Use of satellite navigation\(^1\) for tracking & tracing the transport of dangerous goods

**Setting the scene**

Logistics and freight transport are among the most interesting markets for GNSS technologies. Solutions mostly based on GPS\(^2\) for monitoring, tracking & tracing the transport of goods are widely available on the market and largely adopted in operations, with resulting commercial advantages thanks to improved traceability/monitoring and increased efficiency.

Furthermore, in the case of dangerous goods transport, the use of GNSS is not only a matter of intelligent and efficient logistics, it also implies benefits generated by an enhanced safety and security for the involved industries/commercial stakeholders and for the interested authorities. The shipment of hazardous materials implies several risks, such as traffic accidents with tragic consequences in the case of inflammable products, hazardous spills, environmental damage, etc. Regulations are in place, aimed to protect everyone either directly involved (consignors or carriers), or who might indirectly become involved (emergency services, public). The regulations assign duties and define rules for minimising the hazards related to the carriage and the risk of incidents, and guarantee an effective response.

Today, the majority of the companies transporting dangerous goods by road and rail have GNSS-based tracking & tracing solutions/services. The gathered data are generally utilised by the industries/commercial stakeholders only. However authorities could also take advantages for regulations purposes, risk assessment and support during emergency operations in the case of accidents, and social benefits can derive through improved law enforcement, decreased accidents/impacts of relevant consequences (in terms of human lives and environmental damages), and reduced emergency response time.

Additionally, the availability of advanced technologies based on EGNOS\(^3\) augmenting GPS in Europe and on multi-constellation capabilities (e.g. based on the European Galileo, the Russian GLONASS and the Chinese system BeiDou) gives the possibility to have a more precise and reliable information regarding the position of a certain dangerous material and of potentially dangerous events that occur. This represents fertile ground for many improvements in business, and at the same time, it is crucial for regulators that are responsible for public safety and security.

Over the last few decades, authorities have been showing an increasing interest in the adoption of tracking & tracing solutions using GPS and EGNOS, the relevant deployment on a large scale and the sharing of gathered data with industries/commercial stakeholders. Various initiatives have been developed in Europe. However these initiatives are fragmented, geographically spread, lacking of a common/harmonised approach for a technical/functional architecture and standards, at national and international levels. Moreover, they require information sharing by the involved business actors and stakeholders, without robust incentive models.

Furthermore, in parallel, a regulatory work is being developed by UNECE (United Nations Economic Commission for Europe) in relation to the use of telematics for the transport of dangerous goods, and specifically on the use of tracking & tracing and GNSS (UNECE joint WG\(^4\) on telematics [www.unece.org/trans/danger/danger.html](http://www.unece.org/trans/danger/danger.html)). The WG is defining an architecture/message standard for telematics to deploy the electronic transport document and to improve emergency information management for the transport of dangerous goods. This is based on the concept of Trusted Parties (TP) where two TPs (TP1 and TP2) are foreseen: the first acting at institutional level while the second acting at commercial level and exchanging information.

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\(^1\) Global Navigation Satellite System (GNSS) \\
\(^2\) Global Positioning System \\
\(^3\) European Geostationary Navigation Overlay Service \\
\(^4\) Working Group
**EGNSS**: **EGNOS and Galileo**

EGNOS improves the accuracy of the current GPS signal and provides integrity information. For this reason, it is suitable for applications requiring accurate and reliable positioning. EGNOS is able to enhance today’s operational ITS solutions based on GPS in Europe. Galileo will provide further improvements on a global scale when it will become operational.

EGNOS provides three services:

- **EGNOS Open Service (OS)**, launched in 2009, is delivered free of charge. It is open for use to anyone with an EGNOS-enabled receiver. Today’s mass market GNSS receivers are EGNOS enabled. EGNOS OS is particularly suitable for mass market and some professional applications like surveying.

- **EGNOS Safety-of-life Service (SoL)** is authorised for European civil aviation and operational since March 2011.

- **EGNOS Data Access Service (EDAS)** launched in 2012, delivers a terrestrial commercial data service. It consists of a server that gets the data directly from the EGNOS system and disseminates them via terrestrial networks in real time. EDAS is particularly suitable for professional applications, and it enables to implement software solutions and products for value added positioning services.

EGNOS augments the GPS signal. It provides more precise positioning services (up to 3-4 metres) and in addition, it gives users information on the reliability of the GPS signals (‘integrity data’).

The next figure presents one of the outcomes of extensive trials conducted in various road environments.

**Figure 1 Comparison between the positions measured with GPS-only, EGNOS OS and EDAS**

Users of the EGNOS OS get an enhancement to the accuracy of the position measured with GPS of approximately three metres. EDAS could bring further enhancements up to approximately four metres. Moreover, the use of EDAS provides an added value information called ‘protection level’ (obtained by suitably processing the ‘integrity data’ of EGNOS) for qualifying/guaranteeing the measured position.

Thus above mentioned, EGNOS enables to improve the performances of the services delivered by ITS based on GPS only, making them suitable for applications requiring precise and reliable localisation.

Products and solutions enabling the use of EGNOS are today available on the market, and are ready for Galileo.

**EGNOS for dangerous goods**

In the last decade, various European projects have developed and extensively proven the technical feasibility of tracking & tracing solutions based on the EGNSS technology, primarily EGNOS (being operational), especially for applications and markets for which safety, security and liability play a dominant role. In fact, EGNOS enhanced positioning and integrity enable precise and reliable localisation and tracking in order to meet the challenge of regulations and qualified transport services.

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5 European GNSS

6 Source: the European project EGNOS2road, 2011-2012
The European Research & Development (R&D) project SCUTUM (SeCUring the EU GNSS adopTion in the dangeroUs Material transport, www.scutumgnss.eu), which ended in December 2011, demonstrated that EGNOS adds value to GPS alone thanks to a better accuracy and guaranteed positioning, resulting in higher confidence in the data. SCUTUM also validated the relevant operational benefits in terms of higher safety and efficiency.

SCUTUM also supported the elaboration of the CEN\(^7\) Workshop Agreement CWA 16390, which is the CEN technical specification for the provision of tracking & tracing services based on the use of EGNOS EDAS satellite navigation technologies for the transport of goods (ftp://ftp.cen.eu/CEN/Sectors/List/ICT/CWAs/CWA16390.pdf). CWA 16390 defines the types of information/formats of the position data exchanged between the GNSS receiver (integrated in the tracking device installed on-board of the tankers/tank containers) and the monitoring platform, for the provision of the relevant services.

Today, thanks to SCUTUM, EGNOS is used in the operational transport of dangerous goods by road in Europe, and its expansion to fleets operating in Macedonia and in Serbia is currently ongoing. Around 1,500 road tankers are monitored with GPS+EGNOS, and the tracking & tracing devices installed on-board of the vehicles are enabled to use EGNOS in compliance with CWA 16390.

**CORE demonstrator on the intermodal transport of dangerous goods**

CORE (Consistently Optimised Resilient Secure Global Supply-Chains, www.coreproject.eu) is a research project co-funded by the European Commission under the 7th Framework Programme. Launched in 2014 and with a duration of 4 years, CORE is focused on the security of the freight/transport/logistics and develops various market-led demonstrators. One demonstrator concerns the development/validation of an ITS\(^8\) solution integrating GNSS technologies for tracking & tracing the intermodal transport of chemicals and gas throughout road-rail paths across Europe. In particular, multi-GNSS technologies are used, based on the American system GPS, the European systems EGNOS and Galileo, the Russian system GLONASS and the Chinese system BeiDou.

This CORE demonstrator is an end-to-end validation in real business cases/operations and cross border operations in two European countries: the road/rail transport of Argon through tank containers from Duisburg (Germany) to Terni (Italy) and from Linz (Austria) or Lyon (France) to Terni (Italy). The extension to other business cases is also considered.

Coordinated by Telespazio (one of the world’s leading players in satellite services), the demonstrator involves HOYER (a European transport company operating in the sector of chemical and gas) as a business stakeholder/transport operator, the authorities/regulators from Italy and France (the Ministry of Transport of Italy and France), ERF (European Union Road Federation) and TTS Italia (Italian ITS Association).

Capitalising on SCUTUM’s heritages and outcomes, CORE is conceived to extend them:
- From road to the intermodal road/rail transport through tank containers, and
- To the use of multi-GNSS.

The next figure shows the architecture of the CORE solution for tracking & tracing the intermodal transport of dangerous goods via road/rail tankers. The solution is built on elements based on existing facilities/state-of-the-art components, purposely enhanced/integrated with new developments.

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\(^7\) European Committee for Standardization  
\(^8\) Intelligent Transport Systems
CORE:

- Performs a technical demonstration and validation for the involved business stakeholder and authorities/regulators. More specifically, the focus is on the added value of robust and reliable positions (obtained through the use of EGNSS and multi-GNSS) combined with sensor information about the status of the transported material for enhancing efficiency, safety and security, improving law enforcement and risk assessment.

- Carries out the formal process of revising the CWA 16390 in order to consider normal obsolescence and technological evolutions, including multi-GNSS.

- Supports the establishment of a best practice involving different countries.

- Contributes to the UNECE joint WG on telematics on the establishment of a flexible architecture and a standard, which enable and encourage the adoption of telematics and the introduction of electronic (digitalised) documents in the transport of dangerous goods. In particular, CORE provides inputs to the TP1/TP2 architecture concerning the exchange of data (by proposing modifications to the relevant data model), the validation in real cross-border (Italy-France) business cases and the relevant impact assessment.