mechanism in TRACES:

- A one-time upload of coordinates whereby the current list of addresses is exported from TRACES and run through a custom script that calls the geocoding service and updates the list with the matching coordinates. The list is then used to update the TRACES catalogue back with the collected addresses. This means however, that MSCAs would have to maintain the coordinates themselves in case of a change, or for new locations entered after the batch is run.
- A preferable option would be to implement in TRACES a batch that checks the catalogue at regular intervals (nightly for instance) and queries the geocoding service for catalogue entries that do not have a set of coordinates defined or were updated since the last run of the batch.

¹⁵ See for instance the open source [Geocode | ORS API](https://openrouteservice.org/dev/#/api-docs/geocode) , at <https://openrouteservice.org/dev/#/api-docs/geocode>

Radius, dwell time and hysteresis

Geofencing requires additional parameters to be set in order to define the area to be geofenced. We refer the reader to the Positioning System Design Report (D03.02 Positioning System Design, 2026) for a discussion on those advanced parameters. The report in question proposes default values for those parameters and presents cases where the default values might need to be manually overridden.

We recommend including the possibility for MSCAs to do this in the TRACES Catalogue interface, by adding the required fields to the key location record. For instance, if a MSCA sees the need to extend the radius of a geofenced location because the default radius is too small for that particular area, they could do so from the same TRACES catalogue interface they use to manage the Location address.

Missing or incorrect coordinates for a location

Geographical coordinates can be missing, either because the location itself is not tracked today in the catalogue (see above, for instance crossing points between EU member states) or because the location has been created by the MSCA but not updated yet by the system with its coordinates. In such a case, the geofence will simply not be created in the Geolocation Intermediary Service (D03.02 Positioning System Design, 2026) : this means that the location will not appear in the list of geofenced locations imported into TRACES at the end of the journey. In the example of a journey crossing an internal border for instance, users would see the geofenced place of departure and the geofenced control post in the other country, but not the internal EU border crossing in between. However, if the MSCA decides to import the full list of geolocation events as described above, the MSCA would see the full itinerary as a list of geolocation points (at 15 minutes interval) and should therefore be able to determine which crossing was used between the two member states.

If coordinates are incorrect because either the postal address of the location was incorrect in the first place, or because the geocoding service returned an approximative set of coordinates, the geofence mechanism will not trigger any event and the geofenced location will not be returned to TRACES either. The truck might have stopped at the intended Control Post but since the geolocation sent by the truck did not match with the (incorrect) coordinates of the geofence, no geofence is triggered. Just like in the previous example, if the MSCA were to manually request a full list of geolocations, it would be visible on the map that the truck did indeed stop at the control post.

Identifiers

An important constraint to be noted is the fact that collected GNSS positions might not contain the corresponding Journey Log ID, depending on the scenario for GNSS data collection that will be selected. See (D03.01 - Market Analysis Report, 2025) for an in-depth discussion on the various scenarios available. If GNSS data is collected directly from the truck vendors' FMS

systems (Scenario 2), or from an onboard device (Scenario 4), the position will contain the truck's VIN number, but not the AJL identifier.

This would complicate the consolidation of GNSS positions to AJLs as the VIN number does not offer a full-proof guarantee that a given event must be associated with a given AJL:

- GNSS events around the start and stop of the journey cannot automatically be associated with the JL even though the AJL contains start and stop times: a journey might start earlier or later than planned for instance.
- Trucks could be swapped during a trip, resulting in GNSS positions being tracked on the wrong AJL.

- Data retention & archiving

The Proposed Regulation 2023 defines retention guidelines for AJL data:

“(34) Data concerning the length of the journey and rest periods should be recorded and kept for all journeys, for the purpose of processing the information only for official control and other official activities linked to those official controls. The retention period of these data should be 6 years so that these data are accessible to the competent authorities, in particular with a view to checking whether the organiser or transporter fulfils the conditions required in order to obtain a renewal of an authorisation after the expiry of the 5-year period of validity. Positioning data recorded in the information system connected to TRACES should only be recorded and kept for the purposes of official controls and other official activities linked to those controls. The retention period of these data should also be 6 years.” (European Commission, 2023, p. 25)

While the Regulation describes the purpose (controls & checks for renewals) and the length (6 years) of data retention, it does not really specify how this could be achieved, nor what should happen with the data **after** the retention period. A number of options can be considered:

During the retention period

In order to achieve the intended purpose of the data retention, it should remain possible for a MSCA to consult a completed journey log in all its components: general process data, key data points (durations, temperatures, geolocation data), forms & other documents (pictures, ...) during the entire retention period.

We recommend implementing a read-only access for that period to ensure that the data is not altered in any way during the consultation.

The Commission should also determine whether an organiser or transporter can continue to access the information of the log during the 6-year period.

After the retention period

Typically, in similar applications, cases that reach the end of the retention period are handled in one of three ways:

- Option 1: AJL data is preserved but access is restricted in the TRACES interface to an admin role, to account for exceptional situations where historical journey data needs to be retrieved, usually for legal purposes.
- Option 2: AJL data is partially preserved, for statistical purposes. This means only data points relevant for statistical analyses need to be kept. See also *Section 7 Reporting & Analytics*.
- Option 3: AJL data is simply discarded (physical delete).

In order to define the best course of action, it is therefore needed to define

- If there are any needs to provide exceptional access AJL data through TRACES, albeit in a restricted form, after the 6-year retention period.
- If there are any needs to include data of more than 6 years into the statistical analysis.

Our recommendation would be to go for option 2 as there is definitely added value in keeping AJL summary data over a longer period than 6 years for statistical analysis purposes, while addressing data privacy concerns from transporters since specific data such as geolocation, or individual forms, pictures and documents would have been discarded.

- Reporting & Analytics

The reporting and analytics capability covers all activities required to monitor and analyse the two operational processes discussed so far.

Within the larger context of our study, the capability

- Supports the last phase of the AWT value chain; “Consolidate & Analyse”
- Impacts only the Desktop Application as no reporting features are foreseen within the mobile application.

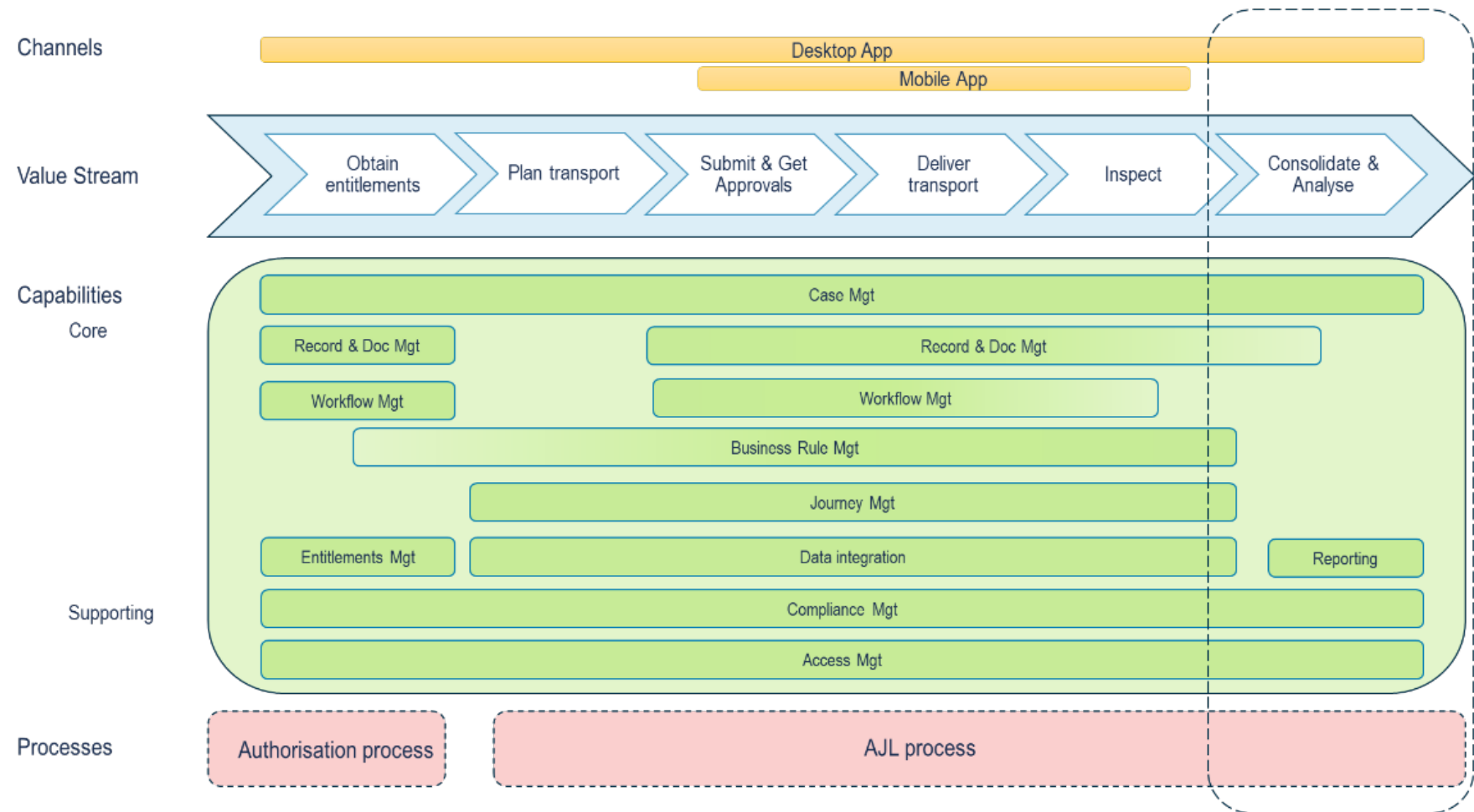


Figure 103 Reporting within the AWT Value Stream

- Reporting Objectives

The objective of reporting is to transform the data captured in Journey logs (geolocation, weather forecasts etc) into meaningful insights and support competent authorities and the European Commission in decision making and identifying potential non-compliances. Reporting should help overcome the limited visibility of actual Journey Logs and provide evidence to explain why certain non-compliances occur. It should enhance the efficiency and transparency by fully integrating data and documentation within TRACES. It should enable the MSCA and the European Commission to analyse completed journeys, identify root causes, and highlight anomalies, non-compliance patterns, and trends in journey conditions.

- Prerequisite: end-to-end digitalisation

Since today most of the work on AJLs is done on paper, the data available in QlikSense is partial. Similarly, for the authorisation process, limited data is available in TRACES, which makes it difficult for authorities to detect patterns of repeated non-compliance for drivers/transporters.

Currently the AJL process is only partially performed in TRACES, which results in incomplete data being stored in the platform. This means that QlikSense does not have access to a full dataset and therefore cannot deliver comprehensive insights. This gap reduces the usefulness of the platform for monitoring, reporting and decision making.

As explained in the task 2 TRACES report, the authorisation process is the preliminary step for any live animal transport activity. Currently, this process is managed through emails or within a national application, making it difficult for authorities to track and analyse the number of rejections, approvals, and renewals for drivers and organisers.

The end-to-end digitalisation of the two processes is therefore a crucial prerequisite if the reporting capability is to achieve the set objectives.

- Use cases

If we consider the contribution of reporting to the overall objective of improving animal welfare during transport, the reporting features that will be needed can be divided along two main dimensions:

- **A *business operations dimension*** where we want to analyse the datasets collected during the operations to detect issues, analyse trends, predict risk profiles etc in order to support welfare improvements.
- **A *process optimisation dimension*** where the efficiency of the processes themselves is analysed. A process can indeed be efficacious in terms of ensuring that welfare rules are followed but inefficient in terms of its implementation, leading to economic loss or partial adoption.

The two dimensions contribute to the same objective but may involve different users, KPIs, tools and use cases. The following figure presents sample use cases by process and dimension to illustrate this:

	Process optimisation	Operational efficiency
Entitlement	<i>understand how efficiently the entitlement process is being handled. For e.g.- cycle times, bottlenecks, rejections etc.</i>	<i>see the history of operators' entitlements requests for a given operator and their outcome to detect fraudulent applications</i>
AJL	<i>identify recurring process issues in Journey management. For e.g.- average duration of the approval step etc</i>	<i>analyse the historical data, analyse trends and patterns. Predict risk profiles</i>

Figure 104 Sample use cases by process & dimension

- KPI definition
 - Journey management process

Below are some of the key performance indicators to measure compliance/welfare

KPI	Data points	Goal
<i>Journey duration deviation</i>	<i>difference between planned and actual duration of the journey</i>	<i>measures the efficiency of the planning phase and supports performance monitoring.</i>
<i>Journey itinerary deviation</i>	<i>difference between planned and actual itinerary – Transporter declaration</i>	<i>measures the efficiency of the planning phase and supports performance monitoring.</i>
<i>Journey time thresholds exceeded</i>	<i># of journey segments exceeding max travel time threshold</i>	<i>detects compliance issue</i>

<i>Temperature thresholds exceeded</i>	<i>TBC (Pending decision on recording actual journey temperatures)</i>	<i>detects compliance issue</i>
<i>Anomalies</i>	<i># of anomaly reports in the AJL</i>	<i>detects welfare issues.</i>
<i>CP Booking</i>	<i>CP Booking attached Yes/No</i>	<i>detects a compliance issue</i>
<i>AJL sections duly completed</i>	<i>All four sections completed and signed Yes/No</i>	<i>detects a compliance issue</i>
<i>Entitlements</i>	<i>All AJL actors carry the required, active, entitlements in their record Yes/No</i>	<i>detects a compliance issue</i>

Below are some of the key performance indicators to measure process efficiency

KPI	Data points	Goal
<i>Timeliness of submission</i>	<i>AJL submitted under right timeline window (min 48 hrs, max 5 days).</i>	<i>prevents last minute approvals and enable authorities to detect any non-compliance</i>
<i>Submission-to-Approval time</i>	<i>time taken from AJL submission to approval by MSCA</i>	<i>identify the inefficiencies, bottlenecks and delays in the approval workflow</i>
<i>Rejection rate</i>	<i># of times a submission gets rejected by the MSCA. Could include the reason for rejection for more detailed root cause analysis</i>	<i>shows the frequency of AJL´s rejected due to incomplete or incorrect information. A high rejection rate could point to a training issue among organisers.</i>
<i>AJL Completion rate</i>	<i>difference between the actual arrival date of animals and the actual</i>	<i>indicates administrative gaps and identifies patterns where MSCAs must go after</i>

	<i>completion of AJL in the system</i>	<i>missing or incorrect information</i>

- Authorisation processes

Below are some of the key performance indicators to measure compliance/welfare-

KPI	Data points	Goal
<i>Submission of mandatory documents</i>	<i>All required documents submitted along with the authorisation request</i>	<i>identify any training gaps and process inefficiencies.</i>

Below are the key performance indicators to measure process efficiency-

KPI	Data points	Goal
<i>Timeliness of submission</i>	<i># of authorisation renewal requests submitted outside the allowed window. The authorisation is valid for 5 years and organisers should apply for renewal one month before the expiry</i>	<i>manage the renewal workflows, ensuring its smooth continuity.</i>
<i>Submission to approval time</i>	<i>average time taken from authorisation submission to approval by MSCA</i>	<i>identify the inefficiencies and bottlenecks or delays in the approval workflow.</i>
<i>Rejection rate</i>	<i># of authorisation requests rejected by the MSCA. Should include the reason for rejection for further analysis</i>	<i>identify any recurring problems in submissions and need for training</i>

- Dashboarding versus Reporting

A dashboard should be designed as a **central, user-friendly control panel** that gives each type of user (organisers, transporters, control posts, and authorities) a clear and real-time view of their relevant data and tasks. The existing TRACES dashboard can be leverage for this purpose and could be extended to include the new KPIs needed to support the Proposed Regulation 2023. It should be intuitive, easy to navigate, and user-friendly, allowing stakeholders to access key insights without the need for advanced technical skills. Below are the functions that can be added: -

- **Role-Based & Customisable:**
Each user should see information relevant to their role — for example, operators can view the KPI´s relevant for their tasks while MSCAs can track compliance KPIs.
- **Real-Time Insights:**
The dashboard should pull **live data** from the AJL and booking systems, showing current journey status, and any compliance alerts or delays.
- **Visual Layout:**

Use interactive charts, colour-coded indicators, and maps to make complex data easy to understand.

- **Alert and notification panel:** A dedicated area for system alerts (e.g. AJL pending approval, delay authorisation etc) ensures quick user action and better coordination.

As an operator, the dashboard should provide below KPI´s that help plan a journey efficiently and track its progress

- Journeys submitted on time- The percentage of AJL submitted on time. The operator can view current status of their AJL.
- Compliance status- To check if the operators' authorisations or certificate, contingency plan, control post booking reservation is attached in the Journey log.
- Rejected rate- This helps to identify recurring bad quality submissions.
- Notification- To view the notification in case of any compliance issue. For example- authorisation expiry, journey delay or deviation, control post booking issue.

As an MSCA, the dashboard should provide below KPI´s that help them detect compliance issues

- On time submission rate of AJL- This would help MSCA to see if operators are respecting the regulatory submission window.
- Number of pending AJL´s To be able to view pending or expired AJL requests.

- Actual vs planned journey duration- This would help them detect delays (due to weather, traffic etc).
- Notifications- This would allow MSCA to identify any risks/alerts.
- Historical reporting and Trends

A trends section helps authorities, organisers, and the Commission understand long-term patterns in animal transport. These trends provide strategic insights on how the transport system is evolving over time. Users should be able to run reports from TRACES and export into PDF, excel etc. Below are the key trends that would be useful to monitor.

1. Journey Distance Trends

- Maximum journey distance recorded. Helps identify long and potentially high-risk journeys.
- Average distance per species or per transporter. Useful for analysing workload and welfare implications.
- Most frequent journey distance range (e.g., 100–300 km, 300–600 km). Shows typical transport patterns across the EU.

2. Destination & Route Trends

- Most recurring destinations (high-frequency routes). This can show hotspots or high-demand regions.
- Least used destinations. This helps detect under-utilised or declining routes.
- Most common origin–destination pairs. This gives MSCA the possibility to improve planning for common routes, ensure to have enough controls and control posts.

3. Trends in Transport Modes

- Most frequently used transport mode (road, sea, rail, air). This would help authorities prioritise inspections, identify infrastructural issues and help in better planning.

4. Species Transport Trends

- Most common and least transported species. In case of least transported species, helps detect special cases and rare transportation. (e.g., cattle, pigs, sheep).
- Species-specific journey duration or incidents. This helps assess welfare risks.

5. Import/Export/Transit Trends

- Countries most involved in cross-border movements. This KPI highlights border control posts and Exit Points needs and supports policy evaluation for cross-border animal welfare supervision.
- Volume of exports vs imports vs transits

6. Compliance trends

- Repeated non-compliance pattern by drivers
- Most common type of non-compliances

This enables MSCA and EC to identify systemic risks, introduce targeted training, or adjust regulatory approaches.

- Data retention strategy

As presented in 6.7.3 Data retention & archiving, it would be useful to implement a data retention strategy that allows to retain data longer than the legal retention period of 6 years, in order to keep valuable historical information to identify trends in transport over a longer period of time.

If this option is retained, it will have to address two key concerns

- 1) Ensure that the data set does not impact the performance of TRACES servers
- 2) Ensure that data is retained only for trending analyses as described in the previous section and is aggregated in such a way that it is impossible to reconstruct individual journeys or operator data from the aggregated data set.

This can be achieved by implementing a two-tier retention strategy.

The first Tier ensures **detailed operational data** of AJLs is collected and stored as it is today, in the TRACES database, for the legal retention period of 6 years. The data is purged at regular intervals, ensuring records older than 6 years are physically deleted from the database.

The 2nd Tier ensures that **aggregated trending data** is collected at regular intervals from the Tier 1. The data is extracted, aggregated, and stored in a separate database, used for analytical queries.

Extracting, aggregating and moving data from Tier 1 to Tier 2 is typically done using ETL (Extract, Transform, Load) pipelines that are very common in datawarehouse suites. The QlikSense suite, used for TRACES reporting today, also supports such ETL functionality.

- Predictive modelling

Predictive modelling refers to a set of statistical techniques that predict one or more outcomes from a given set amount of input data.

It should be noted that this requirement is not mandated by the Proposed Regulation and as such is an optional feature.

In the context of animal welfare during transport, the most obvious advantage of predictive modelling would be to determine risk profiles in advance of journeys taking place so that both operators and MSCAs can take proactive steps to minimise impacts on animal welfare. As such, the feature would neatly align with the overall objective of the Proposed Regulation to provide means to enhance Animal Welfare during transport.

In predictive modelling, the quality of the predictions will largely be determined by a number of criteria that can be considered early on during the design and implementation of the new solution.

Sufficient volume of data

This should not be a problem as TRACES will be centralising AJL data collection and given the high number of journeys across Europe and beyond, large volumes of journey data will be collected. However, given the fact that seasonal effects will certainly play a part in prediction outcomes, sufficient time should be given for data collection prior to the implementation of the predictive model.

Accurate and coherent data

If the processes are implemented centrally, the accuracy and coherence of the collected data would greatly increase. It is indeed critical for predictive models that data points collected are correctly calculated and aggregated and that they rely on definitions that are shared among all stakeholders.

Measures available on key dimensions

A challenge of predictive modelling lies in the fact that undetected variables might have a critical influence on the outcome. It is therefore crucial to identify the dimensions that would need to be included in the predictive model upfront. Dimensions should include at the very least:

- Consignment characteristics
 - Species, subspecies and type, vulnerable animals, ...
- Journey characteristics
 - Scenario (INTRA, IMPORT, EXPORT, TRANSIT)
 - Means of transport (air, road, rail, sea)
 - Distance
- Journey log compliance
 - Presence of required documents (contingency plan, control post booking, ...)
 - Anomaly reports
- Environmental risks
 - Time of year, Weather forecast, ...
 - specific geographies,
 - Traffic history, problematic routes, density of control points on the route, etc...
- Operators' profiles
 - Previous history of non-compliance, inspection outcomes
 - Type of equipment
 - Experience

Clear outcome definition

The model would assign a predicted outcome, such as a risk category, to the analysed journeys. We recommend defining the risk categories in terms of animal welfare rather than compliance as the former is larger in scope. A journey that strictly follows the compliance rules can still end up facing welfare difficulties due to external circumstances for instance.

Another important recommendation is to ensure explainability of the attributed risk category. This is done by highlighting the risk score assigned to the categories that contributed to the overall result.

As predictive modelling is highly dependent on the availability and the quality of the collected process data, we do not recommend implementing it in the early phases of the TRACES

roadmap. However, the requirements listed above should be considered from the outset as they will be prerequisites for any future rollout of predictive features.

- Conclusions

Previous reports within the study have shown that the TRACES software solution provides a strong foundation for the implementation of the new features and functionalities required for the introduction of the Proposed Regulation 2023. In the TRACES Report (D02.01.01 TRACES Report), we reviewed the existing TRACES functionalities in light of the new requirements and carried out an assessment of the key capabilities required under the new Proposed Regulation.

We used the same capabilities as the backbone of the present report, to recommend enhancements to the solution. **We will now summarise those findings per capability.**

The record and document capabilities of TRACES are rather central to the current solution, are very mature and offer robust functionalities to the various domains supported by the application, such as lifecycle management (approve, suspend, cancel ...), document workflows and electronic signature (for MSCAs).

We recommended to link the actual documents (certificates and authorisations, as signed pdfs) to the relevant user records, to facilitate compliance checks and inspections. Other recommendations included the addition of document/record events to improve the notification and task management flows (renewals, etc...), and the introduction of retention, archiving and disposal policies in line with the new requirements.

Workflow management is tightly linked to the previous capability as TRACES supports a document-oriented workflow. We recommended to introduce a process engine in its own right that would decouple document management and task management as we believe the Proposed regulation is placing new requirements in terms of process flows that will require this additional flexibility.

The compliance management capability will require very substantial changes to the TRACES solution as the objective is to enhance both the ability to display non-compliances in the interface and guide the user towards resolution and also features that will enable authorities to better detect, inspect and solve non-compliant behaviours.

This set of features will rely heavily on the ability of TRACES to implement complex business rules that support the compliance requirements. We provided recommendations around the implementation of decision support modules that offer significant advantages over in-code implementation of complex rule sets.

Another capability that feeds directly into compliance management is data integration. We discussed in detail how journey logs could be enhanced with geolocation and weather information through dedicated APIs.

The Access management capability will need to support roles for individual economic operators that will operate in TRACES (desktop or mobile) and will need more fine grain access policies. We also recommended the introduction of a “Case Team” concept to link individuals (both MSCAs and Operators) to a single Journey Log so as to support real time communication between actors during a journey for instance.

Finally, the reporting capability brings transversal support and provides MSCAs with the ability to better monitor, detect issues and improve the overall transport process. The QlikSense solution already provides the required capabilities, but they will only be realised once the two processes under study are fully digitalised and implemented in TRACES. We provided recommendations to include the reporting dimension into the design of the new flows so that all required data points and measures are readily available to QlikSense when the new solution is implemented.

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6.10 D.04.02. Mobile application outline

- Introduction

The present TRACES Mobile Application outline Report forms an integral part of the broader study of the modalities of Animal Welfare during Transport, commissioned under the EU4Health and Single Market Programme and managed by the European Health and Digital Executive Agency (HaDEA).

More specifically, the report builds upon the insights collected during previous phases of the study to address objective 4 of the commissioned study:

“Objective 4: To examine possible modalities for better accessibility to TRACES and simplified use of the system by means of mobile application and the development of such application, allowing the access everywhere. The study should also present options for the IT development, the financing model, general data security considerations, and protection of personal data” (Technical Annex - Annex 1 to Specific contract N° BEACON/HADEA/SANTE/Study on modalities AW during transport - BEACON-000167, 2024, p. 5)

. In order to provide recommendations on the required changes to support end-to-end digitalization of the AWT process, the report consolidates insights gathered in the consultation phase (Task 2) and the analysis of the options offered by modern geolocation systems (Task 3).

While the present report focuses exclusively on the improvement of TRACES accessibility by means of a mobile application, recommendations regarding the existing TRACES solution (desktop solution) have been drafted in the other Task 4 report, (D04.01 TRACES Recommendation report, 2025), to which this report will frequently refer.

- Functional outline

- 1) Context & goals of the mobile application

In the explanatory memorandum of the Proposed Regulation 2023, special attention is devoted to the digitalization of the administrative processes supporting the transport of live animals.

Digitalization is identified as an essential enabler for better implementation and enforcement of the new rules, capable of improving data quality, reducing significantly the administrative burden for economic operators and MSCAs and reinforcing compliance across Member States and operators.

Within this broader strategy, **Article 53** of the draft regulation commits the Commission to delivering a **mobile application** for use by transport operators and competent authorities. The inclusion of this tool directly in the legislative text reflects a policy objective to modernise administrative processes and to fully leverage digital technologies in support of animal welfare. The draft regulation underlines that digital tools such as a mobile application linked to the TRACES information system would facilitate official controls, improve record-keeping, and simplify the planning and execution of transport journeys, thereby reducing paperwork and enhancing compliance.

To achieve these policy goals, the proposal sets a **minimum set of capabilities** that the application must provide. According to Article 53, these core functionalities will include:

- Creation and updating of journey log sections by registered TRACES users
- Submission of journey logs for approval to competent authorities
- Calculation of required space allowances for different species
- Tools for assessing fitness for transport in line with health and welfare criteria and
- Tools to check the weather forecast to support decision-making on transport conditions.

While Article 53 defines this foundational scope, **additional capabilities** are also being considered, as discussed with stakeholders during the consultation phase of the present study. Enhancements such as in-app chat functionality, multilingual support and automatic translation, and improved user guidance modules aim to further streamline interactions and support usability for diverse user groups (e.g. drivers & attendants, keepers, official veterinarians).

These extended functionalities are not explicitly mandated in the regulation but are being explored in this document as a potential addition to the core set of functionalities, in order to further enhance the user's experience and reduce administrative burden.

- 2) Actors and roles

- **Actors**

For the purpose of defining the various actors involved in the AJL process, we refer to the definitions used in the Proposed Regulation (European Commission, 2023).

Organiser means “(a) a transporter who transports or has subcontracted the transport of animals for the whole journey or a part of the journey to at least one other transporter; or (b) a natural or legal person who has contracted the transport of animals to a transporter; or (c) a person who has signed Section 1 of the journey log in TRACES as set out in Annex III.” (European Commission, 2023, p. Art 3)

Keeper means “any natural or legal person, except a transporter, in charge of or handling animals whether on a permanent or temporary basis;” (European Commission, 2023, p. Art 3) . Actors like farmers, assembly centre, control post or slaughterhouse operators are keepers.

Transporter means « an operator whose economic activity consists of transporting animals on its own behalf, or on behalf of a third party;” (European Commission, 2023, p. Art 3). Drivers and Attendants are individual persons working for a Transporter.

Member State **Competent Authority**, or MSCA, means a competent authority as defined in Article 3(3) of Regulation (EU) 2017/625.

It is important to note that the actors listed above do not necessarily align with the concepts of Entity or Economic Operator. For instance, a legal entity active in the transport of animals, ie a transporter, can also fulfil the responsibilities of an organiser, a keeper can be a natural or a legal person, etc...). Rather, the regulation uses the various actors to determine obligations and responsibilities.

- **Application roles**

Next to the various actors involved in the process, we also need to define the concept of application role. The application role is conceived of as a set of permissions assigned to specific individuals / job functions, within the software application.

The role of **organiser** will be fulfilled by individuals entitled to plan journeys and submit planning forms for approval. The role can be assigned to an employee working for a Transporter, or an Organiser.

The role of **driver/attendant** will be fulfilled by employees of transport companies. While there is a functional difference between the driver and the attendant, from an application perspective, it was determined that the two functions did not require a separate role in the application, hence the combined role name.

The role of **keeper** is more straightforward and will give access to the Control Post booking functionalities (for Control post managers) and to the Sections 2 and 3 for all types of keepers.

Lastly, two separate roles will be required for the actor MSCA: **MSCA official** as the role allowing to assess, approve/reject AJLs and **Official veterinarian** as the role allowing to sign sections 3

and 5. This distinction is required for those MSCAs that want to prevent MSCA officials who are not keepers to sign sections 3 and 5.

- **Personas**

A last concept is that of “persona”. The persona is used in the context of Customer journey mapping (see further), represents a typical user of the application and defines his/her journey through the application and the views and actions he/she has access to. As such, the personas will largely align with the application roles defined above. We will define customer journeys for the organiser, the driver/attendant and the keeper. The official veterinarian’s journey will be largely similar to the journey of the keeper in terms of views and actions, so we will define the keeper journey and associated screens, and to avoid the duplication of journey and screens, we will indicate where the journey of the official veterinarian would differ from that of the keeper.

3) Sections of the Animal Journey Log and associated roles

The Animal Journey Log process was described in depth in a previous report (D02.01.01 TRACES report, 2025). In this section, we provide a brief summary of the journey log process, described from the perspective of the five sections that constitute the log and the various roles that play a part in creating those sections. We refer the reader to the TRACES report for a more detailed analysis of the AJL process. The actual forms are listed in **Annex 10.1 AJL Sections**.

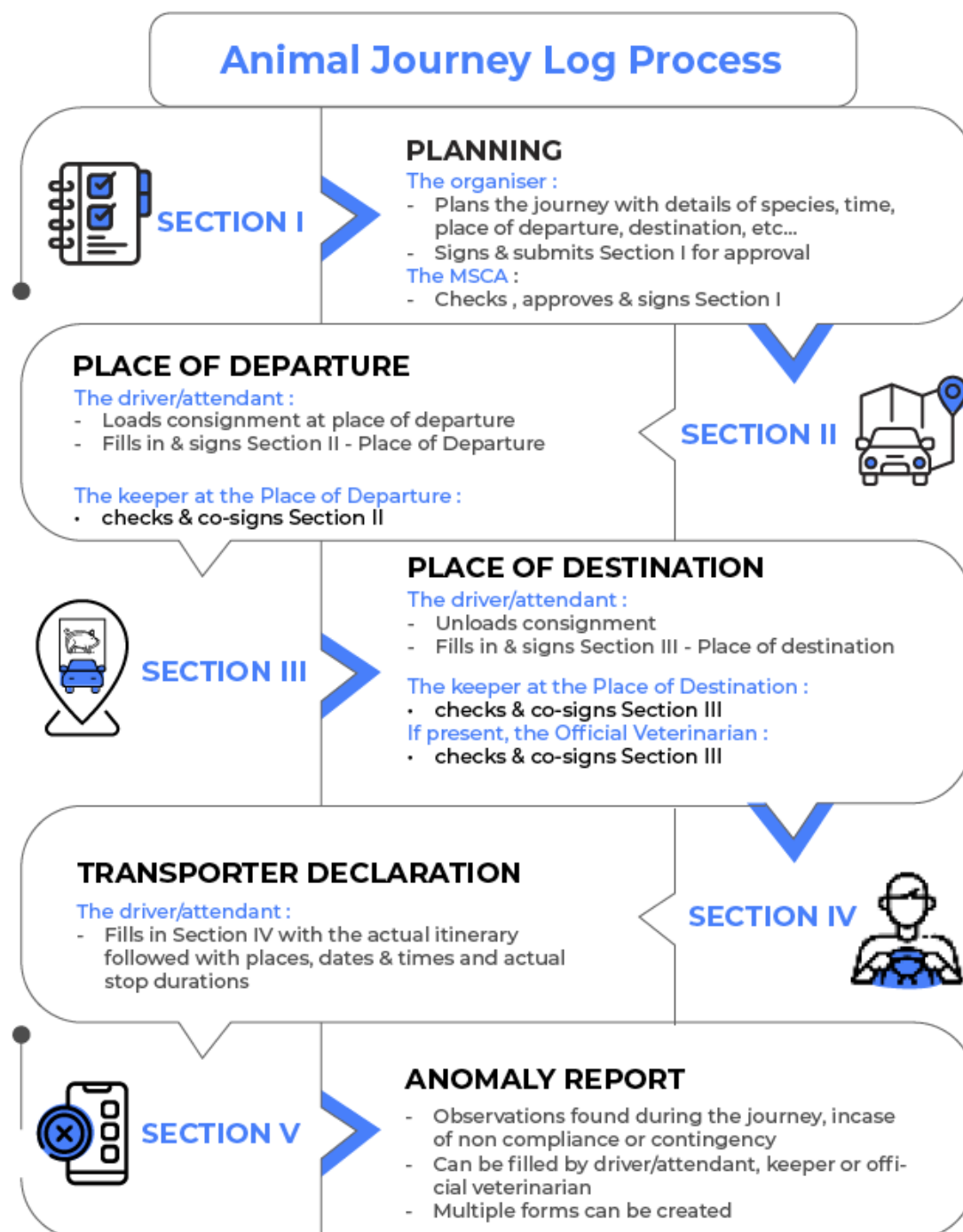


Figure 105 The 5 sections of the AJL Customer Journey Mapping: Purpose & Practice

- **Purpose of creating Customer Journey Maps**

Starting with customer journey maps allowed us to describe and understand the solution from the user's perspective, rather than only focusing on technical requirements or system features.

By mapping the journeys, we were able to:

- Visualize the end-to-end experience of each role, highlighting how they interact with the application at every stage of the process.
- Identify pain points and opportunities where the app can provide value, simplify tasks, or reduce complexity.
- Align the team's understanding of the different user needs, ensuring that the solution addresses real challenges instead of assumptions.
- Highlight dependencies between roles, showing where information must be passed from one user type to another (e.g., organiser to driver/attendant, driver/attendant to competent authority/keeper).
- Facilitate empathy by putting ourselves in the shoes of each user, which supports a more user-centric decision-making.

- **Construction of the Journey Maps**

Based on the interviews conducted during Task 2, we developed a Customer Journey Map for the four personas : Organiser, Driver/Attendant, Keeper & Official Veterinarian. These maps reflect the insights gathered from real user experiences and highlight the key touchpoints, challenges, and opportunities encountered throughout the journey. By synthesizing the qualitative data collected during the interviews, we were able to design an end-to-end representation of the users' interactions with the system.

The resulting Customer Journey Map serves as a strategic tool to:

- Identify pain points and barriers that hinder efficiency or satisfaction.
- Highlight moments that are critical for delivering value to the user.
- Uncover opportunities for improvement and innovation.
- Align stakeholders around a shared understanding of the Driver/attendant's experience.

Ultimately, these Customer Journey Maps provide a clear and actionable framework to optimize the user experience for users, ensuring that the proposed solution is not only functional but also user centered.

- **Structure of the Journey Maps**

Each block within the customer journey maps represents either:

- An action or functionality that the user can perform through the application, or
- A piece of information that the user can access or consult.

For each of these actions or functionalities, we established a direct link with the list of user stories. This ensures traceability between the user experience design and the product backlog.

During this process, two important observations emerged:

1. Overlap between user profiles – Certain functionalities appear in multiple user journeys. For example, both the driver/attendant and the organiser may need to check the status of a journey, or both the organiser and the keeper may need access to compliance documentation. Identifying these overlaps is valuable because it allows us to streamline development, avoid redundancy, and ensure a consistent experience across roles.
2. Transversal functionalities within a single journey – Some functionalities are not tied to one specific step of a user’s journey but instead span across several stages. For example, a “notification” or “document access” feature may be relevant at the preparation stage, during the journey, and at the post-check stage for the same user. Highlighting these transversal elements helps us design features that are flexible and persistent, supporting the user throughout their entire workflow rather than being limited to one step.

- **Outcome**

Using customer journey maps as a starting point gave us a shared foundation to describe the solution. It ensured that we approached the design with a clear view of the users’ goals, tasks, and challenges, and that the application is designed to support real-world workflows across all three roles. Moreover, the direct connection between journey map blocks and user stories guarantees that the application development remains firmly grounded in user needs while maintaining coherence across different user roles.

- **Customer Journey Mapping for 3 Key Personas**

As part of our design process, we created customer journey maps for the four personas of the mobile application:

- The driver/attendant – the person responsible for driving the truck and attending to the animals during the journey.
- The organiser – the person in charge of planning, scheduling, and managing the trip.
- The keeper – the person responsible for the animals at the place of departure, control post and place of destination.

Note : the customer journey of the Official Veterinarian is largely similar to that of the keeper.

Overview of Customer Journey Maps

In this section, we will take a closer look at each block of the customer journey maps, clarifying the features, the interactions between them, and the way they weave together to create the overall experience. We will explore what each step enables, how users move from one stage to the next, and how the different components communicate with one another to support a smooth and coherent journey. Think of it as opening the backstage curtain: every gesture, every transition, every functional detail becomes visible so we can understand how the entire storyline operates.

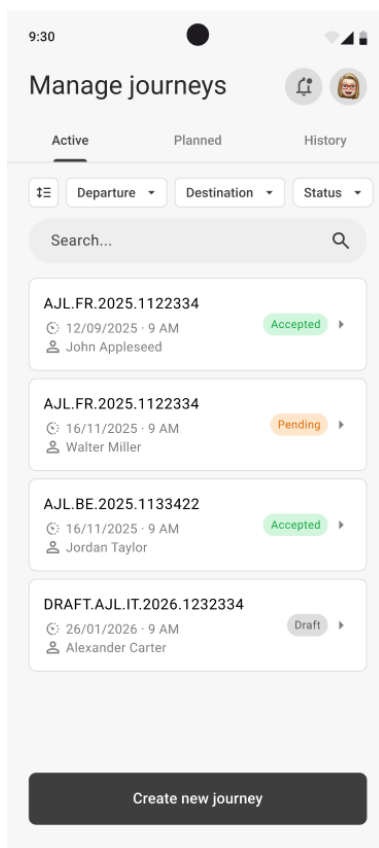
- **Organiser**

The organiser's interface provides end-to-end visibility and control over the full journey lifecycle. From planning and submitting new journeys to monitoring active ones and archiving completed records, organisers benefit from streamlined workflows supported by advanced search, filtering, and status tracking. Automated system alerts and driver-generated notifications ensure continuous awareness and rapid response to evolving conditions. By centralizing data, documentation, and communication, the system empowers organisers to optimize efficiency, maintain compliance, and foster effective collaboration with drivers and other actors along the journey.

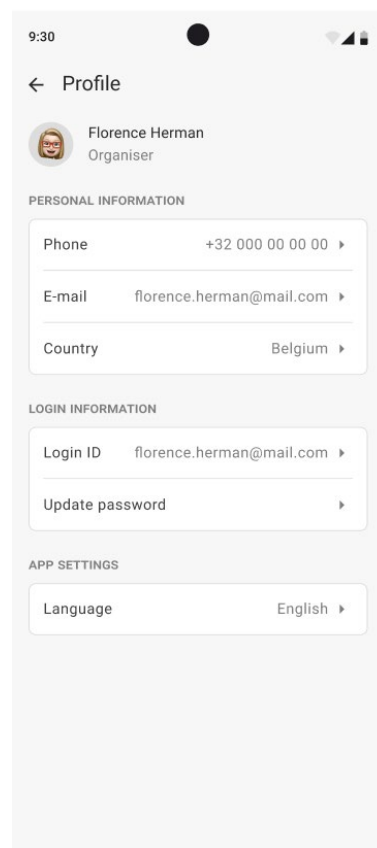
The organiser's Customer Journey is presented in ***Annex 10.2.1 Organiser's Customer Journey***.

Home Screen

After logging into the application, the organiser accesses a centralized home screen that provides a complete overview of transport operations. From this interface, the organiser can view past journeys, active journeys (trucks currently on the road), and upcoming scheduled journeys (planned journeys). He/she can also create a new journey directly from the dashboard and search or filter journeys based on departure location, arrival location, driver/attendants' name, arrival date and journey status. He/she can also access his/her profile section.



Screen 1 Organiser./Active Journeys



Screen 2 Organiser/Profile

The system manages journeys according to different statuses:

1. Planned journeys, which may appear as:
 - Draft – journey logs being prepared but not yet submitted to MSCA
 - Pending – journey logs submitted and awaiting validation by the MSCA
 - Approved – journey logs submitted and validated by the MSCA

- Rejected – journey logs rejected by the MSCA
- 2. Ongoing journeys (in transit, at control post and at place of destination), corresponding to trucks currently on the road.
- 3. Completed journeys, which move into the past journeys archive once Section IV of the journey log has been signed by the driver.

In addition, the organiser benefits from a notification system that ensures continuous visibility and responsiveness:

1. System-generated notifications, automatically triggered by key events such as a status change (e.g. pending to approved by the MSCA), or system alerts requiring modifications for a planned or ongoing journey like extreme temperatures.
2. Driver/attendant-generated notifications, which are triggered by driver/attendant actions, such as the submission of an anomaly report, the driver notifying of his/her arrival at a control post, or the cancellation of a control post booking.

This structured and proactive approach allows organisers to maintain full control over journey management. By combining real-time monitoring, advanced filtering, and intelligent notifications, the application enhances operational efficiency, ensures regulatory compliance, and enables faster, data-driven decision-making across the entire transport process.

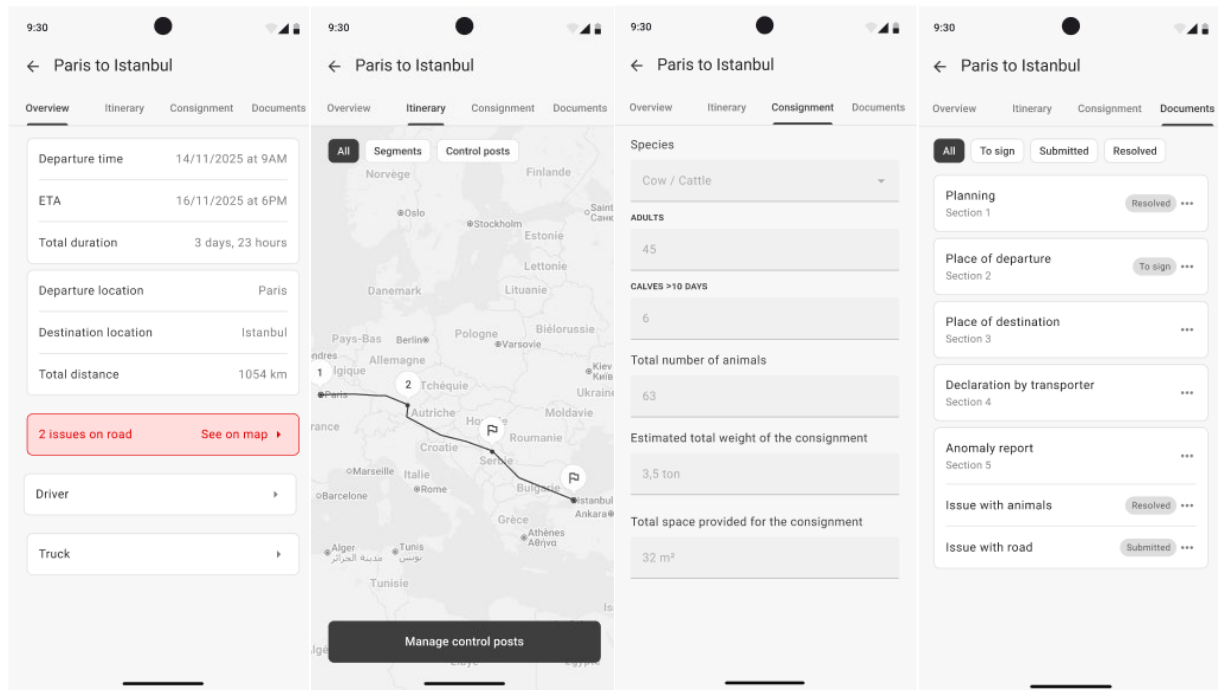
Journey Management: Existing Journeys and New Journeys

Existing Journeys

Users have two main entry points: accessing existing journeys (past, active, or planned) or creating a new journey. Existing journeys share many common functionalities, although some features may be visible or hidden depending on the journey's status.

For clarity, this section focuses on active journeys (trucks currently on the road), as they provide the most comprehensive view of the available features. Detailed variations for other status values can be found in the organiser Customer Journey Maps in **Annex 10.2.1 Organiser's Customer Journey**.

Active Journey



Screen 3 Org. / ActiveScreen 4 Org. / ActiveScreen 5 Org. / ActiveScreen 6 Org. / Active
 journey / Overview journey / Itinerary / 01 Journey / Consignment Journey / Documents

The organiser can have access to:

- A visualization of the planned itinerary on the map

Driver/attendant's contact details, with the ability to initiate an in-app chat session with him/her (optional feature) to streamline coordination in case of incident or delay.

- Vehicle information (license plate) and consignment details (species, number of animals, etc.), supporting accurate preparation for inspections.
- Centralized documentation access, allowing the user to consult and verify all relevant documents before the truck arrives, facilitating faster and more reliable decision-making.

Control Posts

The organiser has full visibility over all control posts along the itinerary, with their availability status. For each control post booked for a given itinerary, the organiser can:

- View the forecasted arrival time and detailed information, such as the location, keeper's name, and contact details of the Control Post (phone number, email, etc.).
- Modify key details, including the arrival date and time or the number of animals.

- Cancel a planned control post (see “Control Post Cancellation” below for more details).

The organiser can also book new control posts when creating or editing a journey (see **section 5.4.2.4.3 Booking a Control Post** for details and illustrations/screen mockups).

For ongoing rest at control posts and control posts from past journeys, the organiser can:

- Access photos and videos uploaded by the driver/attendant during unloading. Note: this is an optional component, see extensive discussion in (D04.01 TRACES Recommendation report, 2025, p. Section 6.5).
- View all documents completed and signed by the keeper

Control Post Cancellation

When a control post reservation is cancelled, the system could automatically prompt the organiser to select a replacement. It could suggest alternative control posts along the planned route, based on:

- The driver/attendant’s estimated time and date of the required stop, and
- The availability of nearby facilities.

Once a new control post is selected, the organiser could visualize the impact of this change directly on the map and on the overall journey before confirming.

Anomaly Reports

For both active and past journeys, the organiser can view anomaly reports, a structured form used to document any issue encountered during transport. Anomaly reports can be created by drivers/attendants and/or keepers. See **section 5.3 Sections of the Animal Journey Log and associated roles** for a discussion of the five forms/sections of the AJL and the associated roles and **section 5.4.2.7 Incident Reporting Functionality (Anomaly Report)** for the anomaly report creation process.

Screens for anomaly reports are available in the Driver/attendant Customer Journey (see **section 5.4.2 Driver/attendant**).

In app-chat

A chat module was presented in as an optional component allowing AJL participants to communicate with each other in real time. See Section 5.1 *Context & goals of the mobile application*.

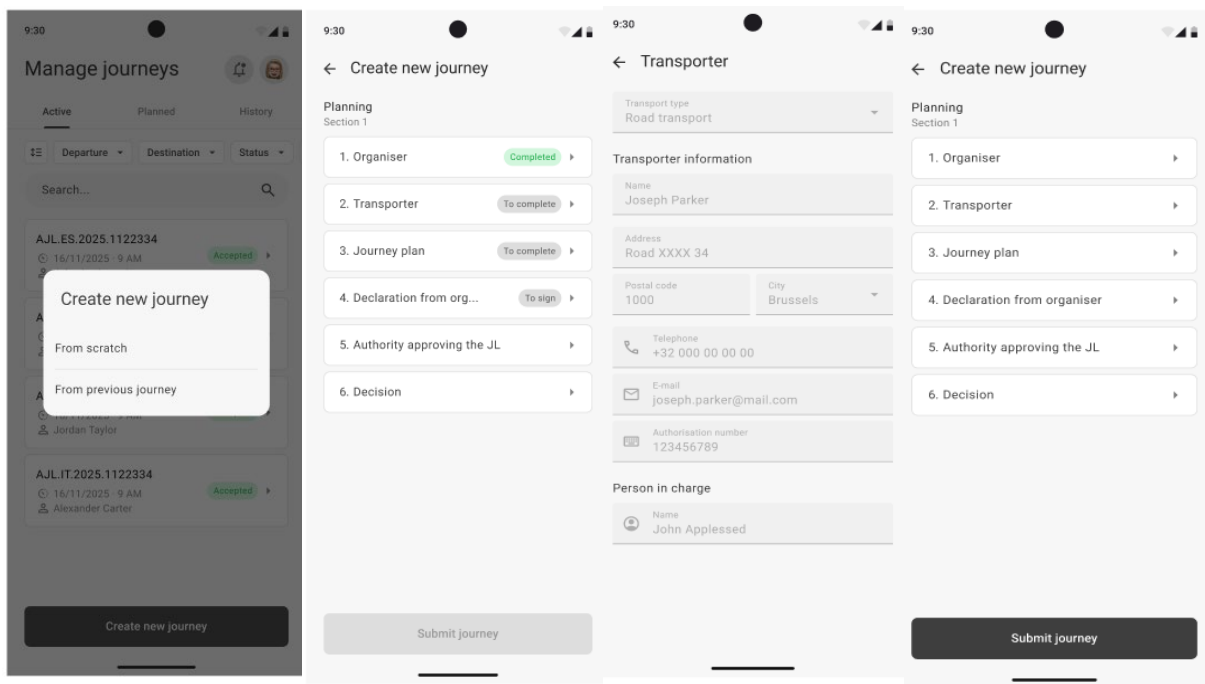
The organiser has access to the full history of all messages exchanged between the driver/attendant and the resource persons (keepers) from the control post. This includes every communication sent or received through the platform, ensuring complete visibility and traceability of interactions. More details on the driver/attendant’s communication features can be found in the “Driver/attendant” section (see **section 5.4.2 Driver/attendant**).

Create new journey

The organiser can either create an entirely new journey from scratch (option 1) or start from a journey already stored on the platform (past, submitted to MSCA, or draft) to duplicate and edit it in order to create a new one (option 2).

The screens presented here illustrate Option 1, while the description that follows focuses on Option 2. This distinction allows us to compare both approaches more clearly: what is visible in the mock-ups represents the first path, whereas the narrative and functional details we are about to examine highlight the alternative flow.

The sequence below illustrates the flow of the AJL creation. Note: the organiser tab should be prefilled with the information available from his/her profile to reduce manual data entry.



Screen 7 Org./Active journey/Create Screen 8 Org. / Create new journey / 01 Screen 9 Org. / Create new journey / 02 Screen 10 Org. / Create new journey / Section 1

9:30

← Paris to Istanbul

Overview Itinerary **Consignment** Documents

Species

Cow / Cattle

ADULTS

45

CALVES >10 DAYS

6

Total number of animals

63

Estimated total weight of the consignment

3,5 ton

Total space provided for the consignment

32 m²

Screen 11 Org. / Create new journey / Section 1 / 03

9:30

← Paris to Istanbul

Overview Itinerary **Consignment** Documents

Species

Cow / Cattle

ADULTS

45

CALVES >10 DAYS

6

Total number of animals

63

Estimated total weight of the consignment

3,5 ton

Total space provided for the consignment

32 m²

Calculator widgets

Fitness check

Required space

Screen 12 Org. / Create new journey / Section 1 / 04

Option 2: Creating a New Journey from an Existing One

Option 2 describes the behavior for “creating a new journey from an existing one”: since option 1 ultimately leads to the same form, the only difference is that the user fills in empty fields instead of editing pre-filled information.

The user can browse the list of journeys (past, submitted to MSCA, and draft) and run a detailed search using one or more criteria: driver name, vehicle license plate, place of departure, or place of destination. Once the desired journey is found, the user selects it to duplicate it.

The system then opens the questionnaire with the information in Section I – Planning already pre-filled. The user can freely edit any of these fields to modify the new journey.

The organiser may choose to reserve the same control posts as in the original journey or select new ones. To do this, they must use the Control Post Reservation module (see below).

System-Assisted Modifications

As the user updates journey information, the system could automatically perform several actions to assist planning:

- Suggest the date and time of arrival based on the duration of similar past journeys.
- Propose available control posts (CPs) relevant to the planned journey, including estimated rest-break requirements.

- Display alerts and system proposals, including:
- View itinerary segments that are non-compliant and suggest corrections.
- Identify non-compliant segments and propose actions:
 - Select an alternative route from the list of pre-approved routes for the chosen destination or define a new one.
 - Choose a pre-approved CP for that destination or manually add another CP.

System-generated proposals may include:

- Selecting a new CP.
- Choosing different route segments.
- Adjusting the time of departure.

The system also updates the map in real time so that the organiser can immediately see how route segments change when modifications are applied.

Additional Tools Available to the organiser

To support journey planning, the organiser can also use several widgets.

Note : since in most cases, the organiser will work from the Desktop application, those features will also be added there.

- Space Calculator Widget by species or by space available

9:30 ← Required space calculator

By species By space available

What species will be transported?

☒ Cow / Cattle

☐ Rabbit

☐ Pig

☐ Poultry

☐ Sheep

☐ Equine (horse, donkey, mule)

Next

9:30 ← Required space calculator

By species By space available

Truck details

Truck area (in m²)
20 m²

Note: For multi-bed truck, enter the Truck Area post adding total floor space of different beds
e.g. 1 bed truck = 30 SQM, 2 bed truck = 60 SQM

Height of truck (in m)
2 m

Calculate space requirements

9:30 ← Required space calculator

By species By space available

Space requirements

Max. number of animals
35

Species
Cattle

Truck area
20 m²

Height of truck
2 m

Close calculator

Screen 13 Space Calc / BySpace / 02 Screen 14 Space Calc / By Space / 04 Screen 15 Space Calc / By Space / 05

- Fitness For transport Widget

For more details, please refer to the Traces Recommendation report (D04.01 TRACES Recommendation report, 2025).

Saving Progress

At any time, the user may save the modifications and exit the form before submitting the journey to the MSCA. The system then asks whether the changes should be saved as a draft. If confirmed, the journey status becomes “Draft”.

The user may also choose to discard all unsaved changes.

Submitting to MSCA

Once all information in Section I is completed, the Organiser validates the form. A request for approval is then sent to the MSCA, and the journey status changes to: “Planned Journey – Pending”

Control post booking

The system could automatically suggest suitable Control Posts based on the planned journey as well as based on the consignment (animal species and number of animals). However, the user may reject these recommendations and instead go through the full Control Post reservation workflow, similar to the one available in the driver/attendant's interface and illustrated in **section 5.4.2.4.3 Booking a Control Post**.

To reserve a Control Post, the user must complete the following three steps:

1. Specify the expected date and time window for the mandatory break

The user enters the date and approximate timeslot during which the driver/attendant is expected to stop for a rest period.

2. Specify the species and number of animals that will rest, including the number of pens required

The user provides the list of animal species carried, the number of animals per species, and the number of pens or resting units required to accommodate the animals during the stop.

3. Indicate the geographical area where the driver should stop

The system provides a search bar where the user can enter a location. Based on this input, the system displays all available Control Posts that:

- Match the requested date/time window,
- Have sufficient capacity for the consignment, and
- Are located within a reasonable distance of the indicated area.

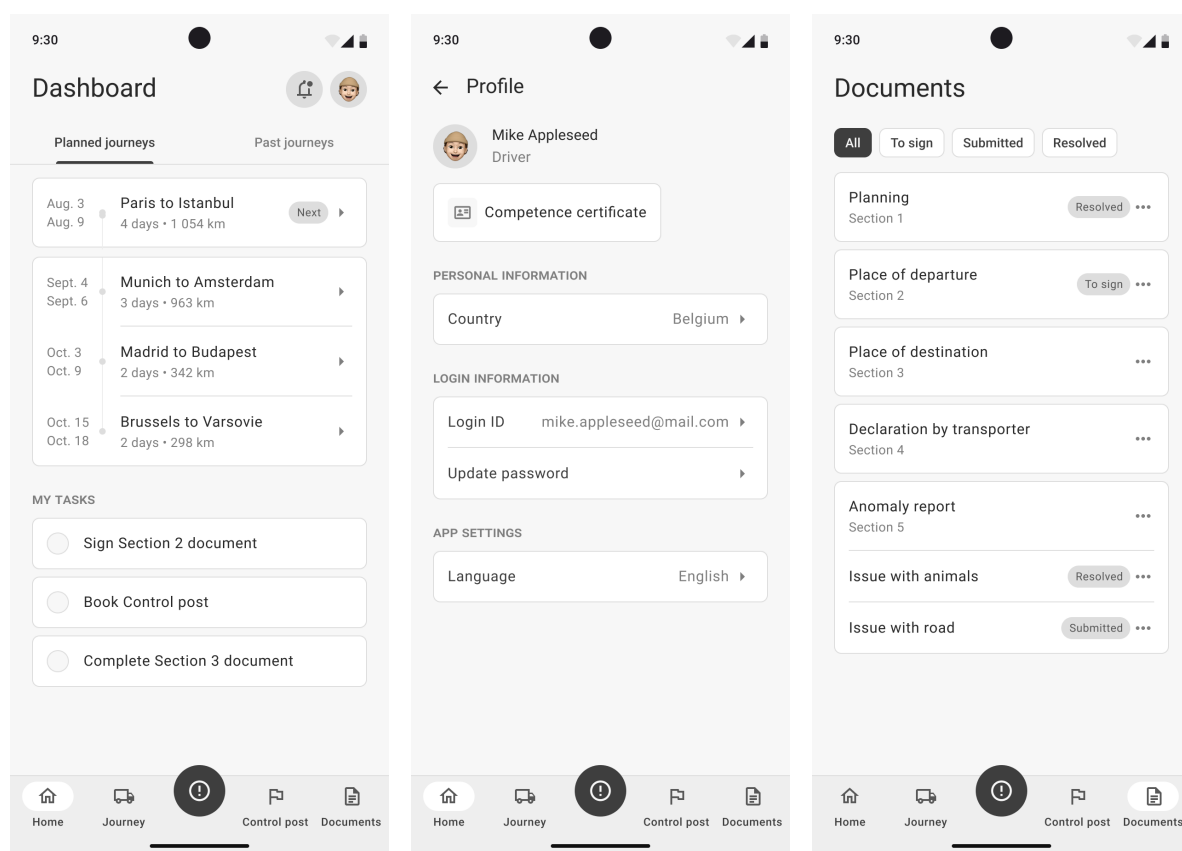
Control Posts are automatically sorted by geographical proximity, from the closest to the farthest, and the system shows the distance (in kilometers) between the requested stopping point and each Control Post.

Driver/attendant

The driver/attendant's interface provides clear, step-by-step guidance throughout the entire journey, from departure to final arrival. Real-time tasks, notifications, and anomaly reporting tools ensure that responsibilities are managed efficiently and in compliance with regulations. By enabling drivers/attendants to submit sections/forms, share supporting evidence, and maintain seamless communication with organisers, MSCAs and keepers, the system enhances accountability, transparency, and coordination across the transport process.

The driver/attendant's Customer Journey is presented in **Annex 10.2.2 Driver/attendant's Customer Journey**

Application Home Screen – User Experience Overview



Screen 16 Driver / Dashboard

Screen 17 Driver / Profile

Screen 18 Driver / Documents / 01

Once logged into the application, the user is directed to the home screen, which serves as the central hub for managing journeys and related tasks. From this interface, the user can:

- **Access past and upcoming journeys:** The home screen displays completed trips (“past journeys”) and those scheduled in the future (“planned journeys”). By clicking on a

specific journey, all detailed information coming from Section I to Section V (see Appendix) is available:

- For past journeys: the driver/attendant can view all the information related to the journey from Section I to Section V
 - For planned journeys, the driver/attendant can view the information that has already been completed by the organiser in Section I. Sections II and III are prefilled as much as possible with information already defined in Section I.
 - The driver/attendant can also view the relevant status of Section I:
 1. Pending: submitted by the organiser to the MSCA but not yet approved
 2. Approved by the MSCA
 3. Rejected by the MSCA
-
- **Search and filter journeys:** Users can quickly locate a specific trip by searching via place of departure or place of destination location or by sorting journeys chronologically according to departure date.
 - **Access key documents:** The application provides direct access to essential documentation such as the contingency plan, driver competence certificate, and other regulatory or operational materials. These documents remain accessible at all times.
 - **Manage personal tasks ("To Do List"):** On the home screen, the user can also see a list of tasks to complete, such as booking a control post, filling in missing information in a form, or signing a document. The task only disappears from the screen once the user has completed it.
 - **Receive notifications:** Informational updates, such as itinerary changes for a scheduled journey or confirmation/cancellation of a post-control booking, are delivered through the home screen. Unlike tasks, notifications are advisory in nature and do not require direct action from the user. Importantly, notifications remain continuously accessible to the driver/attendant, ensuring that no critical update is missed. The user also receives notifications whenever a new message is received through the Control Post messaging system ("in-app chat", see details below).
 - **Consult profile details:** The user also has access to their profile to view their log in information and change the interface language.

This combination of features ensures that the home screen functions as a comprehensive control center, enabling the driver/attendant to efficiently manage trips, monitor their status, access important resources, and maintain compliance with operational requirements.

Before departure

In the organiser journey, we described two options for AJLs whereby: either the journey has already been created in advance by the organiser and therefore appears in the list of planned journeys (option 1 in the Customer Journey Map), or an organiser can create it directly from the mobile application (option 2 in the Customer Journey Map).

From the driver/attendant's perspective, only option 1 is relevant as only an organiser can create the AJL.

The driver/attendant can view all the information that has already been filled in Section I – Planning.

The Planning Section screens follow the structure of the form *Section I – Planning* as defined in the Proposed Regulation 2023 (See **Annex 10.1.1 Section I - Planning** for the actual Section I form). The driver/attendant can review the 6 paragraphs of Section I – Planning : “Organiser”, “Transporter”, “Journey Plan”, “Declaration of the Organiser”, “Authority approving the AJL” and “Decision”.

Going through the various sections of the form, the driver/attendant can view key AJL information such as the planned departure date and time, the booked control posts and all documents related to these bookings. He/she also has the option to cancel control post bookings and submit new booking requests to other available control posts (see more details in the organiser section). He/she can view, complete, or edit the space calculator and fitness for transport widgets.

It should be noted that if modifications of the approved AJL are required, it should be resubmitted to the Competent Authority by the organiser.

The “organiser” and “transporter” screens of the *Section I – Planning* form:

9:30

←

Planning

Section 1

This section has been completed by the organiser.

1. Organiser

2. Transporter

3. Journey plan

4. Declaration from organiser

5. Authority approving the JL

6. Decision

9:30

←

Organiser

Authorisation number

123456789

Name

Warren Daniel

Person in charge of the journey

Name

John Applesed

Telephone

+32 000 00 00 00

E-mail

john.appleseed@mail.com

9:30

←

Transporter

Transport type

Road transport

Transporter information

Name

Joseph Parker

Address

Road XXXX 34

Postal code

1000

City

Brussels

Telephone

+32 000 00 00 00

E-mail

joseph.parker@mail.com

Authorisation number

123456789

Person in charge

Name

John Applesed

Screen 19 Driver/Section 1/01 Screen 20 Driver/Section 1/02 Screen 21 Driver/Section 1/03

The “journey plan” screens of the *Section I – Planning* form:

9:30

← Journey plan

Planning Consignment Stop points

Departure

Name
Farm xyz

Address
Road XXXX 34

Postal code
XXXXX

City, Country
Paris, France

Date
29/10/2025

Time
09:00 AM

Destination

Name
Section 148

Address
Road XXXX 17

Postal code
XXXXX

City, Country
Istanbul, Turkey

Date
29/10/2025

Time
09:00 AM

Estimated duration

x days and y hours

Screen 22 Driver/Section 1/04

9:30

← Journey plan

Planning Consignment Stop points

Species

Cow / Cattle

ADULTS

45

CALVES >10 DAYS

6

CALVES <5 WEEKS

0

UNWEANED CALVES

12

PREGNANT

0

Total number of animals

63

Veterinary

Certificate number
123456789

Estimated total weight of the consignment

3,5 ton

Total space provided for the consignment

32 m²

Screen 23 Driver / Section 1 / 05

9:30

← Journey plan

Planning Consignment Stop points

Assembly center

Address
Road XXXX 34

Postal code
0000

City
XXXXXX

EXPECTED MOMENT OF ARRIVAL

Date
01/11/2025

Time
04:30 PM

Length
7 hours

Control post

Address
Road XXXX 34

Postal code
0000

City
XXXXXX

EXPECTED MOMENT OF ARRIVAL

Date
01/11/2025

Time
04:30 PM

Length
7 hours

Exit point

Address
Road XXXX 34

Postal code
0000

City
XXXXXX

EXPECTED MOMENT OF ARRIVAL

Date
01/11/2025

Time
04:30 PM

Length
7 hours

Screen 24 Driver / Section 1 / 06

The “Declaration from organiser”, “Authority approving” and “Decision” screens of the *Section 1 – Planning* form:

9:30

← Declaration from organiser

I, the organiser, hereby declare that I am responsible for the organisation of the abovementioned journey and I have made suitable arrangements to safeguard the welfare of the animals throughout the journey in accordance with the provisions of Regulation (EU) 2023/XX.

☒ Validation by the organiser

Signed by John Appleseed
16/10/2025 at 9:05 AM

9:30

← Authority approving the JL

Authority

Name
Louis Everett

Address
818 Sanford Lake

Postal code
1000

City
Brussels

Telephone
+32 000 00 00 00

E-mail
john.appleseed@mail.com

Official

Name
Louis Everett

View signed document

Signed 16/10/2025 at 9:05 AM

9:30

← Decision

☒ Approved

Date
16/10/2025

Justification

Lorem ipsum dolor sit amet
consectetur. Tincidunt cursus nunc
aliquet tincidunt vitae et quam est.

Screen 25 Driver / Section 1 / 07Screen 26 Driver / Section 1 / 08Screen 27 Driver / Section 1 / 09

Starting the Journey

Once a planned journey has been validated by the MSCA and the day of departure has arrived, the driver/attendant receives a notification to complete information in the Section II – Place of Departure and provides his/her signature (see Traces Recommendation report for details). This step is mandatory and must be fulfilled in order for the journey to officially start.

9:30

←

Place of departure

Section 2

When starting the journey, this section is to be completed by the keeper and yourself, the driver.

1. Keeper at place of departure

▶

2. Loading

▶

3. Declaration of the keeper

▶

4. Declaration of the driver

To sign ▶

Submit section 2

Screen 28 Driver / Section 2 / 01Screen 29 Driver / Section 2 / 02

9:30

←

Keeper at place of departure

Place of departure

Name

Assembly center

Address

Road XXXX 34

Postal code

1000

City

Brussels

Keeper in charge

Name

Telephone

E-mail

9:30

←

Loading

✓

Country of departure

Paris

First animal loading

Date

01/11/2025

Time

04:30 PM

Number of loaded animals by species

Cow / Cattle

48

Number of loaded animals by category

PREGNANT ANIMALS

0

UNWEANED ANIMALS

0

Total number of animals

63

Home

Journey

Control post

Documents

Screen 30 Driver / Section 2 / 03a

9:30

← Loading

Country of departure
Paris

First animal loading

Date
01/11/2025

Time
04:30 PM

Number of loaded animals by species

Cow / Cattle

48

Number of loaded animals by category

PREGNANT ANIMALS

0

UNWEANED ANIMALS

0

Total number of animals

63

9:30

← Declaration of the keeper

I, the keeper of the animals at the place of departure, hereby declare that I have been present at the loading of the animals. According to my knowledge at the time of loading, the above mentioned animals were fit for transport and the facilities and procedures for handling the animals were in accordance with Regulation (EU) 2023/XX on the protection of animals during transport and related operations.

☒ Validation by the keeper at the place of departure

Signed by John Appleseed
16/10/2025 at 9:05 AM

9:30

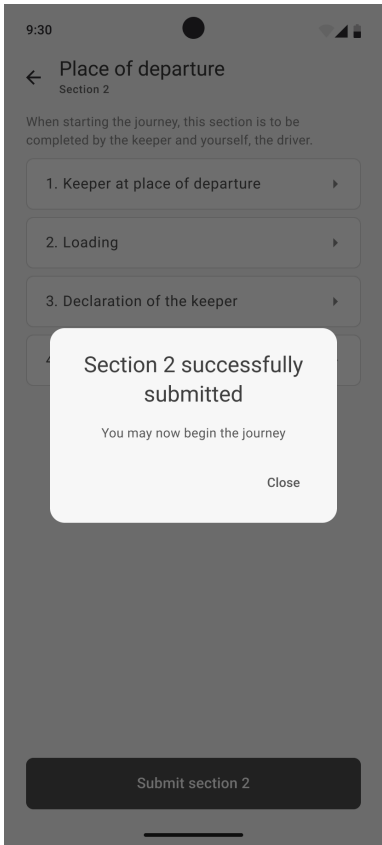
← Declaration of the driver

I, the driver of the animals, hereby declare that I have been present at the loading of the animals. According to my knowledge at the time of loading, none of the animals loaded onto the means of transport were visibly unfit for transport, the facilities and procedures for handling the animals were in accordance with Regulation (EU) 2023/XX on the protection of animals during transport and related operations.

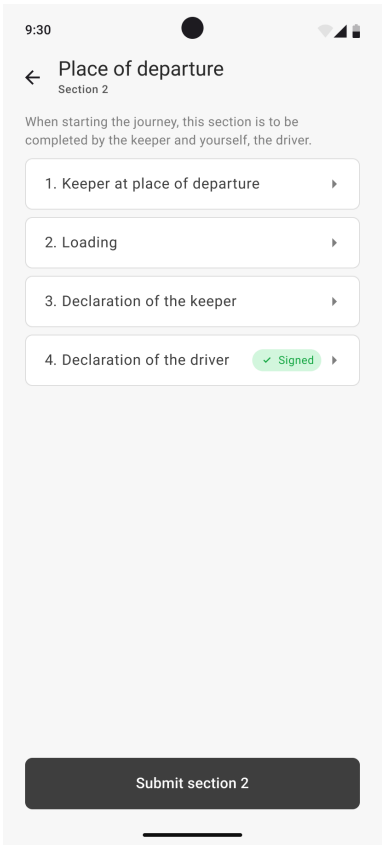
☐ Validation by the driver at the place of departure

Sign

Screen 31 Driver / Section 2 /Screen 32 Driver / Section 2 / 04Screen 33 Driver / Section 2 / 05
03b



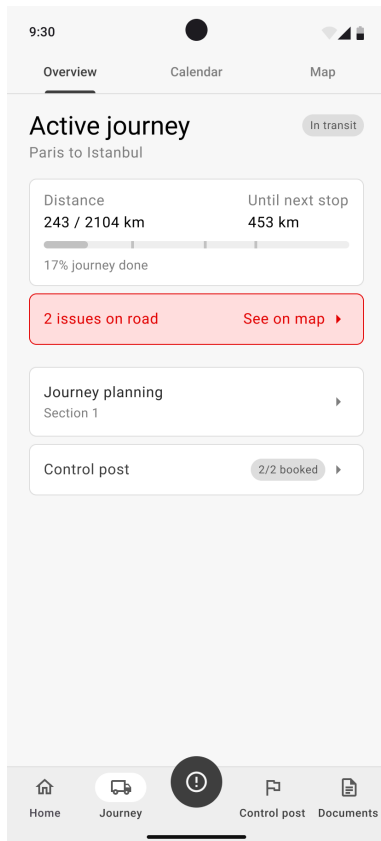
Screen 34 Driver / Section 2 / 08a



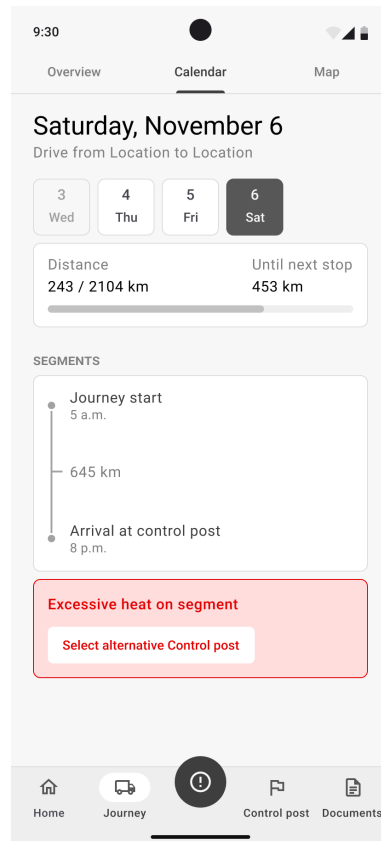
Screen 35 Driver / Section 2 / 08b

During the journey

Once Section II – Place of Departure has been signed by the driver/attendant, he/she can start the journey. The status of the journey changes to “Active Journey”. From the home screen, the driver/attendant can view an overview of their journey. He/she can also access a dedicated “Calendar” tab, which offers a more detailed breakdown of the entire trip — including daily distances and other relevant information that helps them understand the progression of their route.

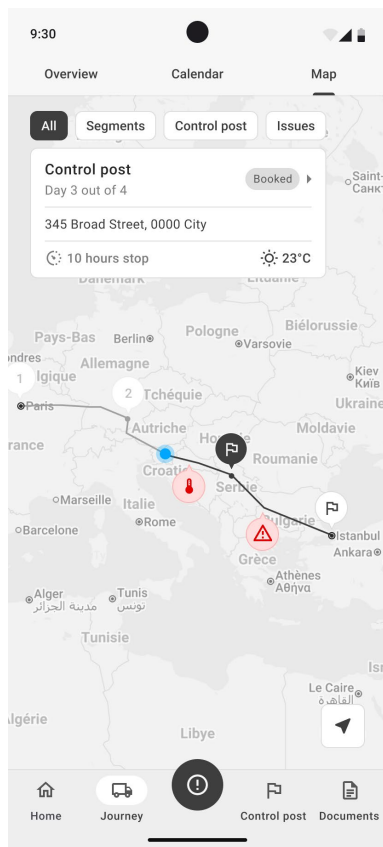


Screen 36 Driver/Journey/Overview

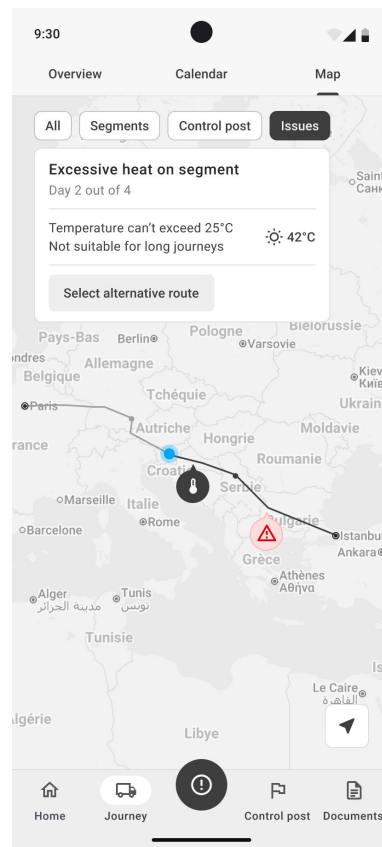


Screen 37 Driver / Journey / Calendar

In addition, a “Map” tab can be available, giving them a more spatial, visual interpretation of their journey and allowing them to explore the different segments with greater precision. With this tab, the driver/attendant could have access to the full visualization of the journey on an interactive map.



Screen 38 Driver / Journey / Map /CP



Screen 39 Driver / Journey / Map / Filter 02

This feature would allow the driver/attendant to:

- View the entire itinerary: route segments approved by MSCA and scheduled but not yet approved.
- View the current location of the truck on the map (using the mobile phone's GPS location if available). **Since location tracking is only collected and sent to TRACES after the journey, this feature would rely on the driver/attendant's phone GPS location and would therefore be only available to them. The information would be used only to display the position on the map and would not be stored in TRACES.**
- Access forecasts of the expected temperatures along each section of the route.

During the animal loading phase, the driver/attendant can take photos or videos if he/she wants to. This optional feature is described at length in section 5.6 of the TRACES recommendation report (D04.01 TRACES Recommendation report, 2025).

Throughout the entire journey, the driver/attendant can visualize the booked control posts for his/her itinerary directly on the map. By default, the active map filter is set to “Booked control posts”, but the driver/attendant can switch between different filters to display:

- All control posts,
- Currently available control posts, or
- Control posts that are already fully booked.

Booked Control Post Details

For each booked control post, the driver/attendant has access to detailed reservation information, including:

- availability calendar,
- approximate arrival time,
- location and photos of the facility,
- animal capacity,
- owner’s name and phone number, and
- all related reservation documents.

The driver/attendant can also update certain details — such as the expected arrival time or the number of animals — and may cancel a booking if necessary.

Cancelling a Control Post Reservation

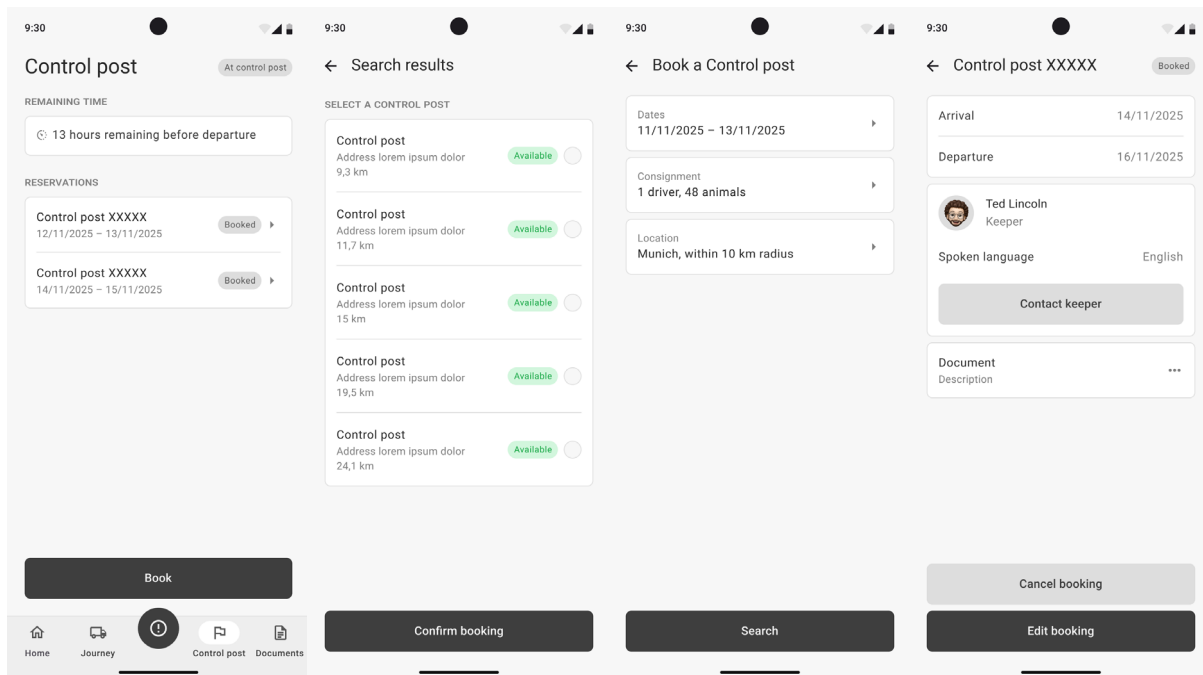
When a control post reservation is cancelled, the system automatically prompts the driver/attendant to select a new one. Other control posts are visible on the map and can be selected by the driver as needed.

Until a new control post is selected, an open task remains visible in the driver/attendant’s “To-Do list” on the home screen, and a notification could be sent to the organiser, allowing them to propose or select a replacement control post on behalf of the driver/attendant.

When the driver/attendant selects a new control post, they can visualize the impact of this change on the map and on their overall route before confirming.

Once the new control post is selected, a notification could be sent automatically to the organiser, and the corresponding task disappears from the home screen.

Booking a Control Post



Screen 40 Driver / Screen 41 Driver / Screen 42 Driver / Screen 43 Driver /
Control Post Control Post / BookControl post / Book Control Post / Detail
results

See the booking reservation system described in **section 5.4.1 Organiser**.

At the Control Post Procedure

Upon arrival at the Control Post, the driver/attendant manually confirms their arrival through the application.

This event triggers a process sequence in three steps, as described below:

Unloading of animals: the arrival of the driver/attendant triggers a notification to the keeper through their application, prompting them to complete Section III – Place of Destination (see Appendix). Once the form has been completed by the keeper, the driver/attendant receives a notification prompting them to review and sign it. If the driver/attendant disagrees with any of the information provided, he/she has the option to submit an anomaly report (see details below). During the unloading phase, the driver/attendant has the option to capture photos or videos of the animals as supporting evidence.

Rest period (24 hours): The driver is required to take a mandatory rest period of 24 hours at the control post. The application displays the remaining rest time and allows the driver/attendant to add manually additional hours of rest if needed. In such cases, the system automatically recalculates the continuation of the journey. If the system identifies risks on the upcoming route concerning too high temperatures, it notifies the driver.

Loading of animals: When loading animals in the truck, the driver/attendant may again capture photos or videos. The driver/attendant indicate their departure from the control post in the application.

Through these features, the system not only ensures compliance with regulatory requirements but also provides real-time decision support, enhancing animal welfare, driver safety, and overall journey efficiency.

Access to Real-Time In-App Chat (optional component)

For every Control Post reserved, the driver/attendant could have access to a dedicated messaging space that would enable real-time communication with the resource persons assigned to that Control Post. These resource persons are defined by the Control Post owner within the Booking Management System, as described in *section 5.4.3 Keeper*.

When the driver/attendant sends a message, in their preferred language, a conversation thread would be automatically created and shared with all identified resource persons. Each time a message is sent, all participants could receive a notification. The driver/attendant may also tag specific recipients, allowing them to immediately see messages that require their direct attention. Tagged messages would be visually highlighted using a more prominent design to reinforce their importance.

The Real-Time component is an optional feature and has been estimated separately in *section 8 Financial estimate model*.

Automatic Translation System (Optional component)

The real time component could include a built-in automatic translation engine. Messages would appear to each participant in the language they have selected for using the application. Users would also be able to choose to display the original message if they wished to read the unedited source text. This would ensure seamless communication between driver/attendants and Control Post personnel, even when multiple languages are involved.

The automatic translation component is an optional feature and has been estimated separately in *section 8 Financial estimate model*.

Procedure upon arrival at the final destination

The procedure followed upon arrival at the final destination is the same as the procedure applied at a control post, with one important distinction. Once Section III – Place of Destination of the journey log has been completed by the keeper and driver/attendant, an additional task is automatically assigned to the driver/attendant. The driver/attendant is prompted to fill in Section IV – Transporter Declaration in order to review the journey summary, make any necessary corrections, and provide his/her signature. The fields containing information that is already

known in the AJL log (Location address, ...) or have been collected through the geolocation mechanism (date / time of arrival) should be prefilled in advance by the system. This final validation step not only ensures accuracy and accountability but also formally closes the process, with the journey log being archived in the “past journeys” section.

9:30

← Place of destination
Section 3

When ending the journey, this section is to be completed by the keeper, the veterinarian and yourself, the driver.

1. Keeper at place of destination

2. Driver / Attendant

3. Official veterinarian

4. Date and time of arrival

5. Checks performed

5. Indicators

6. Declaration of the keeper

7. Declaration of the driver

To sign

Submit section 3

9:30

← Keeper at place of...

Place of destination

Name
Exit point

Address
Road XXXX 34

Postal code
0000

City
Istanbul

Keeper in charge

Name

Telephone

E-mail

9:30

← Date and time of arrival

Date
01/11/2025

Time
04:30 PM

9:30

← Checks performed

For each check performed, please indicate if the outcome was compliant or not.

Transporter authorisation number

☒ Compliance

☐ Non-compliance

Driver's number of the certificate of competence

☒ Compliance

☐ Non-compliance

Means of transport identification

☒ Compliance

☐ Non-compliance

Space allowances
Average space/animal in m³

☒ Compliance

☐ Non-compliance

Journey log records and journey time limits

☒ Compliance

☐ Non-compliance

Screen 44 Driver / Section 3 / 01

Screen 45 Driver / Section 3 / 02

Screen 46 Driver / Section 3 / 03

Screen 47 Driver / Section 3 / 04

9:30

← Indicators

Total number of animals

45

Number of dead animals on arrival

0

Number of injured animals during transport

0

Presence of heat/cold, stress, hunger or thirst

Yes

No

9:30

← Declaration of the keeper

I, the keeper of the animals at the place of destination, hereby declare that I have checked this consignment of animals. According to my knowledge at the time of the check the abovementioned findings were recorded.

Validation by the keeper at the place of destination

Signed by John Appleseed

16/10/2025 at 9:05 AM

9:30

← Declaration of the driver

I, the driver of the animals, hereby declare that I have been present at the unloading of the animals. I agree with the results of the assessment of condition of the animals recorded in this section of the journey log.

Validation by the driver at the place of departure

Sign

9:30

Overview

Calendar

Map

Active journey

Paris to Istanbul

Distance

2104 / 2104 km

End journey

Home

Journey

Control post

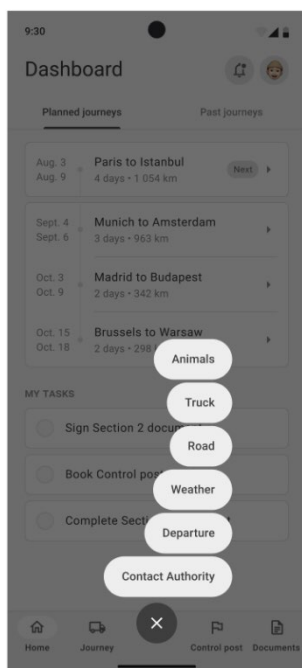
Documents

Screen 48 Driver /Screen 49 Driver /Screen 50 Driver /Screen 51 Driver / Final
Section 3 / 05 Section 3 / 06 Section 3 / 07 destination

Directorate-General for Health & Food Safety

Incident Reporting Functionality (Anomaly Report)

A dedicated button is permanently available within the application, enabling drivers/attendants to report any type of issue at any point during the journey — whether it concerns an injured animal, a technical failure with the truck, a road incident, or a problem encountered at a control post.



Screen 52 Driver / Report button

Depending on the category selected, the driver/attendant is presented with tailored reporting forms.

Each form allows the upload of photos and videos, providing richer context and supporting evidence. Once submitted, the form automatically generates an “anomaly report,” which becomes immediately visible to the organiser. The organiser is simultaneously notified, ensuring that issues are flagged in real time and can be promptly addressed.

The anomaly report can be accessed at any time by the driver/attendant himself or by the organiser.

When the problem is resolved, the driver/attendant has the ability to mark the anomaly report as “resolved” and add follow-up comments. Only the driver/attendant can modify or mark the anomaly report as resolved. The organiser can only add comments. This structured process ensures full traceability, enhances communication between stakeholders, and strengthens accountability throughout the journey.

Example of an Anomaly Report for Animals:

9:30

← Report issue with Animals

Select the species afflicted

☒ Cattle

☐ Rabbit

☐ Pig

☐ Poultry

☐ Sheep

☐ Equine (horse, donkey, mule)

Next

9:30

← Report issue with Animals

Which category? ?

Adults

−

0

+

Adults (lactating)

−

0

+

Adults (pregnant)

−

0

+

Calves

−

0

+

Unweaned calves

−

0

+

Next

9:30

← Report issue with Animals

What best describes the animals' condition?

☐ Injured, ill or with physiological or pathological weakness ?

☐ Unable to walk unassisted or only with pain ?

☐ Cachectic or severely dehydrated ?

☐ Severe open wound or prolapse ?

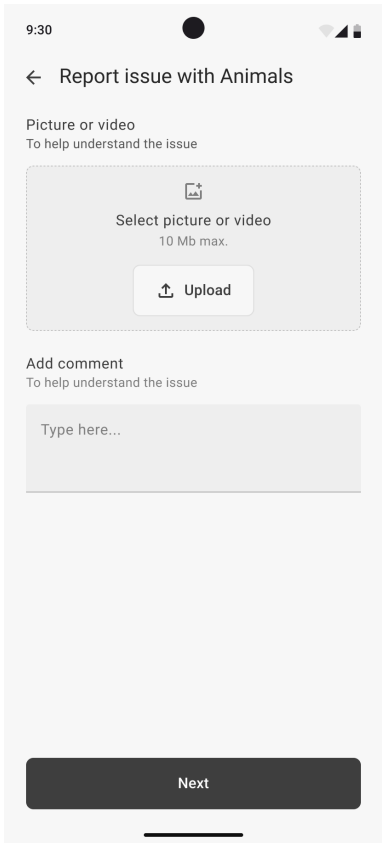
☐ Sedatives used ?

☐ Dead ?

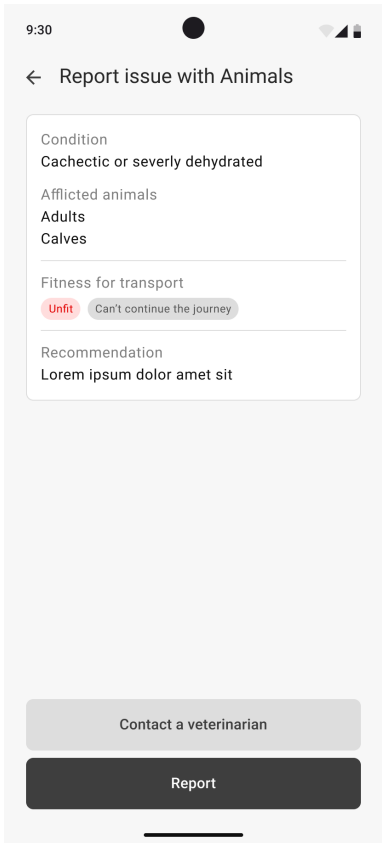
Next

Screen 53 Driver / IncidentScreen 54 Driver / IncidentScreen 55 Driver / Incident

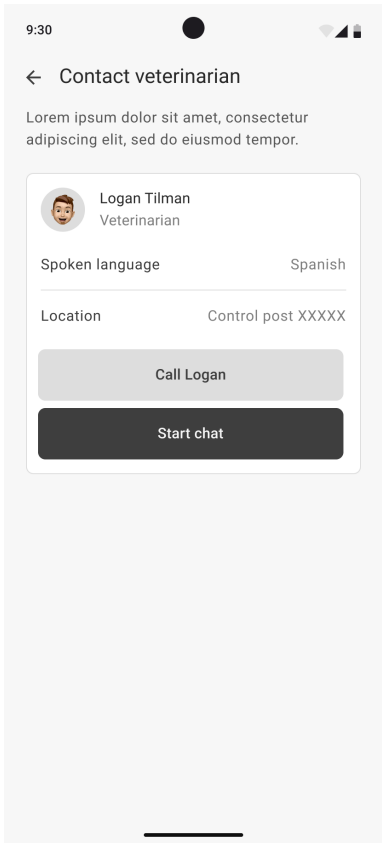
report / Animals / 04report / Animals / 05report / Animals / 01



Screen 56 Driver / Incident report / Animals / 07



Screen 57 Driver / Incident report / Animals / 08



Screen 58 Driver / Incident report / Animals / 09

Example of an Anomaly Report for a problem on the road:

9:30

← Report issue with Road

What issue(s) are you facing?

☐ Unexpected traffic

☒ Obstacle on road

☐ Rough road

☐ Road closed

☐ Other

Next

9:30

← Report issue with Road

Picture or video
To help understand the issue

📎

Select picture or video

10 Mb max.

📤 Upload

Add comment
To help understand the issue

Type here...

Report

9:30

← Report issue with Road

Picture or video
To help understand the issue

✔

Upload complete

IMG_12345.jpg

🗑 Delete

Add comment
To help understand the issue

Type here...

Report

Screen 59 Driver / IncidentScreen 60 Driver / IncidentScreen 61 Driver / Incident
report / Road / 02report / Road / 03report / Road /05

Keeper

The keeper interface consolidates all essential tools to effectively manage operations at the place of departure, control post or final destination. Access to vehicle, consignment, and driver/attendants' information enable accurate oversight and proactive planning. With integrated photo/video documentation, anomaly reporting, and automated notifications, keepers can safeguard animal welfare, ensure regulatory compliance, and contribute to a transparent, well-coordinated transport journey.

The keeper's Customer Journey is presented in ***Annex 10.2.3 Keeper's Customer Journey***

A single persona and customer journey was developed for keepers to avoid unnecessary duplication of journeys and screens but it should be noted that there will be two main differences in terms of functionality, based on the type of keeper involved.

Access to AJL Sections:

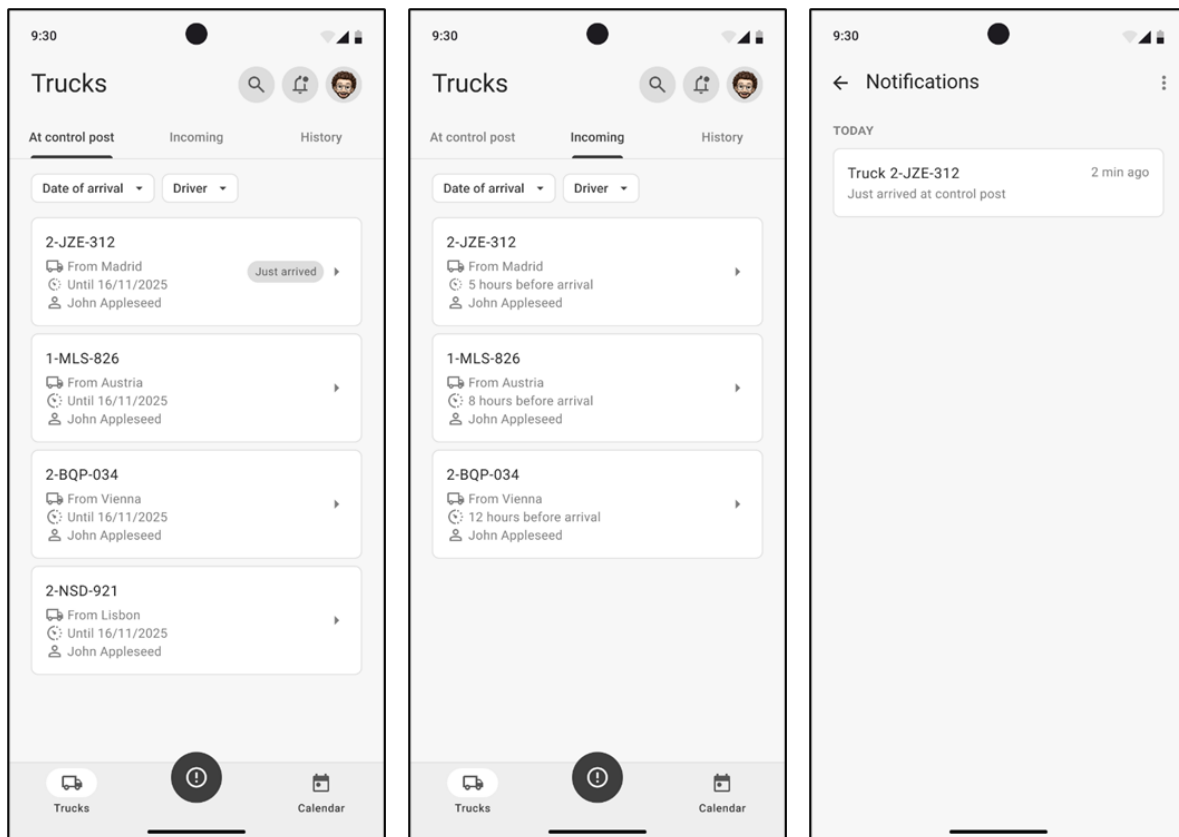
- Keepers at the Place of Departure will have access to Section II - Place of Departure.
- Keepers at the Control Post and at the Place of Destination will have access to Section III – Place of Destination.
- All keepers will have access to Section V – Anomaly report

Access to Booking System:

- Only keepers at the Control Post will have access to CP Booking functionality.

Home Screen

Upon logging into the application, the keeper accesses a comprehensive home screen designed to optimize visibility, anticipation, and control of activities at the control post.



Screen 62 Keeper / Trucks at CP
Screen 63 Keeper / Trucks Incoming
Screen 64 Keeper / Notifications

The interface provides a 360° overview of operations, structured around three main pillars:

- List of upcoming arrivals – Trucks with confirmed bookings are displayed together with these monitoring features:

Planned itinerary.

- Planned time of arrival

Delay notifications, ensuring that users can anticipate disruptions and adjust resources accordingly.

- List of current operations – A real-time view of trucks presently at the control post.

List of historical insights – Full access to records of trucks previously processed at the control post, ensuring complete traceability and supporting compliance audits.

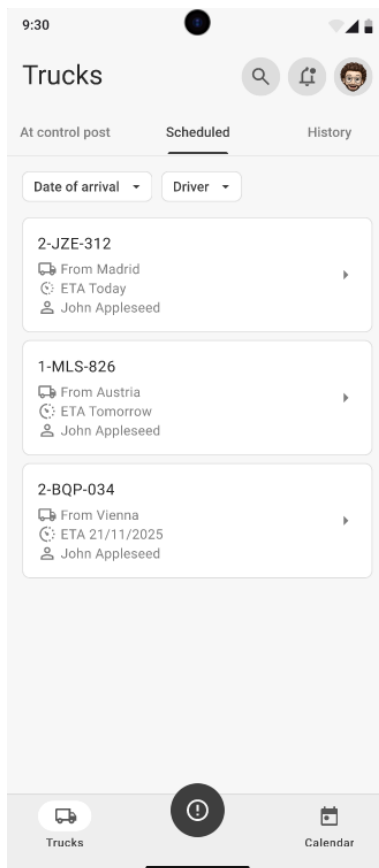
The user can perform searches and apply filters based on the driver/attendant's name or the truck's arrival date at the control post.

Keeper at the Place of Departure

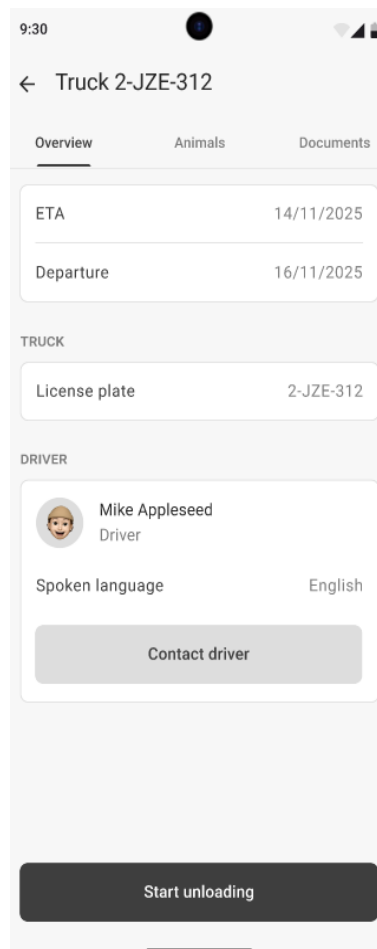
The keeper at the Place of Departure will have access to Section II – Place of Departure. He/she will be responsible to fill in the section along with the Driver/attendant. The functionality is therefore the same as for the driver/attendant.

Keeper at the Control Post

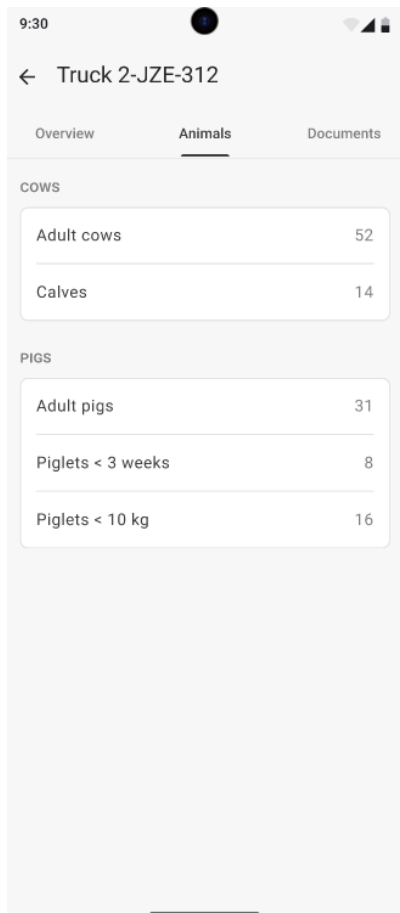
Bookings Overview



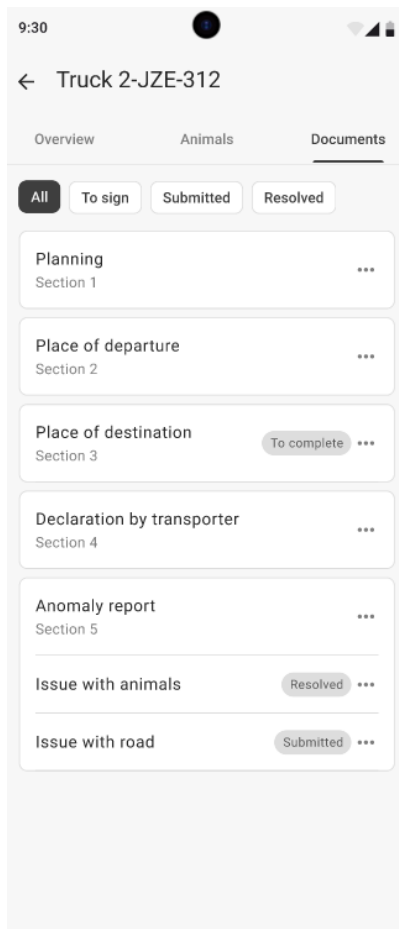
Screen 66 Keeper / Incoming trucks



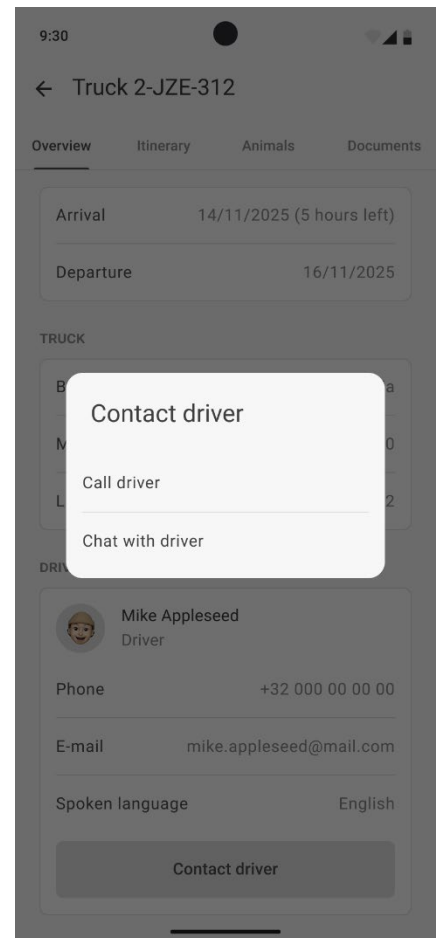
Screen 65 Keepers / Truck details



Screen 69 Keeper / Truck Detail / Animals



Screen 67 Keeper / Truck detail / Documents



Screen 68 Keeper / Contact driver

For all reservations — past, ongoing, or upcoming — the user has access to key information related to the driver/attendant and the vehicle.

Specifically, the user can:

- View driver/attendant details, including the ability to reach the driver/attendant through the in-app chat functionality .
- View the truck license plate number.
- Access information about the transported animals, including species and quantities.
- View relevant documents, such as the contingency plan or any other files attached to the reservation.

Notifications

The keeper receives notifications for all reservation confirmations and cancellation requests, whether they come from the organiser or the driver/attendant.

When a reservation is created, the system automatically checks the availability of the control post, ensuring that there is sufficient space to accommodate the consignment.

However, if a last-minute issue arises (e.g., a facility malfunction, unexpected occupancy, or health-related restriction), the keeper may cancel the reservation. In this case, they must provide a comment explaining the reason for the cancellation.

Once the cancellation is confirmed:

- If the reservation was linked to a planned journey, the organiser receives a notification.
- If it concerns an ongoing journey, the driver/attendant is also notified.

Both parties are then prompted to book an alternative control post.

Users also receive a notification whenever a new message is received through the in-app messaging system. This ensures that drivers/attendants and Control Post personnel are promptly informed of any communication updates related to a planned journey, upcoming stops, or operational changes.

Booking Management System

The keeper has access to a dedicated booking management tool to oversee all reservations associated with their facility.

- *General Information Section*

Within the “General Information” section, the following details are recorded:

- GPS address or full location of the building
- Contact resources: name, function and phone number that can be contacted via the real time chat

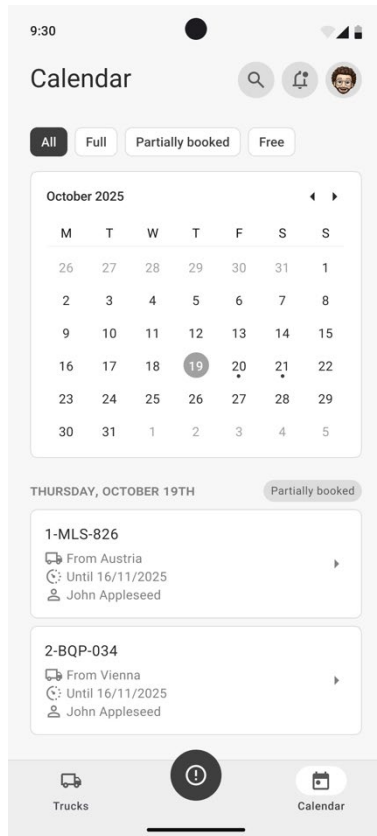
Additionally, the keeper must provide:

- The available surface area (in m²) that can be used to host animals.
- The species that can be accommodated, along with the maximum number of animals per species.

Optionally, the keeper can add photos of the facility (both interior and exterior) to help illustrate the conditions and layout.

Availability Calendar

The keeper has access to a calendar view, which can be updated at any time.



This calendar allows the keeper to:

- Specify opening and closing days of the control post.
- Add specific restrictions for certain days, if exceptional conditions apply (e.g., reduced capacity, limited species acceptance, or temporary maintenance), even if they differ from the general settings.

The calendar provides a clear, color-coded visualization of the facility's status, showing at a glance:

- Days when the control post is fully available,
- Days with partial availability (some reservations but remaining capacity),
- Days that are fully booked,
- Closed days,
- Modified schedule days, when the usual operating hours differ from the general configuration.

Arrival at the control post

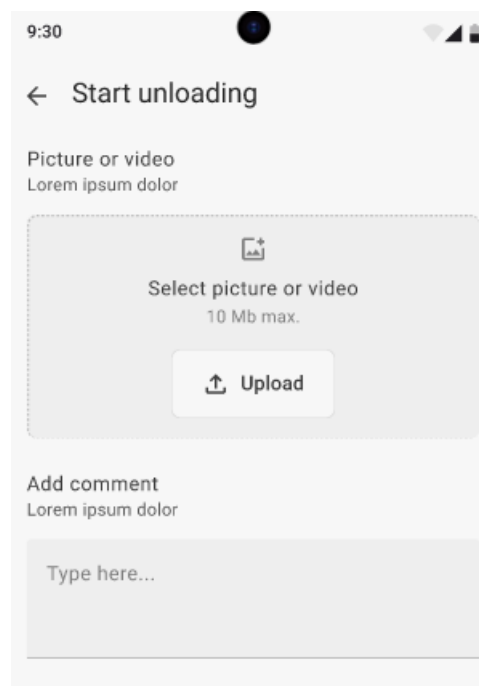
Screen 70 Keeper / Calendar

When the transport arrives at the control post, the driver/attendant initiates the unloading of the consignment.

During the unloading (and reloading) of animals, the keeper has the possibility to upload photos and videos, reinforcing transparency and providing visual evidence that supports both animal welfare monitoring and regulatory checks.

The driver/attendant also signals his/her arrival at the control post through the mobile application. This triggers an action for the keeper to sign Section III – Place of Destination.

Once Section III is submitted by the keeper, the driver/attendant automatically receives a notification inviting them to review and sign the document digitally.



Screen 71 Keeper / Unloading

Departure from control post

The keeper can manually indicate that the truck has departed, using a dedicated action button available at any time. This manual confirmation triggers an automatic workflow, updating the truck's status and moving the CP reservation from the "Trucks currently at the CP" list to the "Past trucks (History)" section.

Keeper at the Place of Final Destination

The keeper at the Place of Final Destination will have access to Section III – Place of Destination. He/she will be responsible to fill in the section along with the Driver/attendant. The functionality is therefore the same as for the driver/attendant and Keeper at Control Post.

For all Keepers

Anomaly report

As with the other roles, a "Report a Problem" button is permanently available, allowing the keeper to raise anomaly reports in real time. They may also update the status of these reports to "resolved", but only for those they have submitted themselves—ensuring accountability and clear ownership of incident resolution.

This process not only streamlines day-to-day operations at the control post but also strengthens three key pillars:

1. **Operational efficiency** – through real-time notifications, structured workflows, and automated reminders.
2. **Compliance and traceability** – by ensuring accurate data capture, auditable reporting, and secure documentation of animal handling.
3. **Transparency and collaboration** – by enabling evidence sharing, proactive communication, and clear accountability across all stakeholders.

Together, these features empower keepers to carry out their responsibilities more effectively, reinforcing trust in the transport process while safeguarding both regulatory compliance and animal welfare.

Real-time chat

Keepers have access to the same real-time chat functionality (optional component) as the other actors of the AJL. See Driver/attendant section for details.

Research licence plate or AJL

See **Section 5.4.4 Official Veterinarian** for details.

- **Official Veterinarian**

The official veterinarian persona is very similar to the keeper persona, except that the official veterinarian does not need to have access to the control post booking features and will sign off Section III in a specific sub section, if present on site.

A specific feature was requested by DG SANTE for official veterinarians that would allow them to search for trucks by license plate or AJL reference number. The feature could also be very useful for keepers.

More specifically, two use cases were identified.

1. Pre-selection based on geographical coverage

Official veterinarians must be able to identify, access, and self-assign specific AJLs for inspection from the TRACES Desktop application, and then view these journeys in the “My Journeys” section of the mobile application.

2. Unplanned / roadside inspections.

Screen 72 Vet / Search transport In the mobile application, the official veterinarian must be able to locate a truck encountered during field operations by searching using the license plate or AJL number. The system then provides access to all key journey details, enabling efficient and informed inspection on the spot.

The user has access to a search bar that is available across all screens, allowing them to quickly locate a truck during an inspection and retrieve the corresponding AJL information.

To start a search, the user enters the vehicle's license plate number (or another journey identifier such as the AJL number). The system then retrieves the matching truck and displays the full details of its associated AJL, shown in the same structured format available to the Organiser for "Active Journeys" (i.e., trucks currently on the road or at a Control Post).

User feedback

A prototype of the application was showcased to representatives of the Transporter sector for validation.

The session's feedback was recorded in an interview report provided separately to DG SANTE. The following points were emphasized during the interview.

- The interface and features proposed in the mobile application outline presented were welcomed as they would greatly facilitate transport operations
- Particularly, the digitalization of the AJL forms would very much simplify the administrative processing of the journey by the AJL actors
- The access management features are welcomed:
 - o Access to the data of the journey through the webapp should be restricted to operators and MSCAs involved in that specific journey
 - o Non-Eu actors should also be in a position to use the mobile application (control posts outside of EU, etc.)

- The ability to upload pictures/videos is perceived as an important element for documenting the state of the animals. The feature should be available at any point of the journey but is most relevant at the end (unloading at Place of Destination) of the transport.
 - Control post booking features are perceived as very useful
 - Note: cancelling a reservation can happen but it is rather unusual
 - The map/itinerary feature is very useful.
 - The ability to display excessive heat in advance of the truck reaching the area would be great.
 - The map could be enhanced with “Points of Interest”, useful resources for a driver/attendant such as places where help can be obtained in case of technical difficulties, additional resources can be secured (bedding...)
- Link with the centralized server architecture & geolocation data

The geolocation report (D03.02 Positioning system design) describes 4 different solutions for capturing user positioning. This document describes the mobile application as the source of geolocation data, either as the end-user application, or as an integrated application embedded in the truck. These two scenarios both specifically allow for synchronizing the journal ID.

The following technical outline contains a discussion about data synchronization patterns which will help define the best synchronization data interval.

Important: This document only covers the mobile application system. The centralized server is discussed in the previous reports (D03.01 Market analysis report and D03.02 Positioning system design).

- Technical outline

The mobile technical part is split between two parts.

- The first part is the “core” technical description. It will be focused around defining the base strategy & patterns for implementing the mobile application. The topics in this section are fundamentally technical but tailored to an audience that is not yet familiar with mobile application development concepts. A development team for mobile applications is expected to be proficient with these concepts and technologies.
- The second part will be focused on features that are specific to the mobile application and have as such not been covered extensively in other reports and that would require a proposition for a specific solution.

The technical outline aims at bridging the gap between the technical aspects of a mobile application development perspective and the impact on the business or the features of the system. It helps both technical-oriented people and stakeholders discuss these topics and their impacts, based on concrete technical material to allow stakeholders to make informed decisions about the future state and aspects of the mobile application.

1) App offline mode & data synchronization patterns

- **Introduction**

The main concern regarding the mobile application is that it should allow for an offline usage. This is required by the intermittency of network connectivity during long journeys.

There are multiple factors and situations that come into play:

- A user can toggle on/off their data connection
- A battery can run out of power / a device can be rendered unusable
- Data connection might not be possible due to economic reasons (for instance in Switzerland)
- A mobile network might not be available, or stable enough, due to geographic or infrastructural factors

- **Data access & synchronization patterns**

Two data synchronization patterns are discussed in this section: *Background* & *Foreground* synchronization patterns. These are a variation of the same principle that aims at optimizing server load & data transfer size.

Important note: other data synchronization patterns are not described here because they would all be a variation in complexity (mostly simpler) of the two that are described hereafter.

The main data that is considered for synchronization at regular intervals is:

- Geolocation (in / out)
- Journey Log updates (in)
- Actual journey log events (in / out)
- (Delayed) chat messages (in / out)

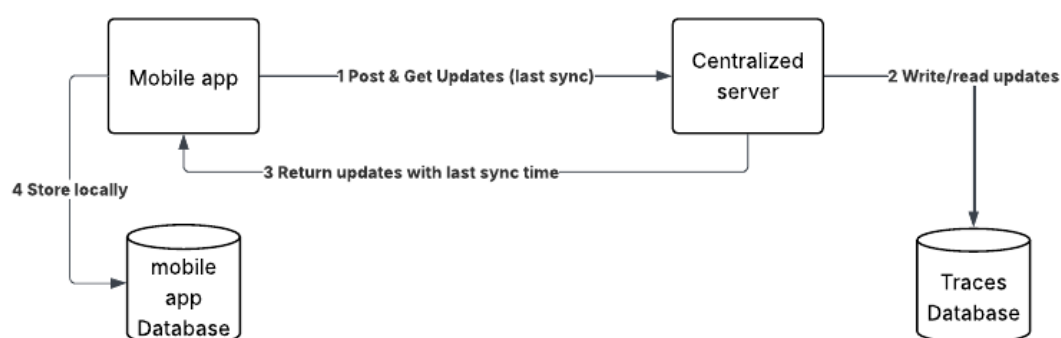
The system should also be able to synchronize documents that can be edited or added by one actor during the journey such as (but not limited to):

- General documentation needed for any journey - Forms, authorizations & certificates (Driver certificate, Transporter authorization, etc.)

- Animal Journey Log to be filled through the application
- Pictures & Video

It is important to note that the files (documents) being heavier in terms of size than a simple synchronization delta (i.e. incoming events on the actual journey log), the development team should consider transferring them in a separate transaction to avoid blocking the main synchronization. If a network connection is available, the app should always try to send the files directly from the main application activities.

The following diagram depicts the main synchronization steps:



Background synchronization pattern at Fixed intervals

Description: as a prerequisite, the user must select the journey they want to view, from the user interface, and mark it to be stored locally, signaling to the system that they want to receive updates on the journey (meaning any data that represents the reality of work performed on the journey; for instance, a document; a weather notification, ...) for its entire duration.

Note: After the journey is completed, the mobile app shouldn't receive any new update on the journey itself. One strategy is to define that a driver can only synchronize one single journey at a time.

The mobile application keeps the full journey log locally and the timestamp on the last synchronization moment. The timestamp of the last synchronization moment must come from the server's database read moment. Every refresh signal comes with previous data synchronization timestamp to check the "Delta" (incremental change) of data. The mobile application then only processes the new data to update its local storage.

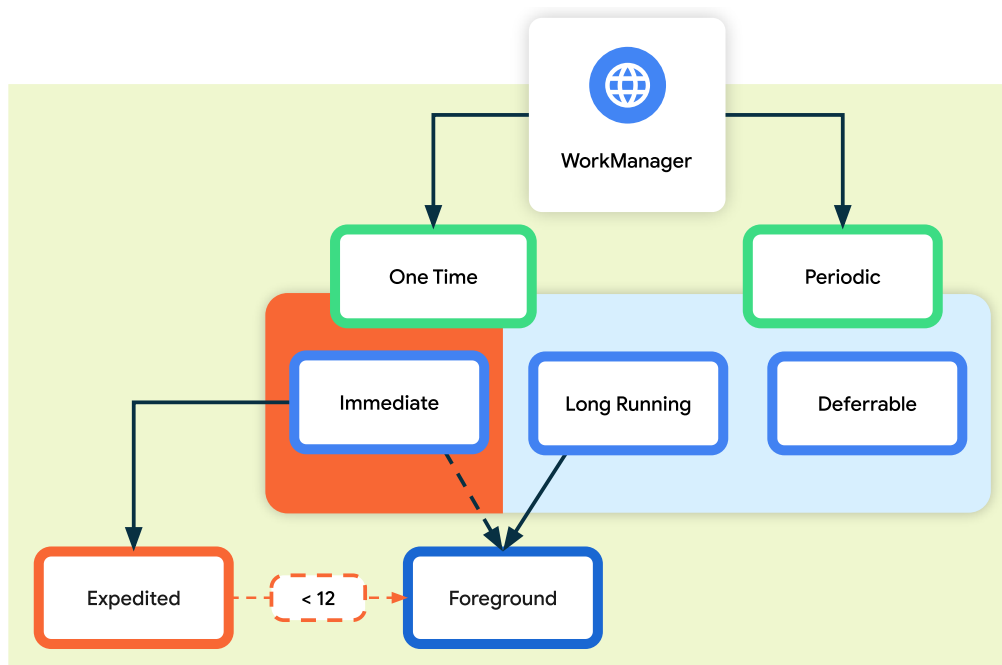
pros	cons

• <i>Data gets seamlessly refreshed for the user even when he's not actively using the app</i> • <i>Data can also be refreshed manually (pull 2 refresh) to force synchronization between 2 intervals</i> • <i>The user doesn't need to worry about network connectivity availability</i>	• <i>Can be complicated to implement</i> • <i>Must be supported by a new (web)service implementation → Not just a Traces API interface change</i> • <i>If the data takes too long to synchronize, the mobile OS could, in some case delay or cancel the data synchronization</i> • <i>Can't be paused easily: the app should thus provide additional mechanisms to control the data synchronization moments. This constraint is mostly relevant when the user's own device isn't a source of geolocation data</i>

The implementation of this pattern will rely on concepts available on the target platform.

- For the Android platform, the implementation will use the *WorkManager* system and specifically the *PeriodicWorkRequest*.

<https://developer.android.com/develop/background-work/background-tasks/persistent/getting-started>



<https://developer.android.com/develop/background-work/background-tasks/persistent>

It has been the recommended way of handling treatment of data & synchronization (identified as “Work” in the *WorkManager* system) that needs to happen at specific time or intervals.

Important: To minimize the impact on battery life, the minimum time interval between two executions (or data synchronizations in this case) is 15 minutes.

- For the iOS platform, the implementation will use the *Background Tasks* system and more specifically *Background Fetch*:

<https://developer.apple.com/documentation/backgroundtasks/refreshing-and-maintaining-your-app-using-background-tasks>

The concepts are like the Android *WorkManager*, the minimum task interval is also 15 minutes. However, the system can decide to delay tasks execution to optimize battery life.

Foreground synchronization pattern

Description: this pattern is a simplification of the background synchronization pattern. In this case however, all data synchronization happens only while the user is using the application. This means that a user's data won't be transferred outside of voluntary usage. In other words, if a user isn't currently displaying the app, the geolocation data won't get transferred to the backend system.

<i>pros</i>	<i>cons</i>
• <i>Mobile app is simpler to implement</i> • <i>No risks of background service being cancelled by the mobile OS</i>	• <i>Users must check their app frequently (best keep it open along the journey, it could thus be a better fit for the onboard OEM device scenario)</i> • <i>If the user's own device is a source for geolocation data, they would be required to maintain the application in use (like a GPS navigation application)</i>

Stakeholder discussion: The synchronization pattern choice should be considered in accordance with the need for the mobile application to be a source for geolocation data and the level of presence that the application should impose on the actors during the journey. In other words, how much should the application be used by the drivers during the journey and the kind of data that is to be synchronized.

If geolocation data isn't sourced from the mobile application, then the choice resides mainly on the amount of time that a driver is expected to use the mobile application during their journey.

If geolocation is sourced from the mobile application, then the choice resides in the ability of the system to pause outgoing geolocation data during drivers' "off time".

Other considerations:

- The most recent journey data that got synchronized is always available to the user. From the screens of the application, they do interact with the data as if they were using the Traces web app. It's up to the overall system to figure out how to perform the resolution of conflicts (see next section).
- The actual journey log modifications are played back in the correct order on the backend. Ensuring eventual consistency (at a later point in time, data is guaranteed to be

consistent) on the actual journey log (i.e. all work performed on the journey such as forms filled in on the field, geo-location data and so on).

- Data transfer size is optimized so only useful data gets synchronized. Only the (actual) journey log that a given user is interested in is flagged for synchronization. Alternatively, a user performing a single activity on a journey log would be able to access it without triggering a full synchronization follow-up of this journey log.

Peer to peer synchronization

It was decided to also include the description of peer-to-peer synchronization for on-field offline scenario. For instance, if users need to exchange data but don't have an internet connection, they should be allowed to continue their work. This synchronization mechanism is optional and doesn't replace the centralized synchronization described earlier in this section.

This communication mechanism offers another way of transmitting data between parties. It works for decentralized communications (peer to peer). It allows users to exchange data through specific channels such as Bluetooth, QRcode or NFC from one device to another.

The scenario that is envisioned here would be that of a driver and a keeper that need to exchange basic information to validate an action on the field (for instance, filling in a declaration as a form within the application). Using a medium like a temporary QRCode (which is easy to setup technically), both actors could simplify the data exchange. It is, however, important for this exchange to be logged centrally whenever the network coverage allows for it. Since a malicious user could use this feature as a breach to insert fraudulent data in the system, there should be automatic checks in the centralized system.

1) Data conflict resolution

During the redaction of this section, it was identified that there exists only one important scenario where conflicts could arise from using a remote and potentially offline system. The scenario is about on-field forms & document declaration.

The scenario is best described as multiple users having to interact with the same form/declaration during the journey. Some fields could be filled in by different users independently (based on their application role) with different values. These differences **could** denote a conflict (conflict is defined as a situation arising when a decision about some difference in a state of data must be made).

There can be multiple ways (patterns) for resolving these conflicts. They mostly fall into two main categories: automatic & manual. A third category can be foreseen and viewed as “assisted resolution” or “combined resolution”.

- In a manual conflict resolution mode, a user having the assigned role on the concerned data perimeter, is prompted to resolve the conflict through a UI activity (here in TRACES). They will need to perform a decision based on the divergent data. This data will then be saved as the final one.
- In an automatic conflict resolution mode, the system will decide which data is to be kept as the final one. This is very useful if the conflicting data can safely and automatically be confronted with the reality of the concerned business. In the scenario of a form to be filled in on the field by two parties in a contradictory manner, if a party fills in a value in a field of the form and another party modifies it later, the system should be able to select the best appropriate value for the dimension (it could be based on a role hierarchy for instance, here the official veterinarian declaration should have precedence over the driver's).
- In a combined conflict resolution mode, the system can automatically resolve some conflicts but yields to a human interaction when the business rules boundaries cannot be used in the automatic process.

Note: the overall aim of such application systems is to provide the most accurate representation of the work performed “on the field”. It should prioritize the data collected from the user closer to the actual work over that which gets done/configured on the central system. The overall system should be as much as possible “fault tolerant”. This consideration would evolve to a more physical constraint when considering automatic data collection systems which can work in complement to this system.

The typical conflict resolution will be handled from a business point of view by the competent authority (as described in ref. D04.01.Traces improvements recommendation report).

Recommendations are also provided in the D04.01 TRACES improvement recommendation report in order to prevent users from modifying form data that is prefilled from other parts of the AJL (addresses, etc) and on the other hand, to allow users to have the possibility to register

divergent accounts of a given reality (contradictory statements). These two business recommendations could greatly limit the need for a technical conflict resolution during form submission.

2) Security

- **User authentication Web services security**

The EU Login system is expected to be used for identification and authentication. Roles and access are also expected to be part of this system.

During the assessment of the EU Login compliance with the offline mode requirement, it was noted that the current OpenID connect implementation could hinder this requirement.

The most important one is the fact that the refresh token lifetime is based on the EU Login session for which there is a fixed limit of 13 hours of validity. Meaning that a new refresh token/access token cannot be obtained after. This can be a concern regarding the offline mode requirement. The exact impact is that a user cannot be offline for more than 13 hours consecutively. This includes resting periods within the journey.

Note: 13 hours seems to be a rather long duration for being out of network connection, but this scenario cannot absolutely be ruled out. A bad User Experience would be to force a user to authenticate more than once for a given journey.

The technical explanation can be found here:

“The Refresh Token lifetime is at most the duration of an EU Login SSO session: 13 hours.”

<https://citnet.tech.ec.europa.eu/CITnet/confluence/spaces/IAM/pages/838810828/OpenID+Connect+Token+Types#OpenIDConnectTokenTypes-RefreshTokenLifetime>

Technical discussion: During the journey, the synchronization mechanism will also be required to fetch new access and refresh tokens before each synchronization transaction. This would ensure the best continuity in the user’s session during their journey. This implies generating a new access and refresh token pair each fixed amount of time (at most every 15 minutes when there is a network connection).

If the refresh token is expired, there should be a mechanism to prompt the user to authenticate back into the system using EU Login. It is also important to consider that this prompt could happen while the driver is busy driving their truck.

Whenever the user is not actively performing work on any journey, the synchronization mechanism could pause the fetching of new access and refresh tokens. This way, they don’t keep an infinite session inside the mobile application and are still prompted to authenticate back for the next journey they’ll have to work on.

Remark on data storage: all access & refresh tokens will be securely stored in the mobile application (see next section).

Once a user is authenticated, they should be able to access the webservices exposed from the Traces backend using the access token received from a successful authentication.

This document comes with the assumption that all available methods from the service provider (identified as the Traces backend) will be available only to authenticated clients (from an EU Login perspective) and that no backdoor or obvious security issues will be present on the service provider (as per OWASP recommendation):

<https://mas.owasp.org/MASTG/0x04e-Testing-Authentication-and-Session-Management/#stateful-authentication>

- **Data storage & device security**

This section discusses the various storage concepts and API for the Android and iOS platforms. It gives an overview of how an application developer should consider storing the application Data in a secure fashion.

This section doesn't contain the exhaustive state of the most advanced secure technologies. The author strongly believes that the application should be developed using standard technologies made available natively through the platform SDK and libraries.

Stakeholder discussion: An important factor in this regard is the need to comply with USA export rules, because the app is going to be hosted from USA service providers (ie. Apple/Google), all services and products that are sold / provided through the stores on other countries than the USA must comply with this regulation. There are a few exceptions (not listed in this document) that allow to skip the export compliance, whenever an application uses cryptographic means that are provided through the existing service/product (ie. As understood here: the native platform SDK and libraries of the iOS and Android platforms).

Important: France also has its own specific regulation for apps made available to this country.

Source : <https://developer.apple.com/help/app-store-connect/manage-app-information/overview-of-export-compliance/>

Important: Before moving on to the technical documentation of each platform, the first thing to ensure when considering end-user security, is to ensure that each device is protected by a lock-screen.

Android:

On android, all data is stored privately to each application, so that no access is possible from outside the scope of one application. As stated in the previous section, a mobile application developer can ensure that the device is correctly secured by checking at each startup / resuming that there is indeed a lock screen configured:

[https://developer.android.com/reference/android/app/KeyguardManager.html#isDeviceSecure\(\)](https://developer.android.com/reference/android/app/KeyguardManager.html#isDeviceSecure())

Android has multiple set of APIs to store and access application data:

SharedPreferences: This API allows to store user preferences. It concerns usually a small amount of data that can be fetched at the startup to configure a user context. User preferences are available through the well-known Android API:

<https://developer.android.com/reference/android/content/SharedPreferences>

Note: android now recommends using the new DataStore API. Depending on whether the application is developed using Kotlin or Java:

<https://developer.android.com/topic/libraries/architecture/datastore>

Note: Developers used to implement their own encryption mechanism to store sensitive data even more securely because the SharedPreferences API wasn't deemed to be secure. This document proposes using the Android Keystore API (see below).

Files (internal application data): is usually also split into two different categories:

- Files managed by the application (pictures, video)
- Structured data that gets stored in a local database (such as Room, Realm, sqlite, ...)

Both categories however use the same security principles:

<https://developer.android.com/training/data-storage/app-specific#internal>

“Other apps cannot access files stored within internal storage. This makes internal storage a good place for app data that other apps shouldn't access.”

The application is not expected to be storing a lot of data at the same time. Meaning that all the data that's going to be used by will get stored locally.

Important: this is valid for applications targeting **android 10** (and newer). This document doesn't discuss older android versions. If earlier versions would need to be considered, the implementation would then implement encryption mechanisms for their local data.

Android Keystore: The android keystore allows for storing cryptographic keys. This is useful to store encrypted data in the SharedPreferences while storing the corresponding cryptographic key in the Keystore.

<https://developer.android.com/privacy-and-security/keystore>

Room/SQLite: Room is the default android API for storing structured Data in a local Database. Room is an abstraction layer above SQLite. It allows for easier data manipulation through DataAccessObjects and Database Entities with object relational mapping (ORM).

<https://developer.android.com/training/data-storage/room>

In summary, for maximum security, use an android Keystore to store a locally generated cryptographic key to encrypt passwords and tokens. The cryptographic key can also be used to encrypt files and the database if deemed necessary. This topic will be expanded in the following section regarding user local authentication and device protection.

iOS:

iOS also stores data securely by default. Using multiple protection layers. Apple iOS also has different API to handle data storage.

UserDefaults: Is the preferred API for storing simple key-values.

<https://developer.apple.com/documentation/foundation/userdefaults>

Keychain: is the API for storing secure data such as keys, passwords, ...

<https://developer.apple.com/documentation/security/keychain-services>

FileSystem: apple iOS file system is meant for creating files and folders. As mentioned in the introductory paragraph, all data is securely stored by default.

<https://developer.apple.com/documentation/foundation/file-system>

CoreData/SwiftData: is the proprietary Framework used to store structured data in a local database. Other alternatives exist but are not discussed in this document.

<https://developer.apple.com/documentation/swiftdata>

Media files storage:

Mobile applications developers must decide where they want to save media files to and where they want to allow a user to select from.

It creates a challenge for applications where media files can be considered “private”.

The recommended approach is to always store the files in the application’s own folder. This way, they can safely be deleted when they aren’t needed anymore (either from the application code or when the user cleans the cache of the application or deletes their application) and not create a confusion with one’s device media library (see next topic).

Data cleanup:

Once a set of local data is not required for a specific user, it should be marked for deletion & allow the system to recover the storage space. This is most important for files that get transferred in the context of a journey.

From a functionality perspective, this data could stay for a few days before it is wiped. The main question is how long would a user need to access local data of previous journeys.

Multiple strategies can be used:

- A background synchronization service can check for old data and delete it.
- Old data can be checked and removed during the application startup.
- If the user terminates their actions on a journey, the application can decide to mark the Data for removal and directly attempt to remove it.

It is however important to ensure that data from the mobile application is synchronized to the central system before it can safely be deleted from the storage of the mobile application.

A solution for marking data for deletion would be to flag the journey from the local database with a specific field.

• **Local user authentication**

The goal of this section is to describe additional security principles and concerns specific to the mobile application security. The key topic is that the mobile devices get shared in the same way that computers are (for instance with family and friends; however, these behaviors largely vary

from one person to another). From a security perspective the system must prevent unauthorized access. Therefore, this document only discusses the scenario of a user having their own mobile device or one that is assigned to them specifically.

For these reasons, the recommendation is that the mobile application should only be used on devices where a local security mechanism is in place. Each platform has its own set of APIs to ensure this and validate that the actual user is the owner of the device along with a biometric confirmation (and a PIN-code / fallback mechanism).

Android:

If a biometric means of authentication is present on the device, it should be used as the main source of user authentication (locally). This local authentication should happen at least during the application startup ensuring the correct user is about to enter the application or perform a secured action. These usually refer to financial transactions, but in this case, it could be for instance, signing a document, loading a journey, ...

Accessing the application is also a very important step to protect. Because the stored access & refresh tokens will be accessed at this stage. Prompting a user to locally authenticate is generally the best way to ensure they are the one using it.

This however poses a coherence challenge for later application ‘activation’. If the user pauses the app (sends it to background) and resumes it, they should also normally authenticate again with the risk that it becomes too invasive for them.

In the scenario where local authentication is used, the application must also implement a custom PIN code (to be stored locally) as a fallback action. Sometimes, biometric authentication fails and cannot be used, the system must provide an alternate way.

More information about local authentication for the android platform:

<https://developer.android.com/security/fraud-prevention/authentication>

<https://mas.owasp.org/MASTG/knowledge/android/MASVS-AUTH/MASTG-KNOW-0001/#biometric-authentication-for-protecting-sensitive-data-or-operations>

iOS:

The same principles apply to iOS with the localAuthentication framework:

<https://developer.apple.com/documentation/localauthentication>

Similarly, the application must provide an additional mechanism if biometric authentication fails. (injured or wet fingers, face unrecognizable due to heavy clothing, ...)

Stakeholder discussion: overall, it is crucial to decide how the application will perform the authentication according to the chosen authentication/authorization strategy. On the one hand, the system must ensure that the correct user is performing the right action on the journey from the mobile application and on the other hand, the system must ensure that its own session (from a webservice perspective) is securely kept along during their journey. This is done by first performing an authentication against the EU identity provider (EU Login) and retrieving a valid session and identity to the application which will be stored securely.

This section emphasizes this last UX requirement, because it will likely go against established common security principles, but this is something that should be enforced to avoid creating a burden on the end-users. i.e. Forcing them to authenticate frequently. Not complying with this will pose a risk that the system will be rejected from the end-users.

The reality is that a global security framework is often defined (and in this case, enforced by the EU Commission) with the highest security possible. This indeed works fine for synchronous online scenarios but not for offline mode usage. Security architects often argue that the risk is too high for allowing persistent & long-lived security on a mobile phone this is because one can never trust the client-side application or that is being used the way it was intended. The risks (reputation damage, information theft, fraud & unauthorized access to data) must be discussed from a business perspective, and a conscious decision must be made. Sometimes, security tradeoffs can and must be implemented for some features and data perimeters.

- **Other security considerations**

The following frameworks can help mitigate security threats by checking a range of device configuration and detect fraudulent system usage.

If a higher level of security is deemed necessary, specifically, the need to ensure that the API and the system are both used the way they are intended to. The developer could implement additional verifications. The main ones would be to prevent an attacking party to use rooted devices or simulators. This way, the system would mostly impose the system to be used in its most pristine state.

Google play Integrity API

<https://developer.android.com/google/play/integrity/overview>

Apple App Attest API

<https://developer.apple.com/documentation/devicecheck>

- **Mobile application technologies**

In this section, the reader will find an overview of the main technologies for developing a mobile application. There exist other frameworks and technologies for mobile application development. To avoid spreading the focus, the following table only compares the most common technologies.

The reader should keep in mind that the native technology is the basis for all other technologies. Other technologies are a layer on top of the native one. This sometimes means that support for the native framework through the layered technology is partial or nonexistent.

Stakeholder discussion: The mobile technology matters less today than it used to. All the main frameworks support the same feature set.

Achieved performance and UX are roughly the same. The choice for the technology will have to be based upon a bias. Either a preference in the stakeholders' own vision, or a preference of the mobile application developer themselves (for reasons they should be able to underline).

A very important topic that needs to be considered is the distribution medium and the distinction between a progressive website and an application that is deployed and installed through the stores (apple & google). The progressive/reactive webapp will be installed through browser navigation. The main factors to consider are access to device capabilities which is limited in a PWA and device support, minimum OS version support and deployment/installation strategy.

For that last part, a QR code can always be used to point either to a website (PWA) or an app store page.

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	Responsive/Progressive webapp	Hybrid (Web-based)	React Native	.NET Multi-platform App UI (MAUI)	Flutter	Native
Brand Names	Capacitor + ionic	Capacitor + ionic	Facebook	Microsoft	Google	Google, Apple
Worload/budget gain	Important	Important	Important	Important	Important	+100% / Platform
UX for simple app	Web experience	Web experience	Close to native	Close to native	Close to native	Native
UX for complex app	Negative impact on complex screens : performances, UI details, ...	Negative impact on complex screens : performances, UI details, ...	Negative impact on complex screens : performances, UI details, ...	Close to native with better performance than React on complex screens	Close to native with better performance than React on complex screens	Native
Community and ecosystem	Rich ecosystem but not mobile app oriented	Active community	Active community	Small community, poor image	Active community	Complete and stable

Sustainability	Web technologies are here to stay	Web technologies are here to stay	Well established Some big app moved away from React Performances are limiting	Xamarin (then MAUI) has lived for nearly 10 years but never succeeded at establishing a reliable framework. It is a candidate for teams only using C# & .Net ecosystem	Good traction from the community Technical fundamentals are stronger than other hybrid Has replaced native for a lot of use cases	Standard technologies for developing mobile applications
Hardware access	Limited : based on the browser and the platform capabilities: https://whatwebcando.today/	Limited but extendable through community plugins or custom bridges to native SDK	Limited but extendable through community plugins or custom bridges to native SDK	Limited but extendable through community plugins or custom bridges to native SDK	Limited but extendable through community plugins or custom bridges to native SDK	Full

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Third parties SDK integration	Impossible	Limited but extendable through community plugins or custom bridges to native SDK	Limited but extendable through community plugins or custom bridges to native SDK	Limited but extendable through community plugins or custom bridges to native SDK	Limited but extendable through community plugins or custom bridges to native SDK	All 3rd party SDK are always available for the native technologies
Offline storage	Limited to web-browser capabilities.	Supported	Supported	Supported	Supported	Native

3) Special features

Three features of the mobile application require further discussion to account for specific requirements or constraints imposed by the mobile environment as opposed to the existing desktop application.

- **Space calculator**

The space calculator feature can be used in the two modes, either online or offline.

The online mode happens whenever an online connection is available. The application will call for the calculation with fixed parameters input by the user from the application.

The hypothesis coming along with this feature is that the calculation rules can evolve over time. And sometimes, the space calculator cannot be used online, requiring the mobile application to provide a local alternative. A simple solution is that the mobile application and its updates should always be shipped with the latest version of the space calculator code.

Note: This code can be as simple as a JavaScript code that is executed locally with the same parameters as with the corresponding webservice call.

Alternatively, this piece of code, could also be updated through the synchronization mechanism, ensuring the mobile app is likely to be up to date with the latest centralized version.

Important: the fitness check can also work on the same principle.

Stakeholder discussion: As the client application code can't be trusted, the offline mode should only be used as a hint and not as a legal compliancy gate. The actual journey log should contain an event logged after the calculation has happened in the central system. This way, a warning can be triggered if the calculation yields a different or invalid result. This warning should be monitored and resolved (either by hand or automatically, as described in the conflict resolution section).

- **In-application instant messaging with automatic translation**

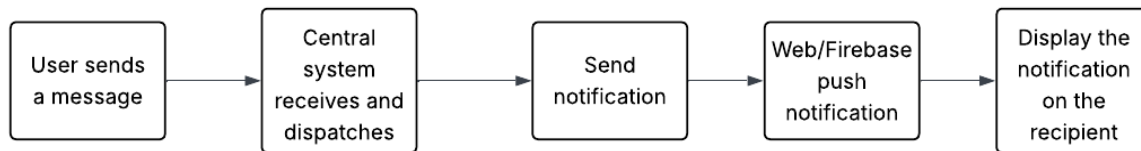
This topic addresses the need for remote interactions between the mobile app users.

The detailed description of such system isn't included in this section. The development team should consider the system load, message availability and latency.

The system should be very basic in terms of technical resources (from an API perspective). Persons or groups related to a specific journey must be accessible from one user willing to establish a communication. These persons or groups could have different availability status.

Once a user has selected the recipient, they can write and send a message. If the message can be sent immediately because the device is connected to the network, then it is handled by the

central system, it will be sent during the next synchronization otherwise. The system chooses the best transfer mechanism to send the message notification, without concern of whether the recipient is online or not (this is the primary goal of the notification principle). The following diagram depicts the different steps of transmitting the message and sending the notification:



It is important to note that the system must store all messages to allow for later consumption and for messaging history purpose.

UX note: a user that is actively communicating doesn't need to receive a notification. The dialog feature will include a highlight for new messages.

The system can send the notifications through two mechanisms:

- 4) Web notifications: in this case, each browser displaying the TRACES application, is bound to the central system using a technology such as a WebSocket. This allows for instant reception of pending messages as the user is monitoring the page.
- 5) Push notifications: in this case, the recipient is using the mobile application and should be notified. The best way to currently achieve this is to use the Firebase Messaging API from google. It encompasses both mobile (iOS and Android) platforms as well as the web platform. It is free of use and is a uniform messaging system. It means that, the backend application, doesn't have to consider the platform the notification recipient is using. Please note, that alternative to Firebase messaging, will still use google messaging system internally for notifications targeting an android recipient.

Stakeholder discussion: This section comes with the assumption that instant messaging requires an ad-hoc communication mechanism, that exists in complement to the main synchronization process. The main factor is that actor's availability and messages can only be transmitted in an online synchronous way.

It is important to acknowledge these to understand the impacts on the overall system in terms of costs (and load). If the requirement evolves in terms of responsiveness, the development team

could address the system with different concepts (for instance: reuse the synchronization mechanism if message can be sent with a 15-minute delay).

Stakeholders should also consider the different scenarios: mobile user to mobile user communication, mobile user to Traces Desktop user communication, Traces Desktop user to Traces Desktop user communication.

This section comes with the assumption that the Traces webapp will be the central hub for communicating with various institutions and users. The concept would remain the same if a separate messaging application should be considered.

Note: Using a third-party messaging system was not considered due to legal (mostly GDPR) reasons.

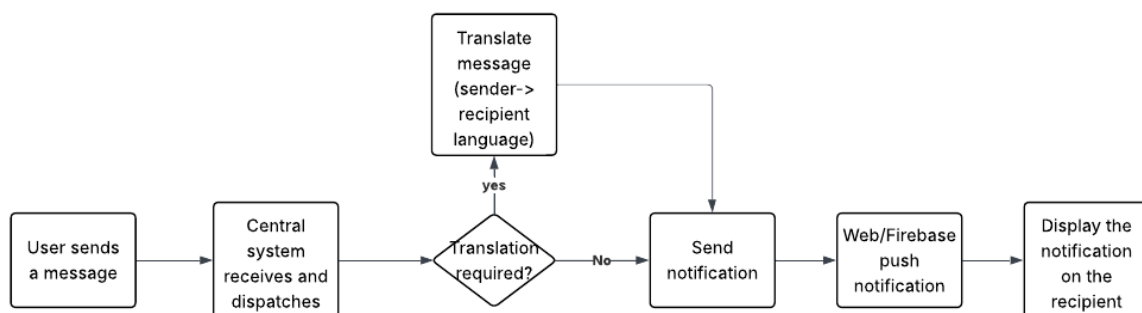
- **Automatic translation of chats**

An additional optional feature that is foreseen for actors' communication is the possibility to request for messages translation. This section doesn't describe any feature of speech to text because they are native to the built-in mobile platform components.

This section complements the previous one regarding the in-app instant messaging.

Important: As all messages are centralized on the server (no peer-to-peer communication), the choice of translating messages will happen at this level. The central system will store the different translations for one message as they could be viewed by multiple users (for instance, in a group chat).

UX note: From an end-user perspective, one could imagine asking the chat users to always use their native language (i.e. The one defined in their mobile OS). It would lower the risk of one user using a different language. It is important to note that many Europeans speak multiple languages and that English is a common language which is widely spoken and written too. The translation feature should account for this.



The addition here is that when the system receives a message, it must know if the translation is required along with the source and language destination. If the translation is possible the message is then translated using the EU translation service API:

<https://language-tools.ec.europa.eu/>

<https://language-tools.ec.europa.eu/dev-corner/rate-limits>

Stakeholder discussion: There wasn't enough time to go more into the detail of these API. The stakeholders of this initiative must keep in mind that there are rate limits on the translation service. If there are too many requests per unit of time, the response time could increase, or the translation could possibly fail. The system should account for this and the rate limits updated accordingly.

- Financial estimate model

Rather than simply proposing a financial estimate for the development of the mobile application, we now present an estimation model that will allow DG SANTE to explore various scenarios and their potential impact on an implementation budget.

1) Core hypotheses

The estimates below assume the development of the mobile application to the exclusion of any TRACES software changes. If a feature or a module needs to be introduced or modified in TRACES, it is assumed that the related effort will be estimated by the TRACES team in charge of the changes.

The estimates are for the development of the mobile application and do not include

- Maintenance costs
- Costs involved with managing the rollout of the application (communications, change management, training, support...)

2) Approach

The selected approach is to work with parameters that can be modified to explore various scenarios. Parameters selected were average man-day price, Sprint duration, Team size.

We added two coefficient parameters to account for the fact that increased complexity can be expected due to the large number of stakeholders and the great disparity in user profiles.

Using those parameters, an estimate was done by groups of features. A distinction is made between required and optional features.

“Required” means that the feature is required from the perspective of the proposed Regulation 2023, meaning that the feature is necessary for operators and MSCAs to comply with the requirements of the Regulation.

“Optional” means that the feature may be mentioned in the Regulation, or was put forward by stakeholders, as a nice-to-have or a feature that would increase usability of the solution but that its absence would not prevent a user from fulfilling his/her obligations.

The required/optional criteria is parametrized in the table below so that DG SANTE can toggle the parameter as needed for budgeting simulations.

For each feature, the estimated number of needed sprints is estimated and then multiplied by the spring duration and the team size/manday price.

Estimates

Parameter	Qty	Unit / Def
Average manday price	650	Euros
Sprint	10	mandays
Team size	11	3 devs 2 UX 1 analyst 1 architect 1 PM 1 SM 1PO 1 Tester
Interaction complexity coe	15%	The amount of time that the team takes to get responses and interact with the ecosystem in terms of Business, fonctionnal, organizational POV
Testing & feedback coeff	10%	The amount of time that the team takes in order to get feedback and integrate it into the mobile app
Sprint price	89.375 €	

Feature	Reg 2023	# of Sprints	Cost	The feature covers :
Login	Required	2	178.750 €	Fns needed to allow login to the app, check access rights & appy user view, and to access user profile
Display AJLs	Required	1	89.375 €	Fns needed to display the AJL, incl itinerary/map, T° readings, ...
Manage 5 forms/sections	Required	3	268.125 €	Fns needed to create, auto fill/manual fill-in, sign, submit, review each of the 5 forms/sections defined in the regulaton
Anomaly Rept & other documents	Required	2,5	223.438 €	Fns needed to manage documents (create/view anomaly rpt, view certificates)
Widgets - Space calc	Required	1	89.375 €	Fns needed to calculate space reqs by entering required inputs
Store deployment	Required	1	89.375 €	All required deployment activities to publish application to PlayStore/AppStore
Widgets - Fitness for travel	Required	0,25	22.344 €	Fns needed to provide access to information regarding Fitness to travel criteria
Journey log creation from within app	Optional	2	178.750 €	Fns needed to create a brand new AJL from within the mobile app (optional as the organiser would normally be doing this from the Desktop app)
Home page notifications	Optional	1	89.375 €	Fns needed to display notifs in case of High T° ahead, new task added (sign a form...) for the user, new chat received, etc...
System assisted modifs	Optional	1	89.375 €	Fns needed to reduce manual data entry and assist with field/form handling - see section 5.4.2.1,7
Manage CP bookings	Optional	2,5	223.438 €	Fns needed to locate, check availability, book & cancel control posts from within the App. For keepers, fns to view requests and approve/reject them from within the mobile app
Upload pictures & videos	Optional	1	89.375 €	Fns needed to take pictures or videos with the mobile phone and upload them to the AJL, incl parameters that would limit the number/size of videos ...
RT Chat Instant messaging	Optional	1	89.375 €	Fns needed to allow AJL actors to communicate from within the mobile app in real time with other actors involved in the same AJL, including automated translation of messages
Geolocation from mobile app	Optional		350.000 €	Fns need to use the mobile application as the source of geolocation information sent to the TRACES server. (Option & estimate described in D03.01 Market Analysis report)

Total Required Features Only **960.781 €**

Total Optional Features Only **1.109.688 €**

Conclusion

The mobile application outlined in this document is a critical element to improve overall TRACES accessibility for stakeholders of the animal journey process. It will provide an easy-to-use channel for economic actors and competent authorities to interact effectively and ensure live animal journeys are conducted in compliance with the Proposed Regulation. It is a key success factor to ensure adoption of the overall process as it will significantly reduce the administrative burden currently placed on process users.

The outline is based on user requirements collected during the extensive consultation phase that took place under Task 2 of the present study.

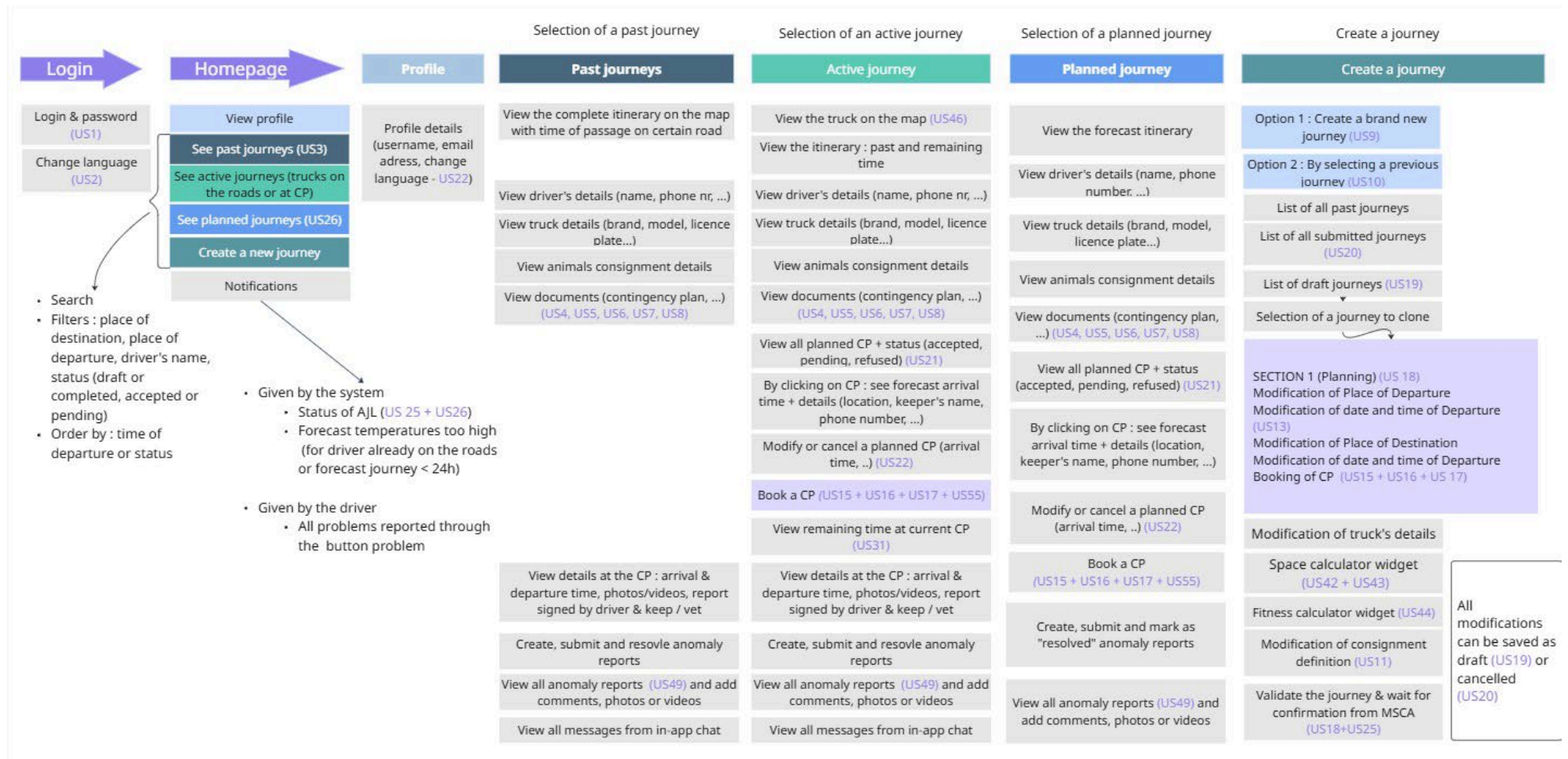
Based on those requirements, we defined customer journeys representing the interactions of the process actors with the application and presented screen flows that illustrate how those journeys should support users by simplifying drastically the administrative overhead and ensuring the end-to-end digitalization of the process.

In the technical assessment, we defined the key requirements that will need to be implemented to ensure that the mobile application meets the explicit demands of the users around personal data protection and security, as well as the needs for offline mode support for long journeys.

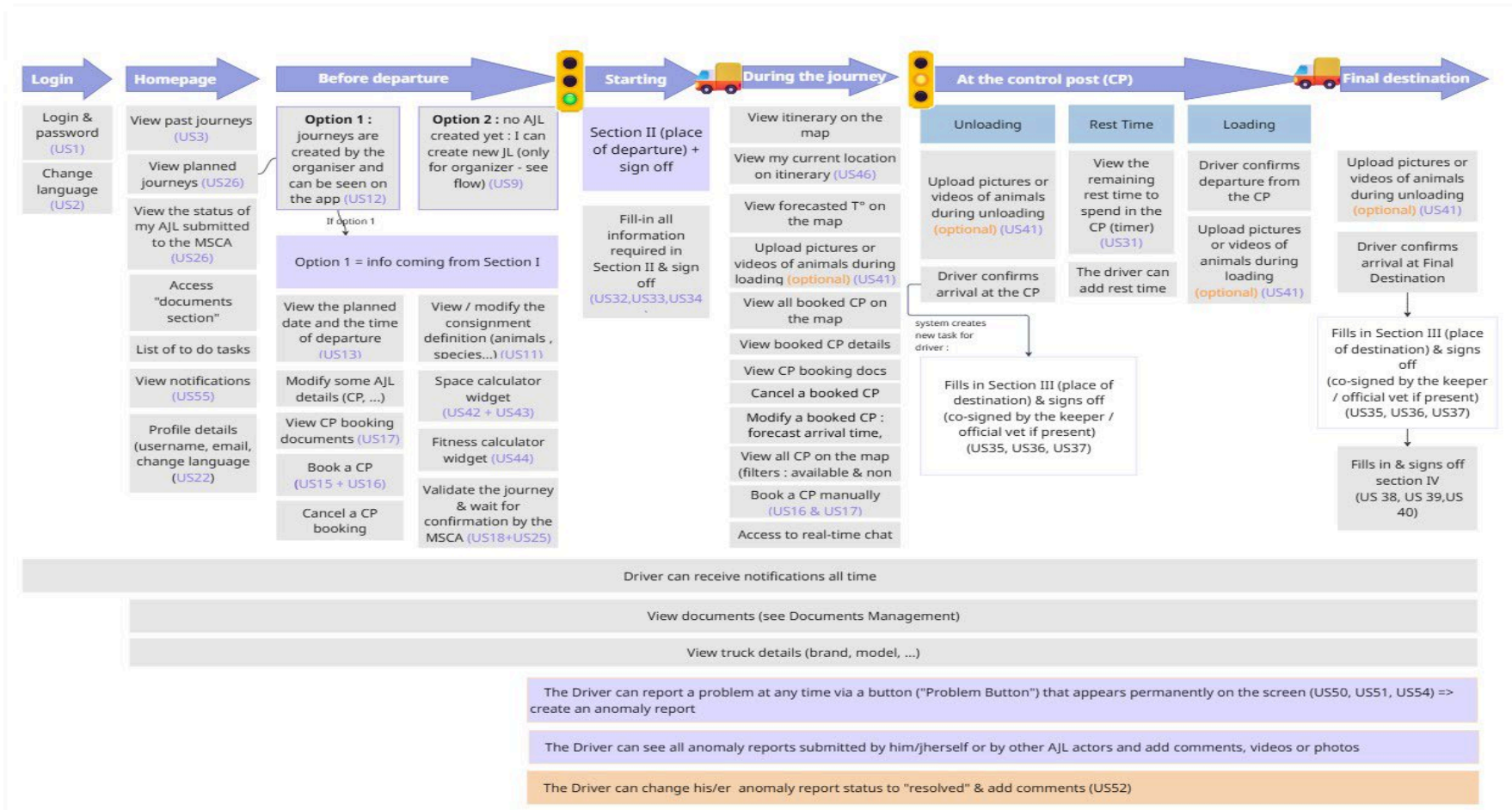
Finally, we proposed a model to estimate the costs involved in developing such a mobile application. The model will allow DG Sante to parametrize the calculations to refine the calculation as needed.

3) Customer Journeys

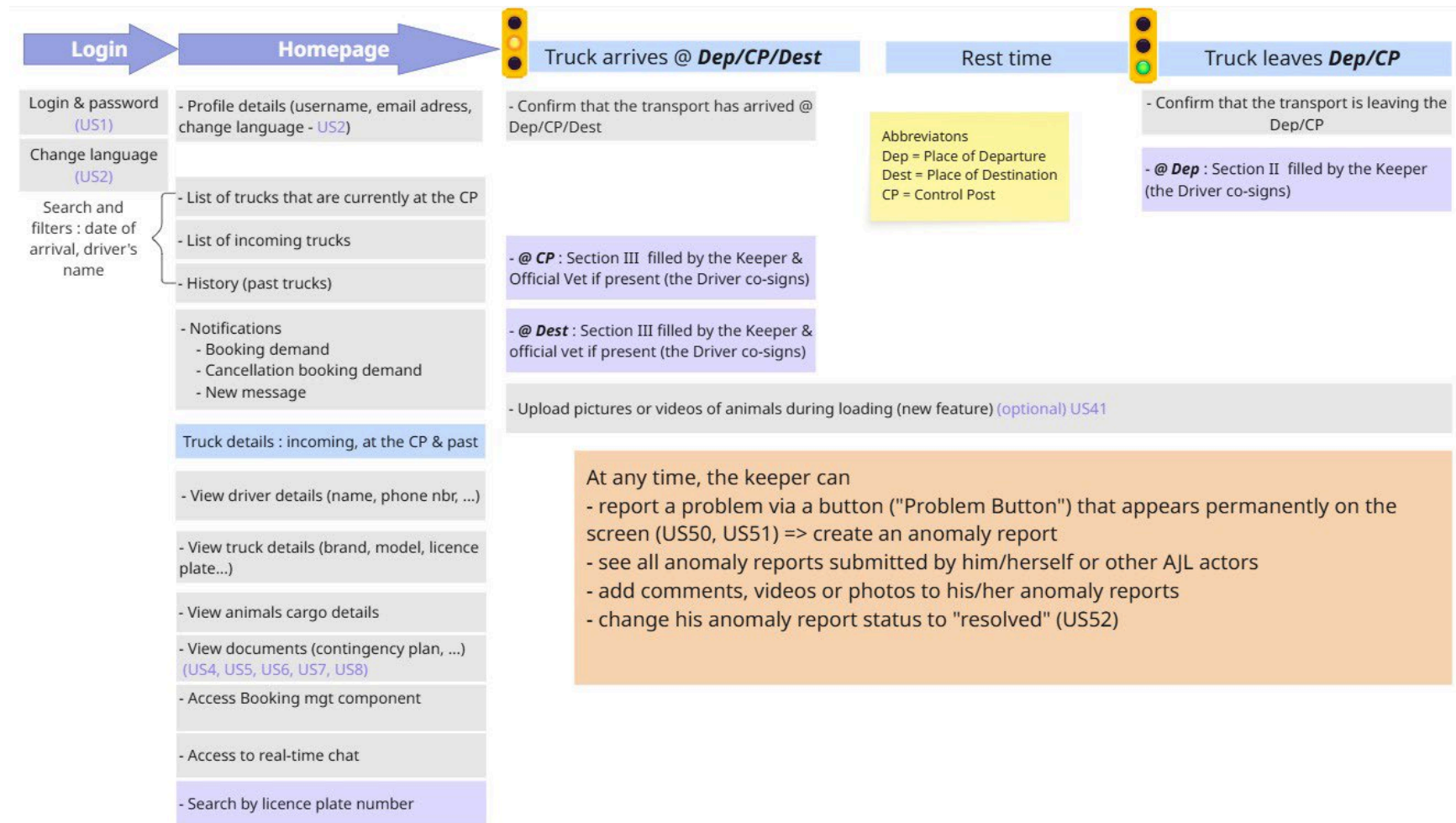
• Organiser's Customer Journey



- Driver/attendant's Customer Journey



• Keeper's Customer Journey



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