Intelligent Access for road transport in Europe - From pilots to regulation and implementation: what are the gaps and how to close them?

PAUL DAVISON

Associate Director in AECOM's Freight and Fleet Team based in Manchester, UK. Master of Town and County Planning from the University of Manchester

THOMAS ASP

Senior specialist at Swedish

Transport Administration and

project leader for the research

program on High Capacity

Transport at CLOSER.

M.Sc. in Civil Engineer from

Chalmers, Gothenburg.

MARCEL OTTO

Strategic Advisor and Coordinator Freight Transport, Rijkswaterstaat, Ministry of Infrastructure and Water Management

Abstract

Intelligent Access (IA) has the potential to be transformational for our transport infrastructure, freight and the wider supply chain. The main objective of this project is to deliver general guiding principles, showing the dependencies, pre-conditions, and necessary steps to move implementation and adoption of IA forward across borders and at national level for the transport of goods by road. There are three key technical work packages associated with this project: understanding the building blocks for an IA framework, which looks to undertake research and engagement to collate knowledge of IA; the development of potential scenarios; and applications of how future technologies such as digitisation and automation could be applied. We anticipate that two to three National Road Authorities will field test the guiding principles developed as a result of this project.

Keywords: Intelligent Access, Freight, Compliance, Road Infrastructure, Technology

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1. Introduction

A two-year project, due for completion in Spring 2026, this significant piece of work aims to enhance the performance of the European road network by supporting the freight sector in using it in an appropriate and less impactful way. Technology increasingly affords NRAs the ability to manage road freight movements more effectively.

What is IA?

IA is an evolving and relatively new concept of ensuring "the **right vehicle** with the **right cargo/freight** operates on the **right road** at the **right time**" to minimise impacts on the environment, infrastructure, human health and safety, and society. IA is positioned as an independent new tool by NRAs for the management of road infrastructure and enforcement of special road transport based on real time telematic data from vehicles. It can be an additional tool to support compliance with regulations about weight and dimensions for road transport in private sector combined with public management of road assets and traffic.

Following a review of the literature and discussion with stakeholders, the following definition of IA meets the consensus:

> ***Intelligent Access*** *refers to a system or policy framework that matches the performance and characteristics of a road freight vehicle with the state and capability of a specific section of the road network. The primary objectives are to enhance road safety, improve compliance with regulations, optimise transport efficiency, and ensure sustainability. These systems collect real-time telematics data from vehicles, such as location, speed, and weight, and use this information to monitor, manage, and regulate the movement of freight vehicles on road networks.*

IA is commonly described as an idealised consequence: the right vehicle with the right load is on the right road at the right time. Although this phrase appears easy to comprehend, it begins to fall short when different actors are introduced. For instance, the 'right' vehicle, road, or time may differ between a vehicle operator and a road operator.

Most literature about IA assumes the goal is to achieve a win-win situation between vehicle operators and road operators. Therefore ***compliance*** is a key theme of this research. Otherwise, the implementation is more likely a typical traffic or asset management approach.

IA is a broad concept, but we are particularly interested in compliance and safety aspects.

The key components of intelligent access systems include telematics devices, data analytics, real-time monitoring, continuous monitoring of vehicle movements and road conditions to ensure compliance with access conditions and detect any violations, integration with existing systems such as tachographs onboard computers, Transport Management Systems (TMS), Fleet Management Systems (FMS), Weigh in Motion systems and stakeholder collaboration.

Adoption of IA in road freight transport can help NRAs to address budgetary and climate challenges by delivering more efficient use of existing road infrastructure capacity, whilst embracing the opportunity to connect to other developments in the field of digitisation, automation and connectivity, both on the government side and in the logistics sector.

Other stakeholders which are set to benefit from IA include service providers, shippers, transporters, hauliers, vehicle manufacturers, and various service providers. IA is a key application of connected vehicles which can provide significant benefits for NRAs as well as providing major commercial and operational benefits to road operators and the logistics industry.

NRAs are seeking to ensure the efficient use of existing road infrastructure capacity against many challenges, including reduced budgets and climate change. Intelligent Access Policies for Road Freight Transport can support NRAs to address these challenges. IA can **help to manage access of heavy vehicles to the road network based on their safety and environmental performance.**

As the freight and logistics sector moves forward with the integration of digital technologies to improve efficiency, there is an opportunity for NRAs to improve monitoring of roads, connected vehicle data and control access using IA.

IA has the potential for:

- Better use of existing infrastructure with traffic management based on time and place
- Less degradation of road infrastructure through improved management of weight, speed, and routing of heavy vehicles
- Realising climate objectives by reducing congestion and prioritising climate-friendly vehicles, for example, management of low emission zones, which will give more transparent and greener logistics
- Increasing road safety through, for example, less overloading or improved insight into where safety incidents arise on the road network
- Creating a level playing field between different hauliers/carriers, improving compliance by hauliers/carriers with regulations as set out by NRAs
- Improving control of the transport of abnormal loads and dangerous goods
- Controlling introduction of high-capacity vehicles
- Faster and more unified and controlled processing of transport documents in cross-border transport through digitalisation

CEDR's Working Group on Road Freight Transport (WG RFT) has conducted work on IA best practices[1] and has made recommendations for its implementation. The research showed there

[1] Intelligent Access (IA): current NRA practices, CEDR Working Group Road Freight Transport, 2022, www.cedr.eu/docs/view/62a343fc227be-en

are many more opportunities, both for NRAs and for all other stakeholders, including society and transport companies.

This project will build on the previous research and explore how IA can be set up, both cross border and at national level, as a part of the digital transformation, to get more insight and control over road use by road freight transport, using IA as a useful aid to regulatory compliance rather than just as an enforcement tool. **The output of this research will identify scenarios where IA could be applied to the management of cross-border road transport of goods and provide transnational benefit, contributing to the further development of the concept within the European context.**

ISAC has been established to deliver this work with CEDR, which has been funded by NRAs from Ireland, the Netherlands, Norway, Sweden and Finland. ISAC includes specialist consultants from AECOM (as the lead), TRT (Italy), Conseso (Sweden), KTH University (Sweden), Alba Consulting (Ireland) and White Willow (UK).

2. Project objective

The main objective is to deliver general guiding principles, showing the dependencies, pre-conditions, and necessary steps to move implementation and adoption of IA forward across borders and at national level for the transport of goods by road. This supports Directive 96/53/EC which states that Member States should be encouraged to establish Intelligent Access Policy schemes **that ensure compliance with rules on the maximum authorised weights and dimensions.**

Dissemination is key to achieving this objective, with the guidelines primarily directed at NRAs; however, it also includes the interests of different stakeholders, as identified throughout the research, to gain maximum support and success for IA.

The primary objective is to investigate how IA could help NRAs to **optimise use of infrastructure capacities** and contribute to more environmentally sustainable road transport of freight.

This includes:

- Exploring how IA can be set up, both cross border and at national level, as a part of the digital transformation
- Identifying scenarios and road maps where IA could be applied to the management of cross-border road transport of goods
- Identifying the dependencies, pre-conditions, and the necessary steps to be taken to implement IA
- Understanding opportunities and challenges, primarily for road authorities and other stakeholders

- Developing guiding principles for the implementation of IA at a national level, for individual countries
- Collaborating with stakeholders, NRAs, industry partners, original equipment manufacturers (OEMs) service providers and other stakeholders in the freight transportation sector
- Disseminating the research produced so all CEDR NRA member states can access it

The project delivers guiding principles and recommendations for the implementation of results to enable CEDR members to **choose an application of IA that fits their national context for cross-border transports for specific groups in road freight transport, specific corridors, and/or specific vehicle configurations.**

3. Methodology

The approach to delivering this project focuses on:

1) **Research** - this underpins the project. The research aims to explore, investigate and establish a research baseline

2) **Engagement** - Engagement is the heartbeat of the project. It tests and provides validation from stakeholders through three online workshops split over three Work Packages (WP) (1, 2 and 3). The purpose of each workshop is to be slightly different for each WP. We have also allowed for focused topic-led workshops for areas that have yet to be defined, should they be required

3) **Development** - This involves the development of IA scenarios and road maps using research information gained from the research and engagement activities.
Development will also include the three reports as well as the final report and presentation

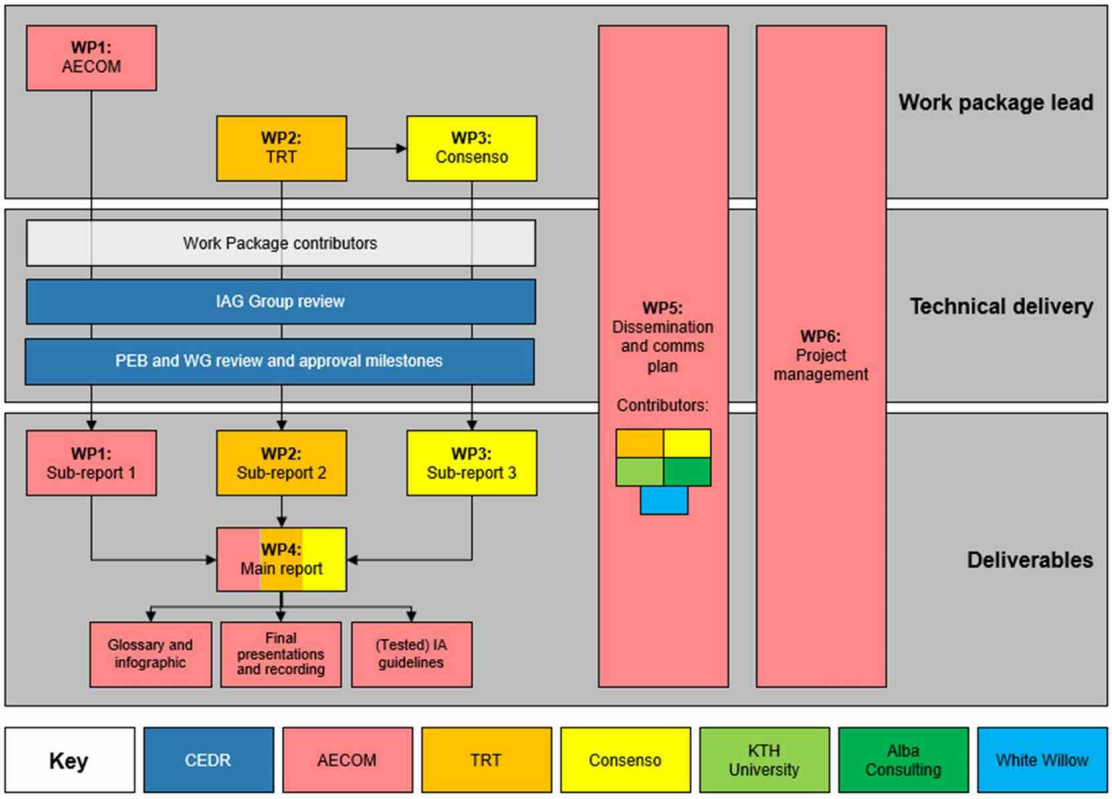

Figure 1: Project Methodology

Figure 1 demonstrates the project metholodgy we are employing on this research, led by different members of the ISAC consortium, feeding into a main report and tested guidelines.

4. Work Package 1 - Emerging findings: Building blocks for IA-framework

This task is the foundation for the remainder of the project. We have developed a set of research questions based on the research needs that are clear and focused but complex enough to allow adequate research and analysis.

We are using the following ***systematic review process*** to explore existing evidence related to intelligent access:

4.1 In-depth literature review

The first step in the systematic review process, is a***sking.*** The research is investigating questions (with relevance to the short and long term) such as 'How can IA be used to manage assets more effectively?', 'How can IA be used to manage traffic better?' and 'How can IA be used to make traffic safer?'

We are assessing schemes such as the Intelligent Access Program (IAP) in Australia[2], which is a technical, functional and regulatory national framework to manage heavy vehicle access through the use of telematics. Developed in partnership with all Australian road agencies, IAP allows participating operators access – or improved access – to the road network, in return for IAP monitoring and compliance with road manager access conditions.

Location, time and identity are remotely monitored using satellite tracking and wireless communication technology via the In-Vehicle Unit (IVU). Road agencies receive IAP data when a vehicle operates outside the permitted access networks or conditions, and a Non-compliance Report (NCR) is issued. NCRs are reviewed and, if validated, may result in further action taken. IAP enables operators to access roads or bridges, operate at greater masses, or use larger and heavier vehicles than would otherwise be available. IAP provides road managers with the confidence and assurance that heavy vehicles are complying with their road access conditions.

We are looking at replicability of this and other schemes across the world for Europe, in respect to the transport network, existing regulations and the logistics sector in each geography.

These include the eFTI project in Estonia[3], which aims to digitize and streamline the exchange of freight transport information. This initiative is part of a broader effort to enhance the efficiency, transparency, and sustainability of freight transport operations in Estonia and align with European Union regulations. Pilots are also informative, including those set up by the Ministry of Infrastrucutre and Water Management in the Netherlands[4], which set up a small scale Pilot Intelligent Access for Special Road Transport (PITbw) as well as Sweden investigating abormal loads and frozen roads associated with the HCT-City Project[5]. The second step in the systematic review process, ***acquiring***, involves searching for relevant evidence. We will start by checking for existing reviews to match the topic. A list of suitable databases (for instance, Google Scholar, Road Safety Observatory, etc) and a list key words and phrases will be generated to conduct a systematic search for evidence. At this stage, the evidence (for instance, reports or articles) is not reviewed in detail; only the metadata is recorded in preparation for the next step, which is ***appraising***. We are appraising each article (for instance, by reading the abstract or introduction) and will rate each piece of evidence according to pre-defined criteria (such as relevance, year of publication, and peer-review status). The fourth step in the systematic review process, ***aggregating***, is the traditional part of a literature review. The evidence is being analysed to extract relevant data and information. The fifth step in the systematic review process, ***applying***, reviews the evidence to identify options that could be implemented to address the key objectives. A ***long list*** of options is being

[2] Australia IAP (TCA Page), 2024, Intelligent Access Program (IAP) - Transport Certification Australia

[3] HV Intelligent Access and e-waybills development in Estonia, 2016, HVTT16: HV Intelligent Access & e-waybills development in Estonia

[4] Lessons learned from the pilot Intelligent Access for special road freight transport in the Netherlands, 2023 Lessons learned from the pilot Intelligent Access for special road freight transport in the Netherlands

[5] Intelligent Access and geofencing - challenges and opportunities in Sweden, 2021, Wandel-Intelligent-Access-And-Geofencing-Challenges-And-Opportunities-In-Sweden.pdf

created and stored in an options database. The sixth step in the systematic review process, ***assessing***, performs an evaluation of the long list of options for potential benefits against a set of criteria to determine which option is preferred for each of the key objectives. The emerging criteria includes:

- Improvements to road safety (reduction of speeding, other offences, and collisions)
- Improvements to the enforcement of offences (including proportion detected)
- Better management of specific vehicle activities, such as longer-heavier vehicles, hazardous and toxic materials (HAZMAT) and abnormal loads
- Reduction of empty loads, Vehicle Miles Travelled (VMT) and fuel use
- Proportionality and appropriateness to geographic areas and specific infrastructure assets such as bridges and tunnels
- Cost effectiveness and provision of financial sustainability
- Reduction of the administrative burden on NRAs and other stakeholders (e.g. Police and emergency services)
- Administrative burden for other offices
- Alignment with the NRA strategies and other national policies e.g. HGV charging and European Electronic Tolling Services (EETS)
- Reputational Risk of deployment
- Policy acceptability

These criteria allow each of the long list options to pass or fail, resulting in a ***short list***. This process will be documented to allow it to be validated or repeated in the future as new evidence becomes available. The short list will then be reviewed by parties not involved in its creation. A preferred option for each key objective will be selected based the criteria set out in the Assessing step and following feedback from the short list reviews. We have also looked at the legal basis the introduction of IA and the requirements from relevant regulations and how IA helps meet them:

- Intelligent Transport Systems (ITS) Directive (2010/40/EU) of the European Parliament and of the Council of 7 July 2010 on ITS – requires interoperability of data
- Commission Implementing Regulation (EU) 2019/1213 of July 2019 on the Implementation of the Directive 2010/40/EU - Details the requirements for data and information exchange between different transport systems to promote interoperability and integration. Article 4: Emphasises the need for compliance with data protection regulations while implementing ITS solutions.
- eFTI Regulation (EU 2020/1056) – Electronic Freight Transport Information - Article 3 outlines that freight information must be electronically accessible to competent authorities.
- Council Directive 92/106/EEC – Combined Transport: Relevant Clause: Article 2(1) encourages the development of combined transport to reduce road traffic congestion, while Article 3 promotes transparency in transport operations.

- Regulation (EC) No 1072/2009 – Access to the International Road Haulage Market - Relevant Clause: Article 3(1) requires operators to possess valid community licenses, and Article 8(2) limits cabotage operations to prevent excessive road use.
- Revision of Directive 96/53/EC – Weights and Dimensions of Heavy Goods Vehicles: 4(4): This article permits certain vehicles to exceed standard dimensions if equipped with aerodynamic devices or running on alternative fuels, provided they meet specified safety and efficiency conditions. Article 10: Outlines requirements for Member States to implement systems that ensure vehicles comply with weight and dimension regulations, particularly regarding enforcement and monitoring.
- Directive (EU) 2023 / 2661 of the European Parliament and of the Council of 22 November 2023 on the Promotion of Digital and sustainable Transport: Article 1: Establishes the purpose of the Directive, which is to promote the digitalisation and sustainability of transport systems across the EU. Article 5: Outlines the obligations for Member States to implement measures that facilitate the integration of digital technologies in transport operations. Article 8: Addresses the importance of ensuring data privacy and protection in the deployment of digital transport solutions.

We have found that IA systems fulfil the requirements outlined in these regulations by automating compliance, enhancing operational transparency, and ensuring data protection in line with European legal frameworks.

4.2 Functional gap analysis of required and available data

Functional gap analysis is used to characterise the difference between what a system can do and what it is required to do. In this case, the analysis will compare the data required to implement IA to the data that is currently available. For instance, telematics, vehicle emissions, and mapping data. The analysis determines any gaps between the actual and desired situations for each data source. It will also comment on whether the gaps are critical or whether users of the system can accommodate them (through changes to system configuration or user practices).

We have identified approximately 40 data areas which could be applied for IA. They include Weight in motion (WIM) systems control and weigh vehicles to increase transportation safety and reduce the damages caused by over-weighted vehicles, **but without having to stop the vehicle**, adaptive signal control technology uses detection technologies to automatically adjust the timing of traffic signals to work with changing traffic conditions and driver behaviour monitoring and control systems to analyse the speed and acceleration of drivers during transportation operations and provide feedback for improving driving. For each data area we undertook an assessment including a subjective gap assessment and associated commentary.

4.3 Stakeholder engagement

As discussed, stakeholder engagement is key to this project and an early task for the project stakeholder workshop with a broad cross section of those associated with the movement of freight, directly and indirectly from across Europe. This includes road freight operators, technology providers and infrastrucutre providers

Stakeholders discussed and agreed upon the specific applications of IA. These included emissions control, dangerous goods/hazardous materials, control on weights and lengths, bridges, lorry parking management, abnormal loads, ability of hauliers to demonstrate compliance, protection of vulnerable areas, convoy management, wintery conditions, curfews, easier border control, road user charging, and deriving real-time data.

The necessary components were identified as data from vehicles, information about infrastructure, a digital roads network with a standardised process for sharing data, and political and governance framework including funding.

Stakeholders were asked to envisage the benefits to their organisations of IA. Identified benefits included better use and utilisation of infrastructure, potential for improved road safety and security, support for compliance with regulations, reduction of stress on infrastructure and people, increased fairness through enforcement, leading to fairer competition, positive environmental impacts, improved air quality, making planning of transport more predictable and quicker access to new data.

They were then asked for reasons why they believed IA, in spite of offering all these advantages, has not been more widely adopted. Their responses included privacy concerns, access to data and data compatibility, legal and political issues, such as General Data Protection Regulation compliance, lack of understanding of the topic and no clear definition, the need to harmonise across Europe, economic barriers (cost), lack of a clear business case, lack of data sharing and lack of standards. Implementation of Intelligent Access was then discussed. For this, it was found that good business cases need to be made, drawing on examples of best practice and with systems compliant with METR (Management of Electronic Traffic Regulations). Pilot projects involving smaller businesses may be a good starting-point, with the need to demonstrate that the system was secure. The support of OEMs, haulage carriers and ideally the general public should be cultivated. Ultimately, cooperation should be sought on a cross-border and regional basis. The systems were most likely to be implemented in countries with **either already well-developed transport networks, rapid growth (such as Eastern Europe), or a particular issue for logistics, such as the necessity for quarantine**. Countries and regions which are predominantly rural, or lack government support for IA, were deemed to be the least likely to implement the measures. Discussion then moved on to the skills needed, and likely obstacles. Skills ranged from expertise in road and bridge maintenance, through to legal, contractual, and technological knowledge, as well as knowledge of the supply chain and stakeholder 'ecosystem'. The need for a 'can-do', delivery-focused mindset was also mentioned. Likely obstacles included hesitancy due to the need for GDPR compliance, unwillingness to share data, and reluctance of some players to comply with new rules. Cost considerations are also an obvious factor.

5. Work Package 2 - Definition of IA scenarios

A key output is the development of scenarios to look at potential applications of IA to govern cross-border transport of goods by road. We will use the outcomes, insights, and results from the research task to develop a series of three draft scenarios with increasing complexity.

It is worth noting that IA schemes increase in complexity according to their intended purpose. As an example, if an IA is intended to simply avoid cross-border congestion during peak hours/days (especially in the case of tunnels), its implementation will need a relatively limited amount of information for access to be granted (i.e. vehicle type, time, position, average traffic on the regulated road sections). But if IA schemes are intended to manage also other situations (e.g. transits of abnormal load on bridges), additional information will be needed (e.g. weight total and by axis of the vehicle and maximum possible load for the bridge). Additionally, if the scheme is intended to also regulate high-capacity vehicles (European Modular Systems) additional information on road technical parameters is needed for matching vehicle characteristics with the state and capability of the infrastructure network (e.g. maximum possible load, possible turning circles and real-time traffic). Moreover, cross-border IA schemes will increase in complexity according to the number of countries (and thus of stakeholders) involved in the scheme, due to either increased data exchange needs or regulatory and governance frameworks to be harmonised. Combinations of these factors could generate an endless number of scenarios. Therefore, criteria and parameters for the identification of the three scenarios will be defined in agreement with the CEDR WG RFT and based as a minimum on:

- The intended purpose of the scheme (e.g. management of congestion during peak hours/days; of transits across environmental sensitive zones; of transits of abnormal loads/high-capacity vehicles; of transit of dangerous goods etc.)
- Countries potentially interested in the implementation of the IA scheme, to be selected within the Programme Executive Board (PEB) funding members (NRAs from Finland, Ireland, Netherlands, Norway and Sweden) and their neighbouring countries. To allow for a detailed investigation, each scenario will involve a maximum of three countries. In this way, scenario results could be used to setting the scene for implementing future cross-border pilots for testing IA guidelines

Initial workshops with NRA stakeholders are underway to discuss and agree on the identification of criteria and parameters for the definition of scenarios. Based on the outcome of the research task, the project team will prepare initial suggestions for criteria and parameters and will circulate them ahead of the workshop to enable an informed discussion. We are currently considering cross border scenarios relating to UK-Ireland, Belgium-Netherlands, and Nordic countries in relation to movements such as timber and abnormal loads.

5.1 Analysis of IA scenarios

The analysis of scenarios will be done in close collaboration with NRAs. For each scenario, two on-line workshops will be organised. The first workshop will be intended to collect information from each country involved in the scenario. The project team will then elaborate the inputs collected in the first workshop, integrate them with additional desk research (where needed) and elaborate on how the IA schemes and services could be shaped, highlighting pre-

conditions, barriers and enabling factors for their implementation. Concept designs and process maps will be developed to show the functioning of the scheme and the role of each actor involved. These maps will be used to brainstorm on type of data to be shared and role of stakeholders and GDPR compliance. Whenever needed, additional on-line interviews will be performed by the project team with selected stakeholders to finetune the analysis. Scenario results will be discussed and validated by relevant NRAs in a second workshop.

5.2 Development of road maps

Lessons learned from the three scenarios will be used to:

- Discuss similarities and differences across the analysed European countries and between EU and non-EU Member States
- Discuss the needs for revision and harmonisation of European and national legislative frameworks
- Outline a road map per scenario and lay down general pre-conditions and interdependencies to be used by a generic European country for organising the concept of IA according to its own national reality.

The road maps will set out the vision, direction, defined timescales, milestones, priorities, and guidance to enable IA to be implemented over time across Europe.

6. Work Package 3 - IA scenarios: Digitisation and automation

To achieve this element's deliverables, the project team will also investigate how IA can improve the ongoing digitalisation, connectivity, and automation for the NRAs, with a particular interest for Finland, Ireland, Netherlands, Norway, and Sweden, as well as in the transport sector itself. Using the same systematic review process described in the research task, we will explore existing evidence relating to how the IA concept connects to other developments in the field of digitisation, automation, and connectivity, both on the government side (asset management, traffic management, data management) and the logistics sector (eFTI, electrification, vehicle innovations, data integration, etc). The investigations are divided into four sub-tasks:

- Make a state-of-the-art of ongoing and planned activities in ITS with respect to IA
- Investigate how IA can impact autonomous driving and smart roads
- Investigate security aspects when bridging data classified for military purposes
- Identify good examples of how new standards for data can be applied

This task in now underway with emerging results expected in Summer 2025.

7. Conclusion

With a focus on compliance rather than enforcement, this vital reseach project is already helping shape understanding of this complex but potentially impactful apporach to managing freight movements on Europe's major road network. We have shown that current applications and pilots demonstrate that IA for freight can make a material difference to the efficiency, safety and effectiveness of Europe's road network. We have also looked at the data and associated frameworks that will need to be applied for IA to work in this context.

We have also started to answer some key questions around the barriers, issues and opportunities, which include addressing national issues and cross border compatibility, GDPR requirements, cost and implentation of schemes, as well as undertaken a review of how IA is required by current and planned regulations. Between now and Spring 2026, we will have developed and refined this early research into guidelines to enable the introduction of IA schemes for a number of cross-border applications, helping achieve national and European targets for many areas including road safety, emissions, infrastructure integrity and congestion and will have further updates across the three main tasks by the time this paper is to be presented in May 2025.