PPP-RTK & Open Standards Symposium

The Galileo Commercial Service

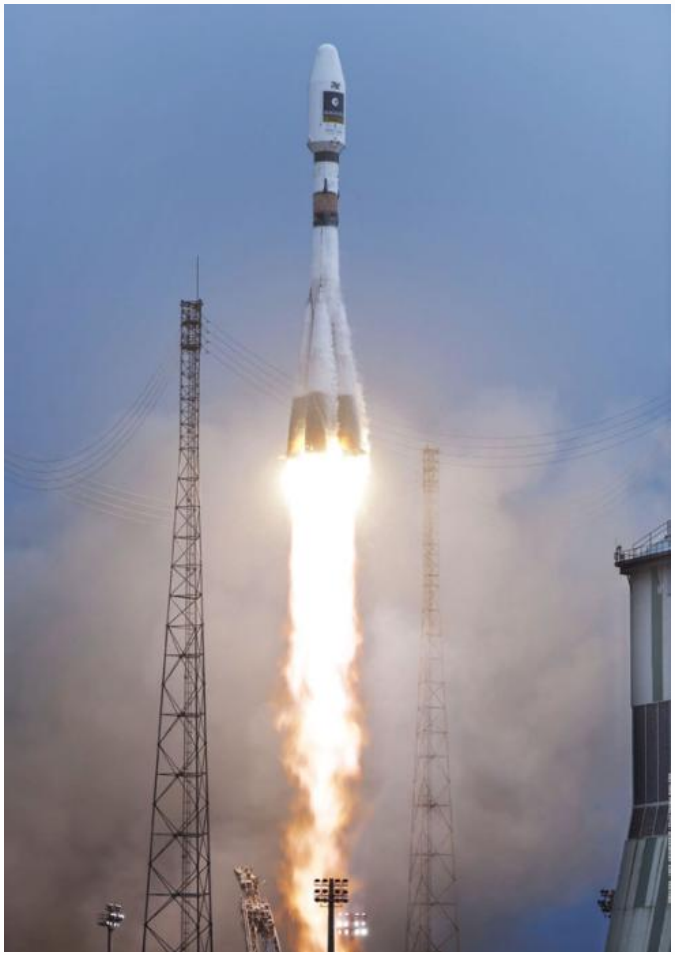
Status and Opportunities

13 March 2012 Frankfurt am Main, Germany

Gian Gerardo Calini and Marco Detratti
European GNSS Agency

European GNSS Agency

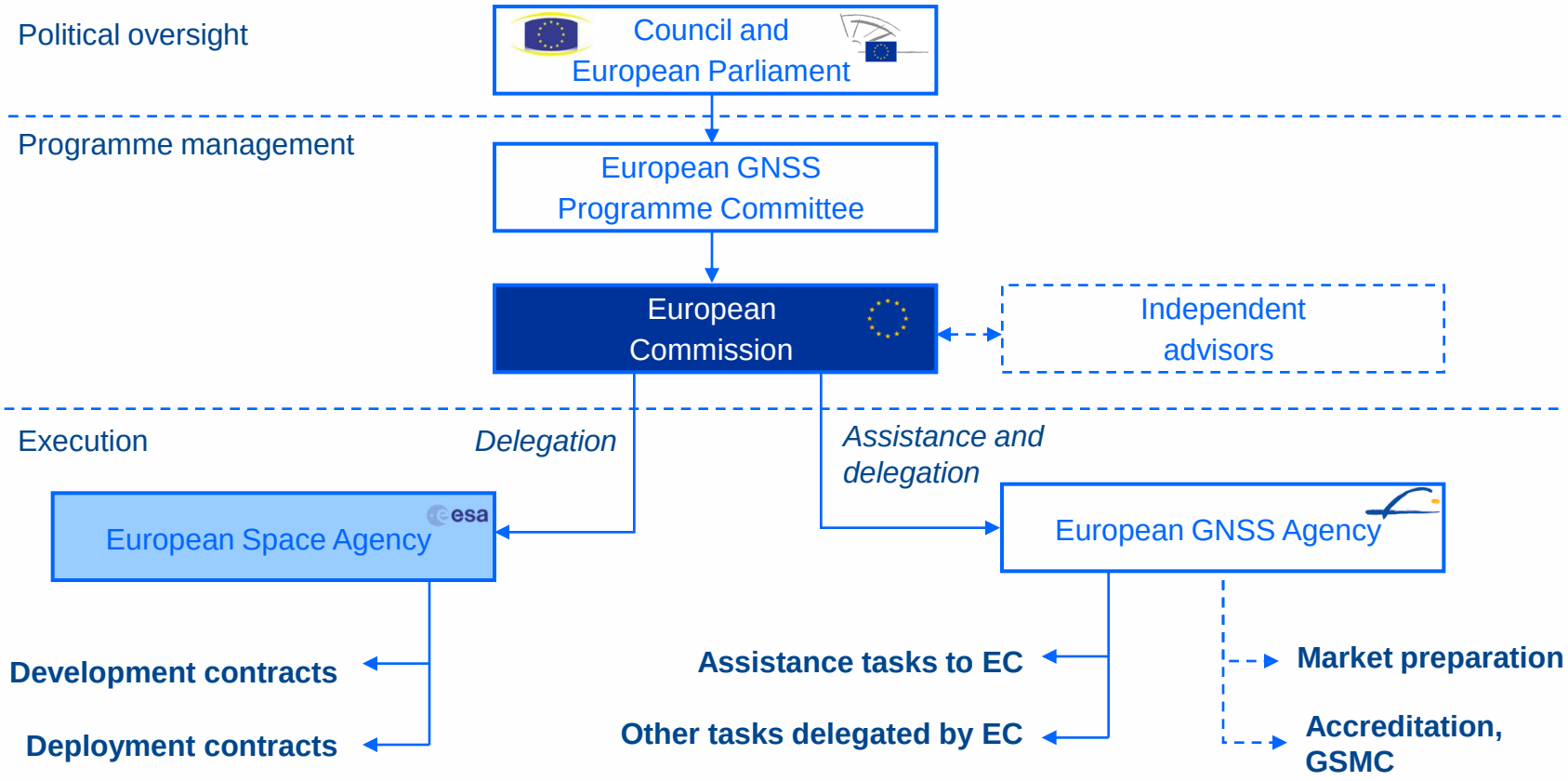
Galileo is taking off



- The first 2 **operational satellites** have been launched on 21 October 2011 (in addition to the two test satellites launched in 2005 and 2008)
- All **industrial contracts** necessary to ensure early Galileo services in 2014 have been signed
- To **accelerate Galileo's deployment** and to further contain costs, the following contracts were signed on 2 February 2012:
  - Additional order for 8 satellites
  - Adaptation of Ariane-5 for Galileo
  - Booking of one Ariane-5

Galileo Governance

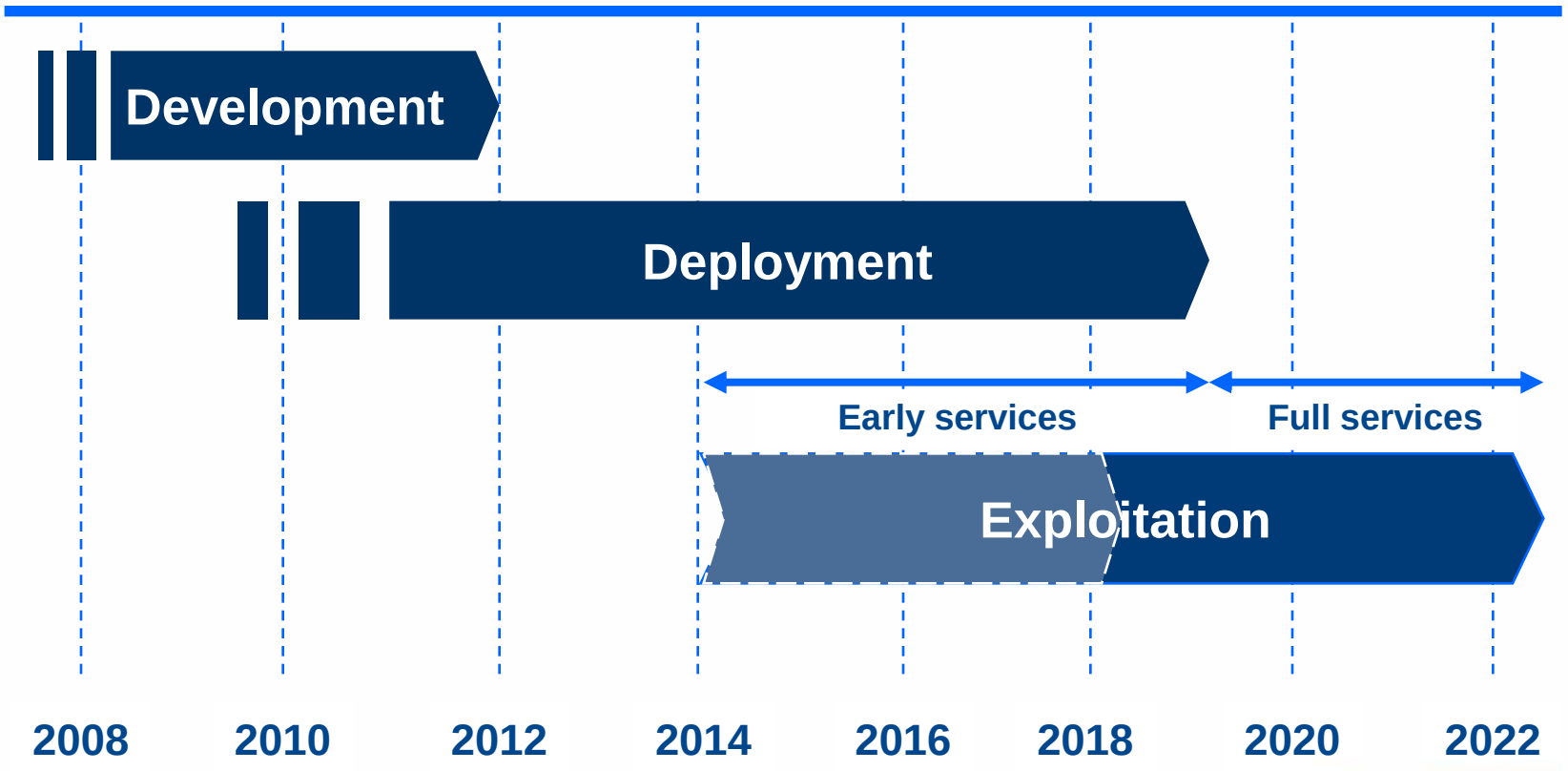
The GNSS Regulation entrusts the European Commission with the role of programme manager



GSMC: Galileo Security Monitoring Centre

Galileo Deployment and Exploitation Timeline

Galileo is moving from the development phase to the deployment phase



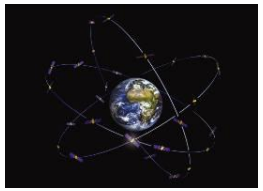
European GNSS Agency

Galileo Implementation Plan

Galileo is implemented in a step-wise approach

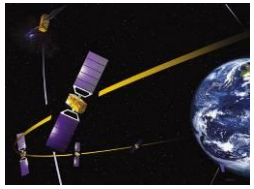
Full Operational Capability
Full services, 30 satellites
2019/2020

Initial Operational Capability
Early Services for OS, SAR
Pilot project for PRS and Demonstrator for CS
2014

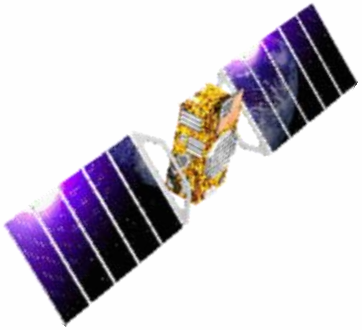


In-Orbit Validation
4 fully operational satellites
and ground segment
2012

GIOVE A/B
2 test satellites
2005/2008

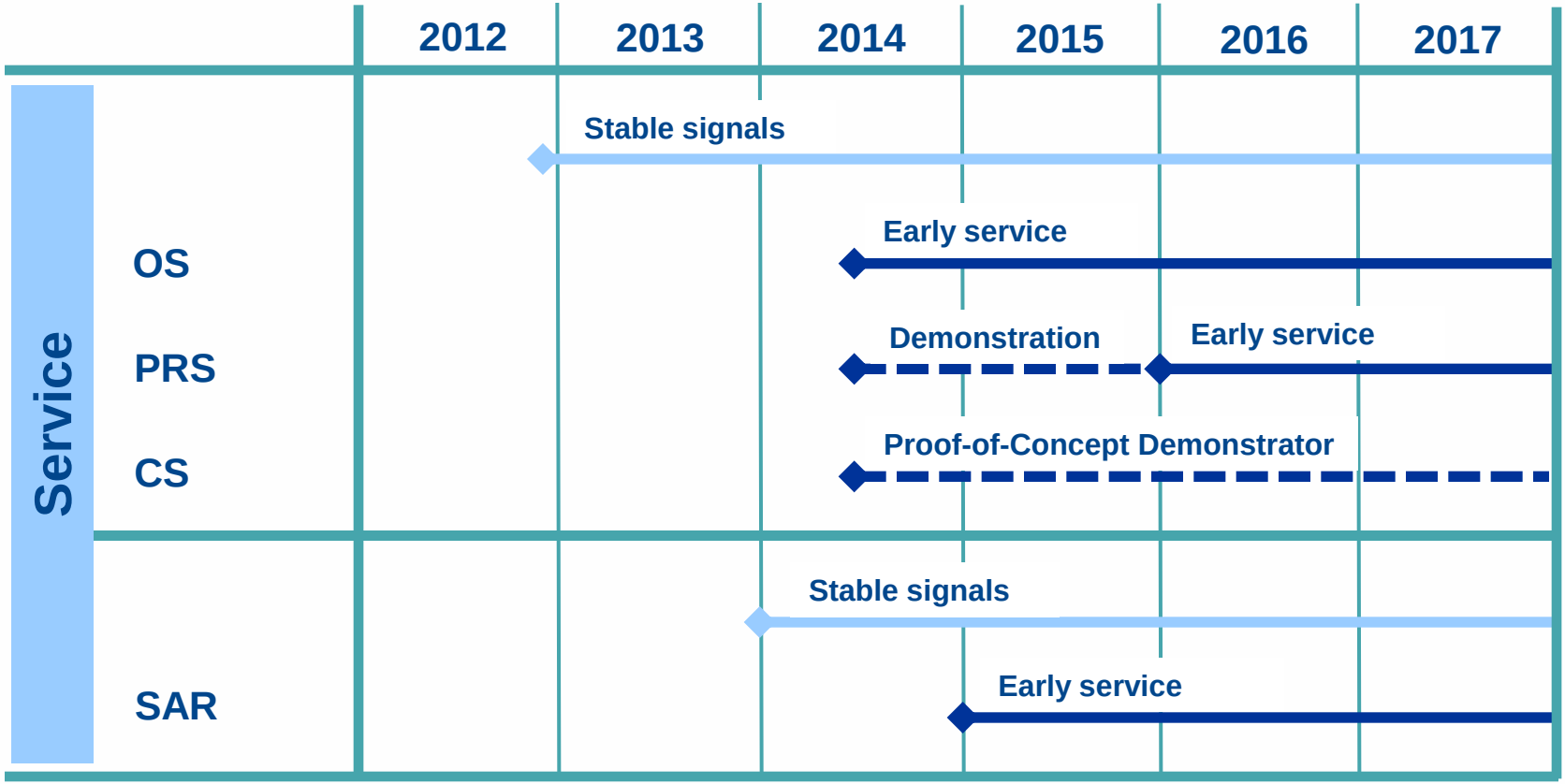


Galileo System Testbed v1
Validation of critical algorithms
2003



Galileo Services schedule

Early services will be delivered from 2014 with a gradual transition towards full services when the full constellation is in place



European GNSS Agency

Stable signals

Demonstration

Early service

Note: Milestones between the services will be synchronized as much as possible

Galileo Services

Early services for OS and SAR will be provided from 2014

Open Service (OS)	Provides freely accessible signals for timing and positioning
Public Regulated Service (PRS)	Encrypted and designed for greater robustness and higher availability
Search and Rescue Service (SAR)	Aids locate people in distress and confirms that help is on the way
Commercial Service (CS)	Delivers authentication and high accuracy services for commercial applications

The SoL service is currently being re-profiled

Safety of Life Service (SoL)	Provides vital integrity information for life-critical applications

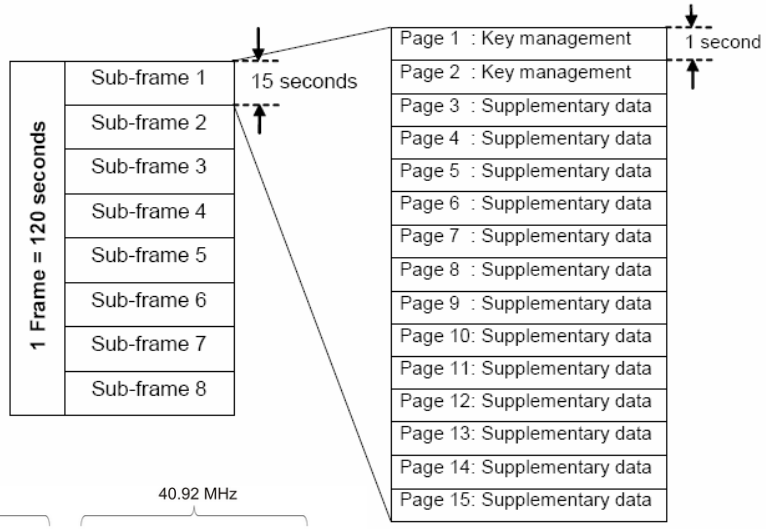
Galileo CS Objectives

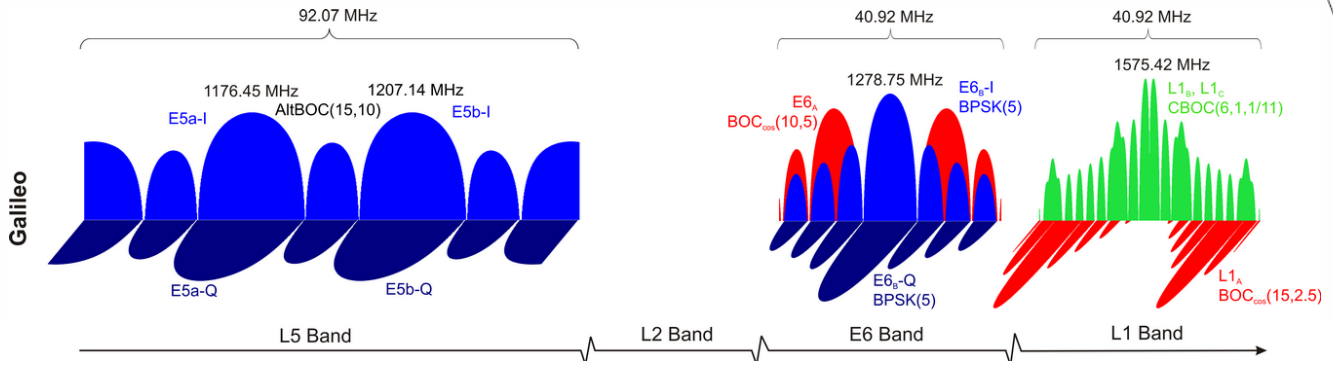
- To ***create public benefits*** by providing improvements in sectors that are important to EU society
- To ***create wider economic value*** and other improvements in sectors that are important for the EU economy
- To ***stimulate European industry*** leadership in GNSS by enabling EU companies at the forefront of CS development to expand globally
- To enhance the image of Europe by ***providing a unique and attractive service*** to users worldwide
- To potentially ***generate revenues*** supporting the operations and maintenance cost of Galileo

Galileo CS E6 signal characteristics

- E6B/E6C
  - E6B:
    - C-NAV message type (no navigation data)
    - Includes almost real Time Data Channel (448bps)
  - E6C: pilot tone
  - 5,115 Mchips/s
  - BPSK (5) modulation
  - Supports encrypted signal
  - Frequencies are not shared with GPS

Word			Tail	Total [bits]
Page type	Commercial Data / key Management	CRC		
14	448	24	6	492





European GNSS Agency

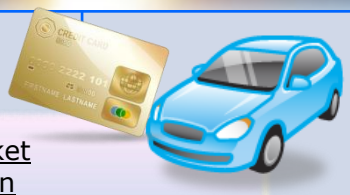
Galileo CS potential applications

- High precision (HP)
  - Provide corrections (orbital, ionospheric, clock etc.) to support a global enhanced precision service
- Authentication
  - Provide assurance that the signal tracked is genuine
  - Support the authentication of generated PVT to 3rd parties
- Data broadcast
  - Navigation related information (e.g., traffic and map updates)
  - Regional alerts (e.g., tsunami alerts)
  - Entertainment (e.g., music, TV)
  - One way messaging (e.g., maritime or outdoor use)

Authentication and high precision markets have been analysed in detail…

Maximum Price Per User Per Year (EUR)

1
10
100
1k
10k



A. Mass market authentication

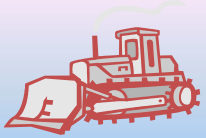
Applications such as RUC or PPUI are fraud sensitive. Service providers cannot trust GPS signals that can be spoofed. Currently they have no choice but to invest in enforcement, additional hardware or tolerate high levels of fraud.

B. Medium precision (10-20cm)

Users like farmers and surveyors are interested in enhanced precision. However they are very price sensitive and cannot afford high end receivers and/or subscription services.

C. High precision(1-5cm)

Some users need the best performance and service level and will get it at any cost.



PRELIMINARY

Precision	10m	1m	0.1m	5 cm	1 cm
Other needs	Authentication	High Availability	Reliable Performance	Service level Agreement	Global Coverage

Requirements

European GNSS Agency

...resulting in 3 attractive market opportunities

Global "high precision" services for demanding professional users

Affordable "medium precision" applications with a cost effective and robust solution

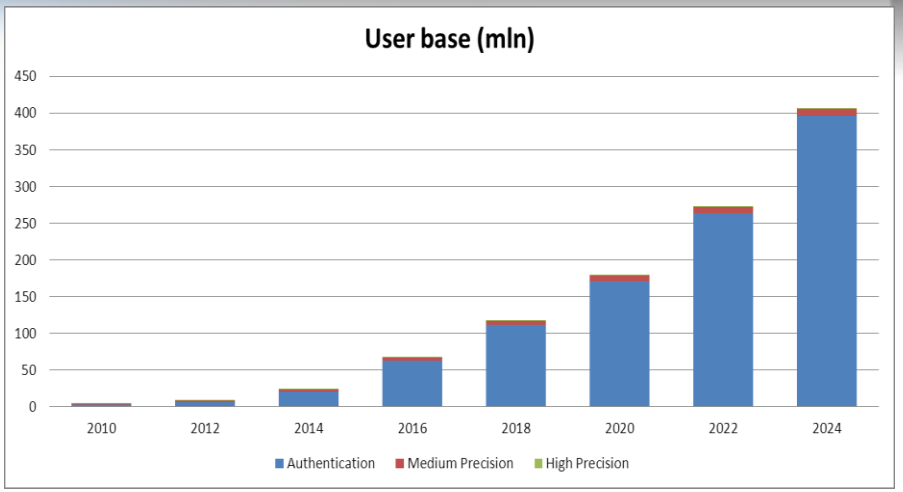
Cost effective, robust authentication solutions for mass market use and professional use

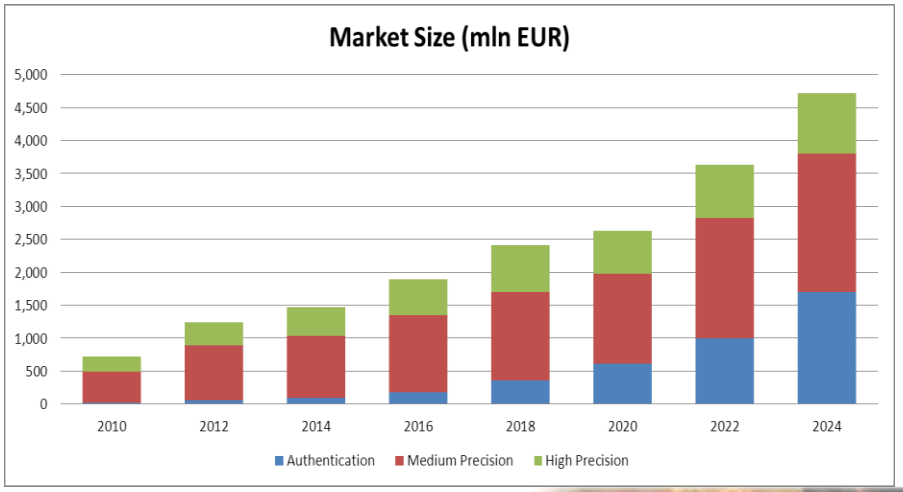
Price sensitivity — Accuracy need

high

low

Price sensitivity — Accuracy need





European GNSS Agency

Galileo CS value proposition covers gaps and can provide better cost/performance trade-off

The Galileo Commercial Service will address the authentication and high-precision markets

- **Why?**
  - Authentication embedded in SiS, no need for additional sensors
  - High precision embedded in GNSS: lower cost, better coverage, easy to use
  - Possibility to offer authenticated High Precision and Timing services

- **How?**
  - GSA and EC are investigating different implementation options and two parallel CS concept studies will be launched soon. A final decision on the detailed CS implementation concept will be taken in Q1 2013.

- **When?**
  - A **first "proof-of-concept" demonstrator** for the Galileo Commercial Service is planned to be put in place **in 2014**, together with the early OS and SAR services.

Main Options (1) – High Precision

Which solution can be adopted for Galileo CS?

- SBAS
  - Pros
    - 'Easy' to implement
    - SBAS standard already recognised
  - Cons
    - Galileo (for the moment) relies only on EGNOS data: Europe coverage and GPS
    - Limited precision
- WA RTK
  - Pros
    - No convergence time: very fast start-up
  - Cons
    - Regional coverage only
    - High data bandwidth requirements
- PPP
  - Pros
    - Worldwide coverage
    - No need of Base station and point-to-point communication
  - Cons
    - Relative slow convergence time (up to 30 minutes)
    - Correction data (orbit, clocks) has to be refreshed quickly
- Other solutions?

Main Options (2) - Authentication

Which type of authentication?

- Encryption of the spreading code
  - Pros
    - Robust solution
    - Already possible within the Galileo Baseline
    - Implicit authentication of HP data
  - Cons
    - Relatively expensive receiver
    - Security 'burden' of crypto-keys
- No encryption of the spreading code
  - Pros
    - Lower cost receivers
    - Lower security constraints
  - Cons
    - Robust authentication not fully demonstrated yet on GNSS signals
    - No implicit authentication of HP data
    - Likely will reduce the number of bits available for HP
- Additional options:
  - SiS Authentication only / end-to-end PVT authentication
  - Standalone Navigation on E6B

Present Status and Next Steps

Efforts in 2012 will focus on the detailed definition of the CS implementation concept

- Jan. 2012:CS Expert Group set-up (follow-on to 2011 CS WG)
- Q2 2012
  - Launch feasibility studies on possible CS concepts
  - Industry consultations
- Q1 2013: Decision on detailed CS implementation
  - Proof-of-concept demonstrator for IOC (2014)
  - Early Galileo Commercial Service (2016)
  - Final service concept for FOC (2018)
- Q1 2013: Issue Commercial Service Implementation Plan

Galileo CS priorities

The Commercial Service is a key Galileo differentiator with the capability of generating significant benefits

Improved user experience
&
Value-for-money

CS is at your service to stimulate your Business

- CS-HP : widest market adoption
- CS-Authentication : new and growing market possibilities, innovative services

European GNSS Agency

Thank you for your attention

For further information
marco.detratti@gsa.europa.eu
boris.kennes@gsa.europa.eu