European GNSS Programmes
European Transport Policy

European Commission & GNSS Downstream Industry in Action

2nd October 2014, Brussels
DG-MOVE Premises
Galileo Services Overview
Non-profit Making Association aiming at developing, promoting and maximizing the potential of the GNSS applications’ market

Comprising key GNSS Downstream Industry players

Representing all elements of the value chain and covering the different application sectors (aviation, maritime, road, rail, telecom…)

Missions:

- Voice Industry concerns & expectations toward the institutions
- Share market experience and knowledge of user needs
- Support the implementation of the European GNSS Programmes
Galileo Services Overview (2/2)

Galileo Services and Oregin federate the most Active and Representative players of GNSS Industry and Research supporting the European GNSS Programmes.

GS & Oregin represent a community of almost 180 organisations.
Context of the Meeting
Galileo Programme Main Objectives

To get a significant share of the huge and continuously growing worldwide GNSS market

Growth / New Business Activities

Jobs & Wealth Creation

ROI in European GNSS

Independence / Autonomy with regard to other GNSS (GPS, GLONASS...)

In Europe

To get a significant share of the huge and continuously growing worldwide GNSS market

- Growth / New Business Activities
- Jobs & Wealth Creation
- ROI in European GNSS
Some key GNSS Applications

**TRANSPORT**
Safety and efficiency increase for aviation, maritime and inland waterways, rail, road transport...

**ENVIRONMENT PROTECTION**
Support to ecologic driving, support to car parking, waste control, low cost sensors for landscape monitoring, Land monitoring and Land Administration through Surveying and Mapping...

**HEALTH**
Tracking and Tracing of medical goods, assistance to elderly and disabled people...

**AGRICULTURE**
Precision Agriculture (steering guidance, farm logistics), Livestock management...

**MOBILITY**
Navigation, road tolling and charging, Location Based Services, multi-modal transport services...

**SECURITY AND SAFETY**
Pay As You Drive insurance, law enforcement, protection of IPRs, secure asset and person tracking, Unmanned Vehicles, integration of GNSS/SATCOM/GMES for civil security services, Customs and Freight monitoring...

**TIMING & NETWORKS**
Synchronization of smart grids, telecommunications, banking and DVB networks...
Some key GNSS Applications

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**SECURITY AND SAFETY**
Pay As You Drive insurance, law enforcement, protection of IPRs, secure asset and person tracking, Unmanned Vehicles, integration of GNSS/EUTELSAT/CMES for civil security services.

The number of potential applications not marketable yet or still to be developed is tremendous

Precision Agriculture (steering guidance, farm logistics), Livestock management...
Market Trends

- GNSS applications: one of the most promising markets
  - Current market boom (in Europe and North America: increase from 1 to 3 GNSS devices per inhabitant expected in the next decade)
  - Annual growth rate of Global GNSS market = ~10%
  - The core and the enabled GNSS markets will reach 110 B€ and 240 B€ respectively by 2022

- Market Trends are not in favour of Europe: Europe - already significantly lagging behind over the past five years - does not succeed at the game
  - European market share: < 20%
    - Usual Europe Market share in other High-Tech Sectors: 33%

- Main Rationale: European GNSS downstream industry suffers from a dramatic competitive disadvantage vis-à-vis industry from other regions
  - Dedicated national programs/strategy in the US, Russia, China, and Japan to support competitiveness of their industry & to enhance GNSS market take up, including:
    - Massive funding from R&D to manufacturing capabilities
    - Regulation
    - Massive Public Procurement

Source: GSA GNSS Market Report – Issue 3
Major Risks

➢ Risks for the EU Industry:
  - Difficulty for EU Industry to survive on the GNSS global market
  - Market boom window of opportunity soon closed for the EU industry
  - Last chance: Galileo early services exploitation phase (2015-2020)

➢ Risk for EU Autonomy:
  - Dependence on GNSS increases together with the Market
  - Galileo may not be used as intended
    (little interest for most of the applications to track 4 constellations, while GPS, GLONASS and BEIDOU are already in place)
  - Critical or most of Galileo equipment are not manufactured in Europe

➢ European Autonomy
cannot be achieved if Galileo is not widely used, with equip/apps made in EU

➢ Socio-Economic expectations
will not be met if EU industry fails to get a reasonable share
Need of a comprehensive and assertive European industry policy to develop EGNOS/Galileo downstream sector aiming at

- Fostering the use of European GNSS infrastructures
- Encouraging EU Industry to develop EGNSS equip/apps
- Fostering the manufacturing of EGNSS based solutions in Europe
- Supporting the European industry competitiveness on GNSS global market and fostering the emergence of European champions

*An industry policy to ensure European GNSS Programme Full Success*
(growth, job creation and autonomy)
Necessity of a European Strategy

Permanent forum between Institution & Industry
Market intelligence / Promotion & Awareness
Availability of necessary skills
Legal & Regulatory Framework
Public Procurement
Support to international cooperation and global market access

Technical support

<table>
<thead>
<tr>
<th>R&amp;D for enabling technologies</th>
<th>R&amp;D for critical GNSS technologies &amp; services</th>
<th>R&amp;D for adequate value added content</th>
<th>Standardisation Certification</th>
<th>Support for Testing activities</th>
<th>Demonstrations</th>
<th>Operative Pilot Projects</th>
<th>Manufacturing capabilities</th>
</tr>
</thead>
</table>

GROWTH

EMPLOYMENT

COMPETITIVENESS
Agenda of the day

Key challenges to be taken up to meet the objectives of European GNSS Programmes, with a focus on E-GNSS applications in Transport domain

Objectives

- To identify the main barriers for the European GNSS downstream industry to entry into the different transport related markets
- To identify key actions to support the competitiveness of European GNSS downstream industry on the global market and to foster the uptake of European GNSS in Transport applications

Today, 7 key topics addressed

1. Challenges for EGNOS-Galileo adoption in Aviation
2. Insertion of UAVs in Civil Airspace
3. Adoption of EGNOS-Galileo into the ERTMS-ETCS railways train control system
4. Maritime transport
5. Ship Energy Efficiency & Safety
6. Incorporation of GNSS in various transport sectors
7. Key GNSS related technologies and features for transport applications
Key Topic 1 - EGNOS-Galileo adoption in Aviation
EGNOS & GALILEO successful adoption in aviation should:

- Be performance driven
- Be synchronized and efficient between all involved stakeholders
- Provide valuable services/savings to operators for massive adoption

What are DG-MOVE lessons learned from GPS in aviation, and more closely from EGNOS, in order to define accurate deployment strategy for adoption

Sources:

- Support to GSA for EGNOS adoption
  - 22 EWA in place
  - 110 airports with LPV procedures
  - 15 operators with SBAS/EGNOS aircrafts & helicopters
Performances for EGNOS and Galileo Open Signal:

- To guaranty of a “Minimum Operational Performance Standards” for OS and then associated with GPS – e.g. GPS– DO208 spend 10 years before FOC (1994) and first MOPS for aviation (2004)

- EU funding to support new generations receivers technologies developments (R/D effort at low TRL levels) for:
  - Open Signal differentiator compare to existing GPS, GLONASS, Integrity, interference monitoring (see ICAO last request)
  - multi constellation technologies, and operational concept to match with regional mandates (low SWAP)
  - with and/or without augmentation (SBAS,…)
  - while remaining certifiable.

What is DG-MOVE strategy using Galileo for creating competitive industry base in Europe in the field of Aviation multi constellation receivers
Ensure GALILEO and EGNOS are delivering end to end services available thanks to a **synchronized and efficient** deployment between all involved **stakeholders**: Receiver industry, ANSPs, Air transport industry and operators, airports, and airframe providers

- e.g. current GSA-ESSP program for EGNOS adoption
- Then synchronize Galileo with **ATM master plan** and insure consistency with ATM deployment process

Provide valuable services/savings to operators for massive adoption

- Make incentive schemes available to early adopters (Airlines and/or operators), to facilitate on board integration and to offer guaranty with “**best equipped best served principle**”

What is DG-MOVE strategy in defining an European Air Navigation system based mostly in EGNOS / Galileo optimizing the current network of NAVAIDS
Key Topic 2 - Insertion of RPAS in Civil Airspace
RPAS in Civil Airspace

• Insertion of Remotely Piloted Aircraft Systems in Civil Airspace
  - RPAS will be more and more used both for Public (border surveillance,…) and Commercial applications
  - They are extensively relying today to GPS data
  - Military RPAS landing → Cat B EDA’s AUTARKIA program to use GPS based GBAS

• Need to provide RPAS with EGNOS & Galileo availability/integrity using multi-hybridization sensors technics

• What about a DG-MOVE strategy in introducing RPAS in Civil Airspace, both Commercial and Public
Key Topic 3 - EGNOS-Galileo adoption in Rail
**EGNSS & ERTMS**

**Space technology**
- **EGNSS**
  - EGNOS V2 operative
  - EGNOS evolution (rail not yet included)
  - GALILEO early services

**Ensure ERTMS compatibility**

**Making investments more attractive for local and regional lines**

**Virtual balise**

**Rail applications**

**ERTMS**
- EGNSS foreseen on the new MoU
- EGNSS on the ERTMS roadmap
  - NGTC
  - Shift2Rail JTI
Impact of GNSS on ERTMS evolution

- Extend ERTMS on local/regional lines
- Increase safety on old lines
- Enhance ERTMS world-competitiveness
- Industrial benefits for rail sector

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### Regional & Local Lines in Europe

<table>
<thead>
<tr>
<th>Protection Level</th>
<th>Type</th>
<th>Costs</th>
<th>Benefits</th>
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<td>No protection</td>
<td>A</td>
<td>€5,000,000,000</td>
<td>€20,000,000,000</td>
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<td>Basic protection (warning/stop)</td>
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<td>€5,000,000,000</td>
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<tr>
<td>Basic protection (warning/stop)</td>
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<td>€500,000,000</td>
<td>€2,000,000,000</td>
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<tr>
<td>High protection (discrete s.v.)</td>
<td>D</td>
<td>€200,000,000</td>
<td>€800,000,000</td>
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Bocconi: Economic evaluation of the introduction of GNSS technologies on the Train Control Systems

Rail & Space are becoming tightly intertwined

- Increase utilisation of EGNOS
- New products & services
- Reinforce GALILEO-GPS liaison
- Industrial benefits for space sector

~ 60 times aviation
Adoption of EGNOS-Galileo into the ERTMS-ETCS railways train control system is foreseen in the ETCS MR2 by 2017

- **Challenges:**
  - Current EGNOS system designed to answer the Aviation requirements: positioning accuracy, integrity, continuity of service
  - Rail requirements are different and cannot be achieved with current system
  - Increasing competition from USA-led companies already adopting GPS

- **Galileo under deployment and EGNOS V3 under definition**

- **Need:**
  - Important and urgent need to set up a plan for upgrading EGNOS for meeting the ERTMS requirements taking advantage from the know-how already available of the aviation sector
  - Plan to be implemented in the forthcoming evolution of the EGNOS system and involving the railways community
Key Topic 4 - Maritime transport
1. European GNSS opportunities in maritime transport
2. Standardisation needs of multiconstellation receivers
E-GNSS opportunities in maritime transport

- Utilisation of Galileo and EGNOS within eNavigation / eMaritime:
  - Safety / Robustness / Resilient PNT
  - Efficiency, vessel / ports (ships are the new trucks)
  - Cost saving
  - Sea routes / special requirements

- Maritime authentication (open or commercial service)

- Use of Galileo time as primary or backup time in AIS/VDES

- Adoption of EGNOS (Version 3) in maritime applications

- Some application examples
  - Galileo SAR return link
  - Hydrographic services
  - Container tracking
  - Fast ferries
  - Autonomous ships
Standardisation needs for multi-constellation receivers

- Demonstrators
  - Integrity concept
  - Minimizing single failure mode risk

- Galileo standardisation activities already ongoing:
  - Maritime infrastructure and augmentation systems (LIONS)
  - Multiconstellation receiver (RTCM SC-131 and IMO)
Key Topic 5 - Ship Energy Efficiency & Safety
Ship Energy Efficiency & Safety

- GNSS to improve Ship Energy Efficiency Management System SEEMP

- GNSS to improve Safety of nearshore and inland waterways navigation
Vessel performance can be enhanced by use of GNSS as motion sensor and steering. Trials performed indicates:

- Saving in the range of 3-5% on dynamic trim
- Saving in the range of 4-6% on GNSS heading compared to conventional Gyro

Barrier to market

- Still unknown and technology
- Need of more tests and demos on performance
- IMO regulations stops using new technology like hybrid Gyro.
Safety and integrity in nearshore and inland waterways

Accuray available in GNSS Precise Point Positioning service PPP enables vessel crew to be able to look forward and predict clearance above below and sideways to an accuracy of 10 cm. The benefits are:

- Berthing aid will reduce damages to vessels, shore infrastructure and environment
- Above mast and below keel clearance will avoid collisions with bridges
- Use of bottom contour for enhanced navigation integrity and below keel clearance will reduce groundings

Needs for development:

- Project to define standards for bottom height instead of water depth
- Funding for development of user application
- Funding for development of continuous update of bottom data.
Key Topic 6 - Incorporation of GNSS in various transport sectors
Incorporation of GNSS in various transport sectors: A system provider perspective

These slides provide the view of a system provider on the incorporation of GNSS in the different Transport & Traffic user communities based on:

- Broad and worldwide offering in the Transport & Traffic segment
- Direct contact in Europe and worldwide with customers and stakeholders who are candidate to take benefit from the European GNSS

Customers have different considerations with respect to the usage of E-GNSS, but most of them concur in a number of areas which should be addressed to allow full exploitation of the European GNSS potentialities

Integration  Regulatory framework  Awareness
Incorporation of GNSS in various transport sectors: A system provider perspective

Integration

Customers demand **availability of the location-related business information anywhere / any time**. Integration shall be improved at different levels:

- **Technology**: GNSS capabilities are maximized and fulfill new and more demanding user needs when used in conjunction with other positioning technologies and communication means. R+D activities shall be reinforced.

- **Data sharing**: Trans-national and cross-sectorial information exchange shall be promoted with particular attention to protect the rights of the data owners and the privacy of the final users.

Regulatory framework

- Availability of precise and reliable location information is seen increasingly as an enabler for a number of applications having **liability** requirements.

- But customers do not see them as business case up to the moment that a **regulatory framework** is established.

- **Trustability** of the location information (including protection against attacks) becomes also mandatory.
Incorporation of GNSS in various transport sectors: A system provider perspective

**Awareness**

- Dissemination of the advantages and differentiators provided by the European navigation systems needs to be reinforced to customers and stakeholders, but also to final users.

- Systems providers, in particular ones with experience in EGNOS and Galileo, are increasingly incorporating E-GNSS based solutions in their portfolio, contributing to this awareness.

- But demonstrations in real use cases shall continue, as an effective tool to show to the decision-makers how E-GNSS can contribute to their business.

- **Final users** are in some cases reluctant to share location information. An effort shall be also done to ensure users about their privacy (supported by the appropriate regulatory framework) and appeal them thanks to the added-value services derived from sharing this information.
Key Topic 7 - Key GNSS technologies & features
Key GNSS technologies & features

- Main challenges of GNSS-based services at user level:
  - Reliability, robustness, security, and high performance

- Requirements not satisfied yet:
  - Integrity, confidence, reliability, robustness and security
  - Availability, continuity, high accuracy

- R&D effort aiming at improving GNSS performances to be pursued:
  - Multi-constellation multi-frequency receiver: GPS, Galileo, Glonass, SBAS…
  - Multi-sensor receiver: hybridisation with other positioning sensors and ICTs
  - Advanced integrity algorithms: RAIM, SBAS, GBAS
  - Advanced interference detection and robustness capabilities
  - Improved resilience to jamming and spoofing

- Galileo services added-value:
  - Compatibility and interoperability with GPS
  - Improved performance: Open Service more robust than GPS wrt multipaths
  - Authentication: Open Service Authenticated, Commercial Service
  - High precision: Commercial Service
  - Robustness & Security: Public Regulated Service
Example: Added-value in ITS

- TACOT project (EC/GSA): Secure multi-application GNSS receiver
  - Objectives:
    - To demonstrate the feasibility of a solution providing trusted PVT data
    - To boost penetration of European GNSS in road transport through Digital Tachograph
  - Approach: Development of a low cost GNSS function able to detect major GNSS related threats and to evaluate various input data
    - Increased PVT availability (dead reckoning), GNSS attacks detection (jamming, spoofing, meaconing), Trusted PVT (confidence level)
  - First step security solution complementary to Galileo authentication
  - Concept demonstration: Integration in DT

- TACOT follow-up: FOSTER ITS (EC/GSA)
  - First Operational, Secured and Trusted galileo Receiver for ITS

Trusted GNSS function can benefit to many ITS applications, notably in the domains of Security, Safety and Law enforcement.
Example : Added-value in ITS

• Transport of Dangerous goods
  - French R&D project: Geo-located Transport of Dangerous Goods including cross border issues
    → GNSS positioning and hybridisation
    → Trusted GNSS positioning and time stamp, jamming and Spoofing detection

• Road Tolling
  - Different Road Tolling have been deployed within Europe
    → Germany, Austria, Italy, etc…
  - German Toll Collect based on GPS, others mostly on DSRC
  - Strong added value of Galileo authentication feature in this field
  - What about an adoption plan of EGNOS-Galileo into future Road Tolling?
Additional key messages from GS Members
Key messages from GSA in charge of exploitation is at the center of infrastructure, service and application development

- GSA to coordinate development of downstream markets to ensure consistency of all three parts of the chain and coordination of all key actors/actions (EC, GSA, ESA, Service Provider)

- ESSP, as EGNOS Service Provider, fully involved in the EGNOS services development, adoption related tasks and EGNOS based applications supporting tasks

- GNSS adoption to be also enabled by
  - **Regulatory framework**
    - Aviation framework is clear and allowed ESSP to put in place EWA containing all required working arrangements (including NOTAM) and roll out the service that is already ramping-up
    - Regulatory/application framework definition is key enabler for other sectors (rail, maritime, UAV, etc.)
    - Key role of the Service Provider to support definition and implement the application framework
  - **Services to be tailored to the need of each type of users. New downstream applications to be developed in close cooperation with the Services Providers.**
    - Service Definition Documents to provide customized information/commitment to users
    - Service Provision interfaces to be customized (helpdesk, web, EWAs, notifications, etc.)
    - Ad hoc expert support to user communities
    - CONTACT/INVOLVE THE PROVIDER!

This slide presents ESSP views, which are not necessary the views of all GS members
Conclusions & Way Forward
Conclusions & Way Forward

- Some European GNSS opportunities in Transport addressed today, but European GNSS opportunities in other domains still to be addressed
  - LBS, Timing and Synchronisation, Critical Infrastructures, Internet of Things, Special applications

- Necessity of a comprehensive European SatNav downstream industry policy to ensure the European GNSS Programme Full Success
  - Crucial to enhance both the competitiveness of the European GNSS downstream sector in the world wide market & the European GNSS market uptake

- All stakeholders of the European GNSS Programmes must organise themselves and combine their strengths to ensure benefits from EU GNSS in Europe

For more than 12 years, Galileo Services and its Members are committed to the full success of the European GNSS Programmes
Galileo and EGNOS
ESA certification of Galileo Fixes

70% of Companies recognized by ESA as Galileo pioneers belong to GS/Oregin Community
Thank you for your attention
For Further Information

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