European
Global Navigation
Satellite Systems
Agency

EUROPEAN GNSS APPLICATIONS

Gian Gherardo Calini
Head of Market Development

Paris, 13 January 2017

The application R&D shall follow the technology evolution happening in the market

The evolution of GNSS user technology is influenced by three major factors:

- **Changing trends in users' behaviour** and expectations
- **Evolution of GNSS infrastructure**, such as the appearance of new signals and frequencies
- **Evolution of underlying technologies**, largely driven by the IT & Communications industries

TI-4100 NAVSTAR GPS Receiver, 1981
One of the first commercial GPS receivers.

Magellan NAV 1000 GPS, 1988
World's first handheld GPS receiver.

Benefon Escl, 2001
World's first personal navigation phone with mobile maps.

BQ's Aquaris X5 Plus smartphone, 2016
First European smartphone with Galileo capability.

Fitbit Blaze, 2016
One of the most popular wearable devices, which includes GNSS, a heart rate monitor and a battery life of up to one week.

Technology trends together with EGNSS contributions will allow innovative applications

Key Performance Parameter (KPP)	EGNOS contribution*	Galileo contribution*
Availability		●●
Accuracy	●●	●●●
Continuity	●●●	
Integrity	●●●	
Robustness		●●●

* ●●● = major contribution, capable of enabling new GNSS applications, ●● = medium contribution, enhancing the user's experience so benefits (e.g. operational, at cost level), are achieved, ● = minor contribution, performances improved but no major differences at users' level

Transport safety & liability critical solutions

Main drivers and trends:

- Connected vehicles pave the way to active Advanced Driver Assistance Systems
- The drive to automation is fuelling Research & Development in location technologies
- The need for safety, reliable performance and accuracy will drive the adoption of multi-frequency for commercial drone operation

Technology trends together with EGNSS contributions will allow innovative applications

Key Performance Parameter (KPP)	EGNOS contribution*	Galileo contribution*
Availability		●●
Accuracy	●●	●●
Indoor penetration		●
Time To First Fix (TTFF)		●●

* ●●● = major contribution, capable of enabling new GNSS applications, ●● = medium contribution, enhancing the user's experience so benefits (e.g. operational, at cost level), are achieved, ● = minor contribution, performances improved but no major differences at users' level

Mass market solutions

Main drivers and trends:

- Need for ubiquitous location drives development of:
  - Sensor fusion
  - Chip-based indoor location technologies
- Increasing demand for further accuracy
  - Availability of raw GNSS measurements
  - Multi-frequency chipsets promise improved accuracy in urban canyons
- Improved power efficiency and miniaturization at all levels

Technology trends together with EGNSS contributions will allow innovative applications

Key Performance Parameter (KPP)	EGNOS contribution*	Galileo contribution*
Availability		●●
Accuracy	●●	●●●
Integrity	●●●	
Robustness		●●●

* ●●● = major contribution, capable of enabling new GNSS applications, ●● = medium contribution, enhancing the user's experience so benefits (e.g. operational, at cost level), are achieved, ● = minor contribution, performances improved but no major differences at users' level

High precision, timing and asset management solutions

Main drivers and trends:

- New developments enable low-cost receivers capable of cm-level precision (with multi-frequency and multi-constellation support)
- PPP and integration solutions are emerging in agriculture and surveying ; Integrated solutions with GNSS and complementary technologies
- GNSS a pillar of integrated farming management
- Synergies between GNSS and earth observation

GNSS User Technology Report: a new publication on user technology supporting the R&D of applications

The 1st edition of the GSA's GNSS User Technology Report provides an overview of the state-of-the-art of GNSS receiver technology

Including:

- General overview of the latest GNSS receiver technology common to all application areas
- An in-depth analysis of GNSS user technology as it pertains to three key macrosegments:
  - ✓ Mass market solutions
  - ✓ Transport safety and liability-critical solutions
  - ✓ High precision, timing and asset management solutions
- Supplement on location technologies that looks beyond GNSS in the positioning landscape

Available for download here:

HTTP://BIT.LY/2CGARXF

European Global Navigation Satellite Systems Agency

H2020 Galileo 2014-2015 calls

Source: www.visionaryadvertising.co.uk

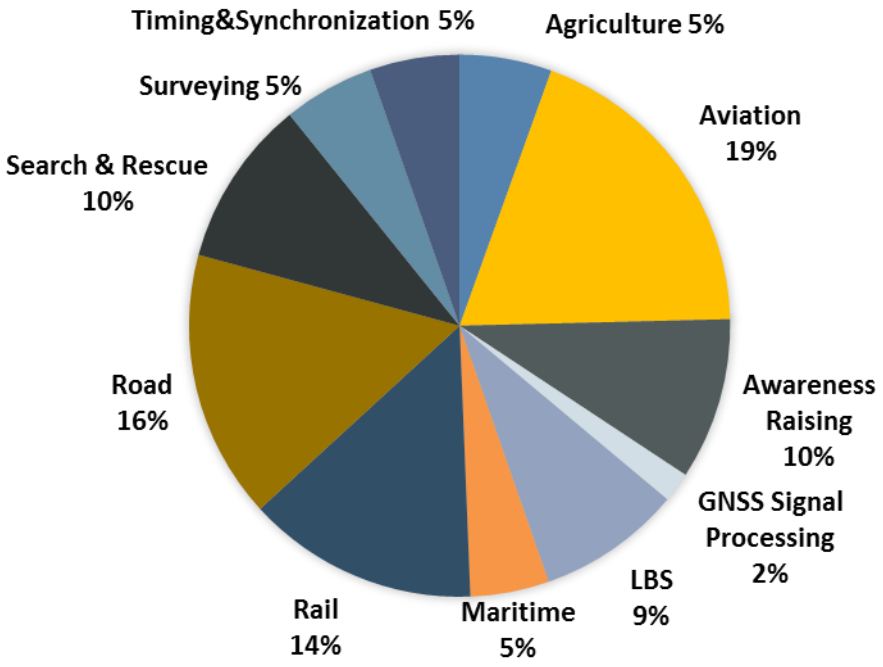
H2020-Galileo-2014-2015 Calls

	1st Call	2nd Call
Budget available	40.2 mln EUR	25.0 mln EUR
Budget requested	174.3 mln EUR	192.2 mln EUR
Projects funded	27	13
Projects submitted	105	89
	26% success rate	15% success rate
Beneficiaries	221	100
Applicants	775	634

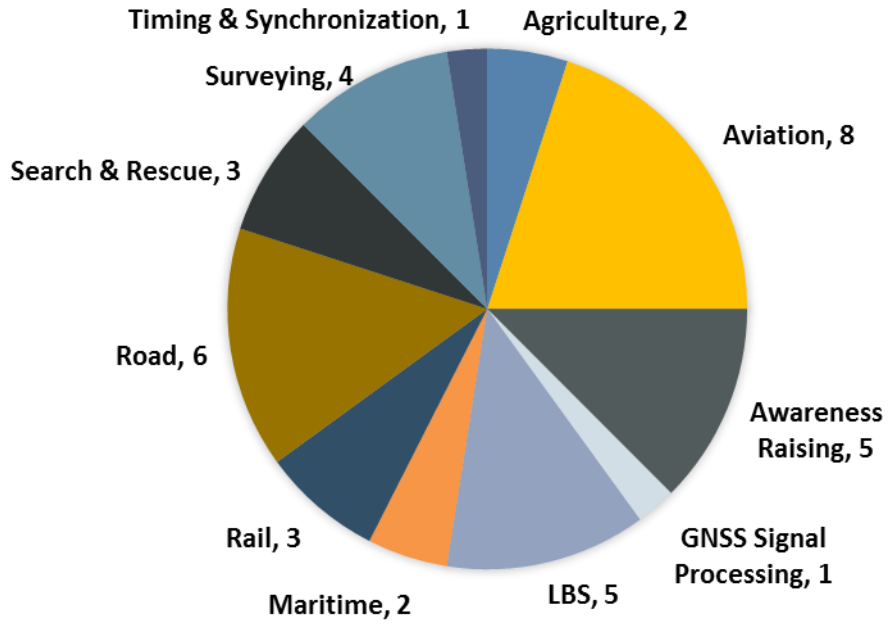
Horizon 2020 Application R&D portfolio (1st + 2nd call) fostering application development and adoption in priority markets

Horizon 1st and 2nd call – Application Projects by market segment

Budget split by market segment

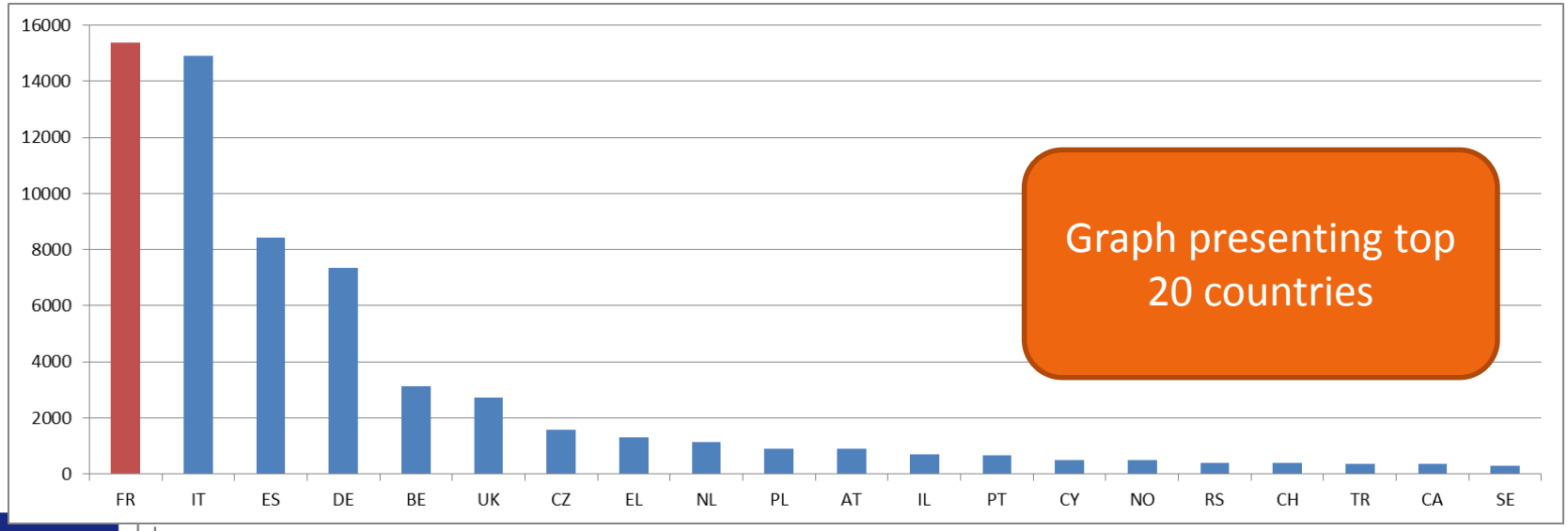


# of selected projects by market segment



French participation in H2020

Grant allocated to France	
TOTAL H2020 budget-1st and 2nd Call	**64,851,739 €**
TOTAL Grant Allocated to FR	**15,330,704 €**
% of the grant allocated to FR	**~ 24%**



Grant requested by country (top 20 countries)

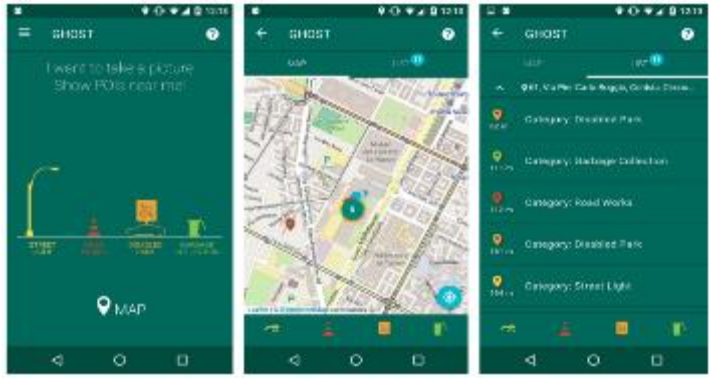
40 ongoing projects (~65 m€) are delivering first tangible results

- **4** patents granted
- **>20** Advanced prototypes:
  - **G-MOTIT:** Galileo-Enhanced electric scooter sharing service
  - **SAT406M:** Galileo SAR Personal location beacon
- **2** products close to the market:
  - **GEOVISION:** GNSS driven EO and Verifiable Image and Sensor Integration for mission-critical Operational Networks software (3 apps in iOS and Android)
  - **GHOST:** GALILEO-based intelligent system for vehicles as Booster of Smart Cities
- **223** scientific papers published in international scientific magazines providing visibility to the projects' early results

mapKITE

SAT406M

GHOST



Success stories in Transport

GRICAS: Galileo SAR Return-Link Implementation for better Civil Aviation Safety

- Development of **GRICAS ELT-DT** (Emergency Locator Transmitter for Distress Tracking) **prototype** with internal GNSS receiver transmitting alert messages and receiving them on MEOLUT.
- Operational concept for Galileo RLM activation of ELT-DT welcome by RTCA SC229/EUROCAE WG98 and COSPAS SARSAT

Project duration: 21 months
EC contribution: 2,783,637 €

SAT406M - Application providing an end-to-end solution based on the SAR/Galileo service using the Return-Link-Message (RLM)

The project develops an **EGNSS application to improve the Search and Rescue** of people in distress, comprising:

- An improved **Personal Locator Beacon (PLB)**
- A **new communication method** enhancing the standard communication **between the PLB and the SAR/Galileo system.**

Project duration: 36 months
EC contribution: 998,375 €

Success stories in Transport

inLane — Lane Navigation Technology

Low Cost GNSS and Computer Vision Fusion for Accurate Lane Level Navigation and Enhanced Automatic Map Generation

InLane project proposes new generation, **low-cost**, **lane-level**, precise **turn-by-turn navigation** applications through the fusion of EGNSS and Computer Vision technology. This will enable a new generation of enhanced mapping information based on **crowdsourcing**. InLane is targeting to:

- deliver lane-level information to an in-vehicle navigation system giving drivers **the opportunity to select the optimal road lane**, even in the case of dense urban traffic
- **reduce the risks** associated with **last-moment lane-change manoeuvres**
- enable a **new generation of enhanced mapping information** based on crowd sourcing

INLANE target products:

✓ **In-vehicle computer**: navigation system / driver assistance / Autonomous Driving

✓ **Aftermarket device:** navigation system / driver assistance

✓ **Smartphone:** navigation system / driver assistance

Project duration: 30 months
EC contribution: 2,642,935 €

vicomtech ik4 research alliance · ERTICO · HONDA · intel · TeleConsult AUSTRIA · TOMTOM · TU/e · RACC Automóvil Club · IFSTTAR · Ajuntament de Barcelona

Success stories in LBS and Agriculture

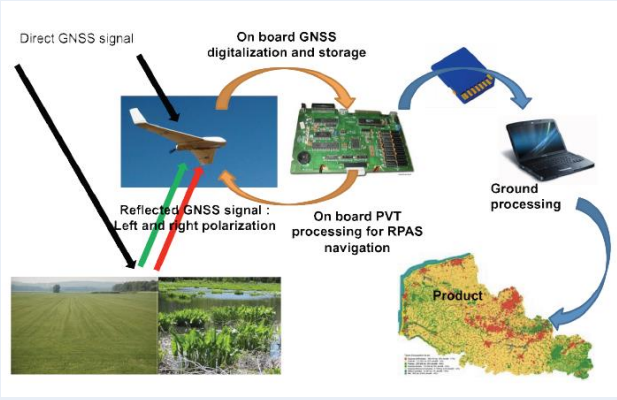
ELAASTIC - European Location As A Service Targeting International Commerce

EU-based, **worldwide service** to provide and/or enable location for **LBS** and **M2M applications**, combining mature Assisted-GNSS and **WiFi based location techniques** together with new features providing enhanced performance based on the use of E-GNSS signal specific features.

Project duration: 18 months
EC contribution: 1,750,805 €

Telespazio A Finmeccanica/Thales Company
life.augmented
ThalesAlenia Space
nx networks
novero

MISTRALE - Monitoring of Soil moisture and water-flooded areas for agriculture and environment



GNSS Reflectometry (GNSS-R) sensor embedded on a **dedicated Remotely Piloted Aircraft Systems** (RPAS) platform using the GNSS reflected signature.

Project duration: 36 months
EC contribution: 2,599,246 €

MISTRALE will have many applications:

- Soil moisture measurement
- Management of irrigation
- Monitoring of flooded areas (crisis management)
- Monitoring of wetland (environmental management)

m3 SYSTEMS
ENAC
Starlab Living Science
GET GÉOSCIENCES ENVIRONNEMENT TOULOUSE
AeroVision
L'AVION JAUNE

H2020 Galileo 2017 Call

Source: www.visionaryadvertising.co.uk

H2020 Open Call:
Applications in Satellite Navigation-Galileo-2017

Type of Action	Topic	Budget (EUR mln)	Funding rate	Indirect costs
IA	EGNSS Transport Applications	14.50	**70%** (except for non-profit legal entities, where a rate of 100% applies)	**25%** of the total eligible costs excluding: • Subcontracting • Costs of resources made available by 3rd parties • Financial support to 3rd parties
IA	EGNSS Mass Market Applications	9.00		
IA	EGNSS Professional Applications	8.00		
CSA	EGNSS Awareness raising and capacity building	1.50	**100%**	
	Total budget:	33.00	**Opening: 08** November 2016 **Deadline: 01** March 2017	

Work programme and submission :

https://www.gsa.europa.eu/r-d/h2020/introduction
https://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/calls/h2020-galileo-gsa-2017.html

IA: activities aimed at producing plans and arrangements or designs for new, altered or improved products, processes or services.
CSA: accompanying measures such as standardisation, dissemination, awareness-raising, networking, policy dialogues and studies.

Galileo-1-2017 EGNSS Transport Applications

Aviation	Road	Maritime	Rail
Advanced navigation 	Autonomous vehicles 	Vessel navigation & Traffic Management 	Train signalling/ control 
CNS and ATS 	eCall 	Port operations 	Passenger information 
Unmanned vehicles 	Connected Cars 	Fisheries 	Asset management 
Search and rescue 	Digital tacograph 	Search and Rescue 	Multimodal logistics 

Synergy and complementarity with ongoing initiatives, e.g. SESAR, Shift2Rail

PRS (Public Regulated Service) applications are out of scope

Project Indicative funding: 1 to 3 million €

GSA

Galileo-2-2017 EGNSS Mass Market Applications
EGNSS will contribute to better performance in LBS

Mass market applications

Internet of Things

Smart cities

Emergency services

Commercial LBS

- Foster the adoption of EGNOS and Galileo in mass markets.
- Applications that will make best use of EGNSS innovative features such as better multipath resistance, authentication…
- Foster competitiveness of the European GNSS industry in the area of mobile applications, with special focus on SMEs
- Maximise public benefits by supporting the development of applications that will address major societal challenges.

PRS (Public Regulated Service) applications are out of scope

Project Indicative funding: 1 to 3 million €

GSA

Galileo-3-2017 EGNSS Professional Applications

EGNSS differentiators are already acknowledged in professional segments

Professional applications

Agriculture		• Machine guidance • Precision farming • Field boundary measurements
Surveying and mapping		• Land survey • Cadastre and geodesy • Advanced constructions techniques
Timing and Other professional applications		• Timing and synchronisation for power grids • Timing and synchro for finance • Earth observation with GNSS

PRS (Public Regulated Service) applications are out of scope

Project Indicative funding: 1 to 3 million €

GSA

Galileo-4-2017 EGNSS Awareness raising and capacity building

- Support building of **industrial relationships** by gathering private and public institutions around services offered by EGNSS and related applications
- Support the **competitiveness of EU industry** by identifying strategic partners and by developing market opportunities
- Support to **incentive schemes** should foster the emergence of new downstream applications based on either Galileo and/or EGNOS and therefore to support the EU GNSS industry

PRS (Public Regulated Service) related activities are out of scope

Project Indicative funding: 0.5 to 1 million €

H2020 2017 Call's evaluation criteria

Excellence

- **Extent that proposed work corresponds to the topic description in the work programme**
- Clarity and pertinence of the objectives
- **Soundness of the concept**, and credibility of the proposed methodology
- Extent that proposed work is beyond the **state of the art**, and demonstrates **innovation potential**
- Quality of the proposed coordination and/or support measures

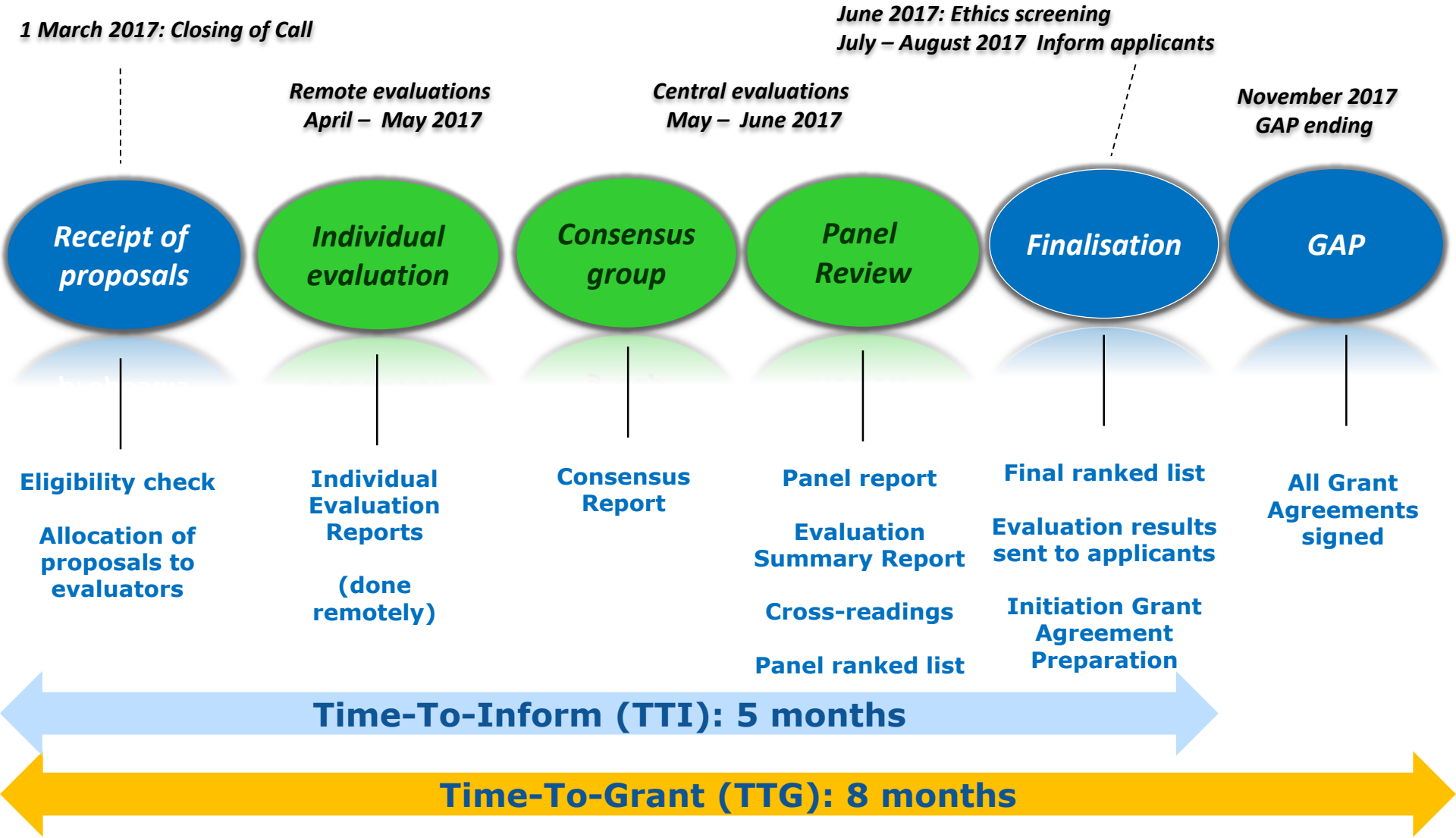
Impact

- The expected impacts listed in the work programme under the relevant topic
- Any substantial impacts not mentioned in the WP, that would enhance **innovation capacity**; create new market opportunities, strengthen competitiveness and growth of companies, address issues related to climate change or the environment, or bring other important benefits for society
- Quality of proposed measures to:
  - Exploit and disseminate project results (including IPR, manage data research where relevant), communicate the project activities to different target audiences

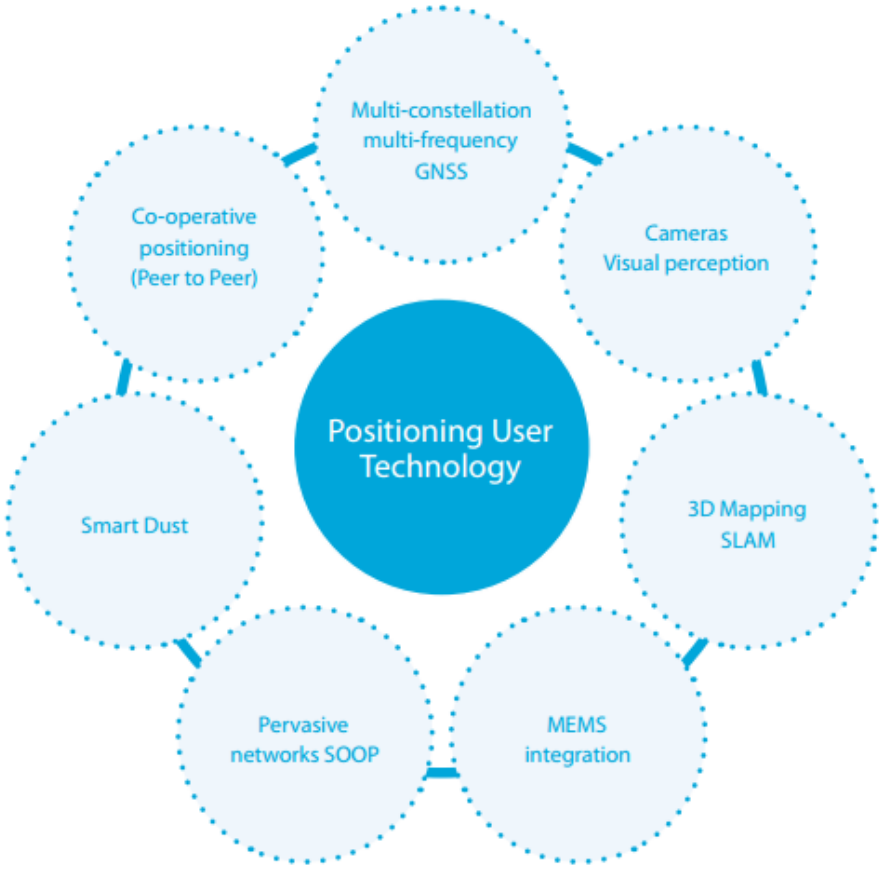
Implementation

- **Quality and effectiveness of the work plan**, including extent to which resources assigned in work packages are in line with objectives/deliverables
- Appropriateness of **management structures** and procedures, including **risk and innovation management**
- Complementarity of the participants which the consortium as a whole brings together expertise
- Appropriateness of allocation of tasks, ensuring that al participants have a valid role and **adequate resources** in the project to fulfill that role

H2020 2017 Call's evaluation planning



Is this call addressing only EGNOS and Galileo?



The call scope is wider, encouraging innovative use of GNSS and fusion with other positioning technologies.

Towards new Positioning Navigation and Timing (PNT) applications.

However… the applications should leverage Galileo and EGNOS differentiators

PNT based applications shall benefit from a variety of E-GNSS differentiators:

- **Higher accuracy** and **Better multipath mitigation**, thanks to
  - Dual (or triple) frequency
  - Wide bandwidth signals (AltBOC)
  - Data-less (pilot) channels

- **Message Authentication (freely accessible)**

- Satellite based real-time **Precise Point Positioning (PPP Galileo Commercial Service)**

- **Better accuracy for single-frequency users (NeQuick** model)

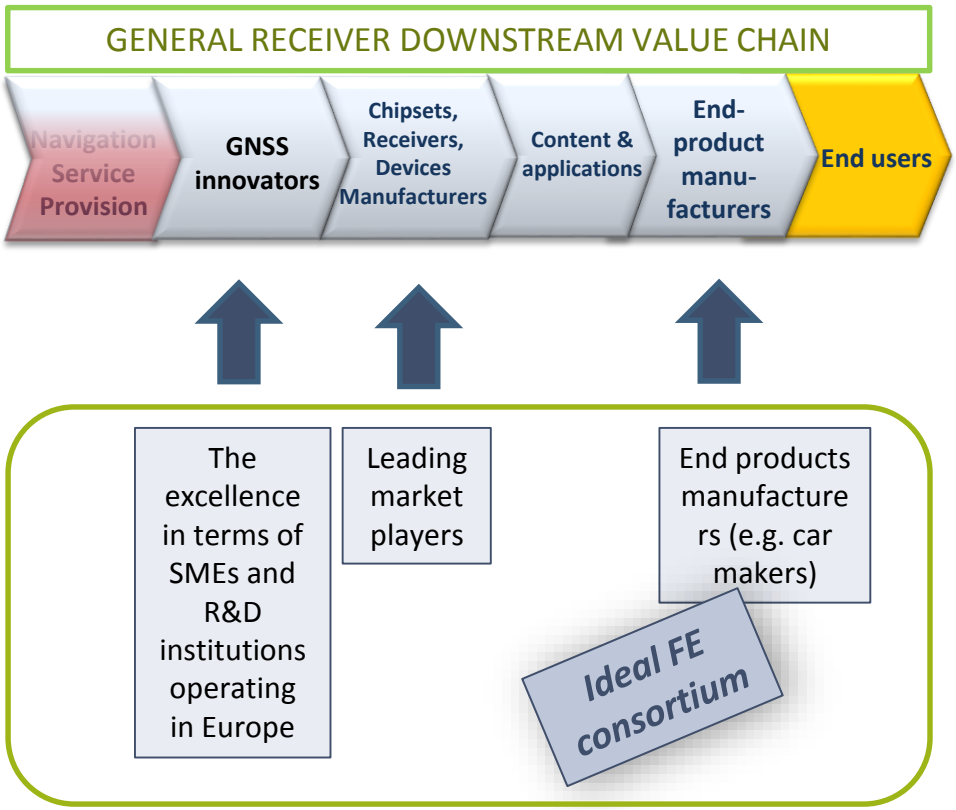
FUNDAMENTAL ELEMENTS

Fundamental Elements fosters the development of innovative GNSS receivers and chipsets

- Fundamental Elements Programme was created by the 2013 GNSS Regulation

- High-level objectives
  - **Facilitate the adoption of the European GNSS Systems building on innovative services and differentiators**
  - **Increase the EU industry competitiveness**
  - **Address the user needs in priority market segments, maximising the benefits for the citizens**

- Budget envelope
  - **€111,5 M total**
  - **€75.5 M for non-PRS projects**



https://www.gsa.europa.eu/r-d/gnss-r-d-programmes/fundamental-elements

Fundamental Elements

Interest in Fundamental Elements is growing

- Bidders are getting more engaged, requesting clarification and extension of the deadline for proposal submission:
  - 12 EU GNSS experts and innovators, including 10 SME
  - 5 global chipset/receiver Industry leaders
  - 2 end product manufacturers
- Technological challenges proposed are attractive: key example is a Global Chipset maker not able to participate in the Low end double frequency mass market receiver and got interested and decided to invest in Galileo E5
- Mitigation actions are expected to further improve participation rate

FE project on-going
ESCAPE: European GNSS engine for safety-critical automotive functions (grant)

RENAULT

Autonomous Vehicle integrating GNSS + Cameras + CANBUS

Renault + UTC + Prof. Quddus

Advanced Galileo Rx and Roadmap for multifrequency

Teseo V

ST Microelectronics

Additional Key Assets: Standardization, Safety, Engineering +Business model

IFSTTAR +Renault + GMV…

ESCAPE: European Safety Critical Applications Positioning Engine

Consortium

Industrialization +

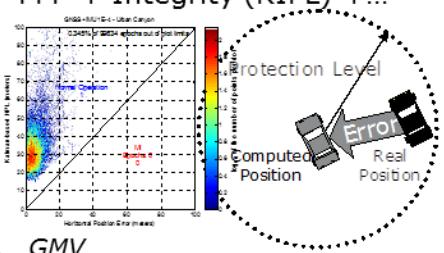
Standardization+ Safety+ Business Model + Engineering =

Advanced Galileo Rx +

Integrity +

Autonomous Vehicle +

Advanced GNSS technology: PPP + Integrity (KIPL) +…



GMV

Advanced Telematic Unit (TCU)

FICOSA

http://www.gnss-escape.eu/

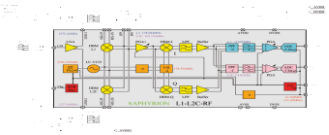
GSA

FICOSA

FE project on-going
Development of high-end professional receivers and antennas (grant)

Receiver manufacturer (BE)

University research group (ES)



R&D centre (IT)

Integration + Test +

Demonstration campaign + Business plan

Antenna-receiver integrated product for 3 selected professional use-case scenarios

High-end all-constellations all-frequency antenna +

High-end all-constellations all-frequency receiver +

Dedicated Galileo differentiators and features for the use-cases

Applied research centre (D)

Multidisciplinary technological business group (ES)

+

Status: Awarded, grant agreement process ongoing

Additional FE projects are about to start

Aviation DFMC SBAS receiver (procurement)

Description:

- Design, develop and test a prototype of the DFMC SBAS user terminal for the aviation SoL service, augmenting GPS and Galileo capabilities.

- The developed receiver, besides the SBAS DFMC functions (for GPS and Galileo), shall also:
  - ✓ Include Horizontal ARAIM and the currently defined RAIM
  - ✓ Be at a sufficient level of maturity to, as a minimum carry out flight tests in a representative environment (i.e., TRL 7*)
  - ✓ Enable industrialisation of a commercial product (i.e., TRL 9*) upon the completion of the contract

Status:

- Evaluation under completion, one tenderer selected

http://www.gsa.europa.eu/r-d/gnss-r-d-programmes

Fundamental Elements
2017 – 2018 upcoming calls

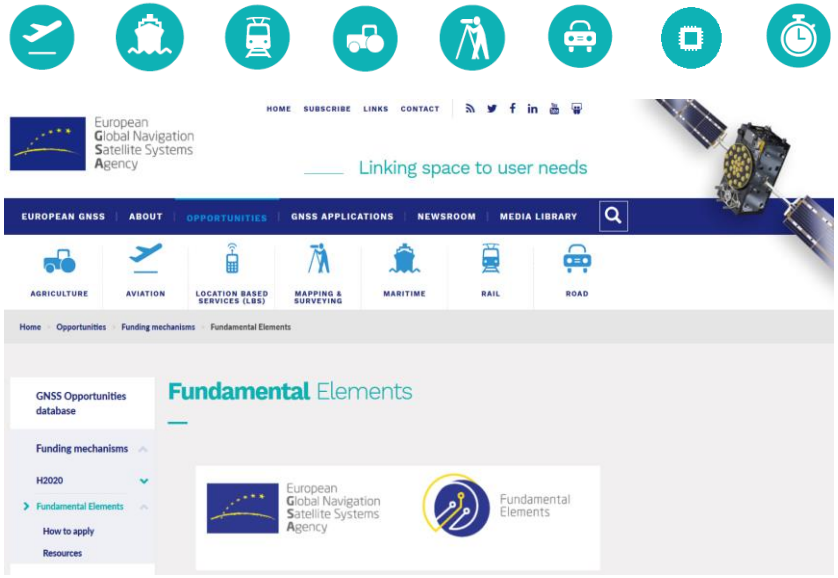
Fundamental Elements

The end product target the users in all market segments

The following projects are planned (publication and submission deadlines: check the website):

- ✓ Advanced RAIM Multi-constellation Receiver
- ✓ MEOSAR Beacon prototyping
- ✓ Maritime Receiver Development, test and validation
- ✓ Open Service Authentication User Terminal
- ✓ Timing Receiver for Critical Infrastructure
- ✓ Multi-frequency Multipurpose Antenna for Galileo
- ✓ Commercial Service user terminal

Re-scoping of previous “low-end mass market receiver” and “road engine” is ongoing targeting new projects in 2017.



https://www.gsa.europa.eu/r-d/gnss-r-d-programmes/fundamental-elements

Grants:
- **Up to 70% co-funding; 7% indirect costs**
- **IPR with the beneficiaries**

Procurements:
100% funding
IPR with EC/GSA

Planned projects in 2017* : ARAIM

Name	Type	Summary	Indicative budget
Advanced RAIM (ARAIM) Multiconstellation Receiver  	**Grant**	- Design, develop and test an Advanced RAIM (Receiver Autonomous Integrity Monitoring) prototype, following the lines as defined by the ARAIM Technical Sub-Group; - Assess and develop ARAIM for aviation: - enabling global Horizontal Navigation as well as Vertical (LPV-200) operations including threat allocation and mitigation; - Test the performance in number of test scenarios	2.5 Mil EUR (e.g. up to 2 projects envisaged)

GSA

*The description of nature and scope of services given below is only indicative, aimed at outlining the concept in broad terms. It may need substantial adjustments. It shall not be considered final or binding.

Planned projects in 2017* : Maritime

Name	Type	Summary	Indicative budget
Maritime Receiver Development, Test and Validation	**Grant**	Objectives: develop SBAS L1 receivers for maritime use compliant with IMO Resolution A.1046(27). - The receivers will have to process a specific selection message types to implement the SBAS correction and to inform the user about the system integrity. Open Service receivers can be adapted by using additional software to process this integrity information - Perform qualification and demonstration activities - Contribute to the preparation of a guideline for receiver manufacturers for the implementation of the solution developed - Analyse potential impacts on relevant standards	1 Mil EUR (e.g. up to 2 projects envisaged)

*The description of nature and scope of services given below is only indicative, aimed at outlining the concept in broad terms. It may need substantial adjustments. It shall not be considered final or binding.

Planned projects in 2017* : MEOSAR

Name	Type	Summary	Indicative budget
MEOSAR Beacon prototyping 	**Grant**	Objectives: - Development of Galileo-based MEOSAR beacons and its technology building blocks; - Testing and demonstrating the product capabilities (ELT, EPIRB and PLB) The following capabilities shall be incorporated: - return Link Service (RLS) - independent location accuracy - cancellation function - better encoded location - additional data encoded in beacon message - automatic activation on indication of emergency	4 Mil EUR (e.g. up to 4 projects envisaged)

*The description of nature and scope of services given below is only indicative, aimed at outlining the concept in broad terms. It may need substantial adjustments. It shall not be considered final or binding.

Planned projects in 2017* : OS –NMA Auth

Name	Type	Summary	Indicative budget
Open Service Authentication User Terminals 	**Procurement**	Objectives: - Development and extensive testing of an OS Authentication User Terminal protecting against spoofing attacks up to the maximum extent, including a central authentication management software to enable end-to-end user solutions; - Development of a end-to-end validation facility able to generate test scenarios and validate the terminal; Applications scenarios: - Regulated applications (e.g. digital tachograph) - Specifications of interfaces and Application Programming Interface (APIs) for silicon-embedded chipsets, firmware based equipment and devices operating systems will be also developed to enable a wide market take up of OS Authentication.	Indicative overall budget for the Authentication topic: 3.7 – 4.7 Mil EUR

*The description of nature and scope of services given below is only indicative, aimed at outlining the concept in broad terms. It may need substantial adjustments. It shall not be considered final or binding.

Planned projects in 2017*: Timing Receiver

Name	Type	Summary	Indicative budget

Timing receiver for critical infrastructure		- Develop and test a low cost Galileo timing receiver able to determine the timing with high accuracy in bias and drift;
		- Essential requirements (derived from, e.g., regulatory agencies):
		  - Robust anti-jamming receiver solutions
		  - Low overall costs of the receiver
		  - Low cost of the timing determinations and
		  - Low cost of the anti-jamming operations
		- Include a demonstration campaign of the receiver with real data.
			Indicative budget for Timing receiver: 2.7 to 3.7 Mil EUR

*The description of nature and scope of services given below is only indicative, aimed at outlining the concept in broad terms. It may need substantial adjustments. It shall not be considered final or binding.

Aviation Call for Grants

Acceleration of EGNOS adoption in civil aviation: Aviation grants programme status

Objectives:

- Foster the implementation of EGNOS based operations
- Development and/or installation of EGNOS enabled avionics
- Development of enablers to accelerate EGNOS adoption and preparation for futures capabilities, including drones

Maximum EU financing rate: 60% of the costs

Programme status:

- **1st Call**: 6 M€
- **13 projects started in Sept 2015 to foster:**
  - Regional operators
  - LPV approach procedures
  - Rotorcraft operations
- 1 project finalized
  - LPV on non-instrument runway

- **2nd Call**: 6 M€
- **14 projects started in July 2016 to foster:**
  - LPV APCH procedures
  - Rotorcraft operations
  - General operation
  - Drones

- **3rd Call**: 6 M€
- ❖ *publication on hold*

27 ongoing projects fostering EGNOS operational implementation

Aviation Grants overview
2014-2015 Calls

	1st Call	2nd Call
Budget available	**6 mln EUR**	**6 mln EUR**
Budget requested	11.83 mln EUR	10.85 mln EUR
Projects funded	**13** 34% success rate	**14** 48% success rate
Projects submitted	38	29
Projects with FR participation	2	1
Budget allocated to FR	**1,644,527 EUR**	**436,762 EUR**

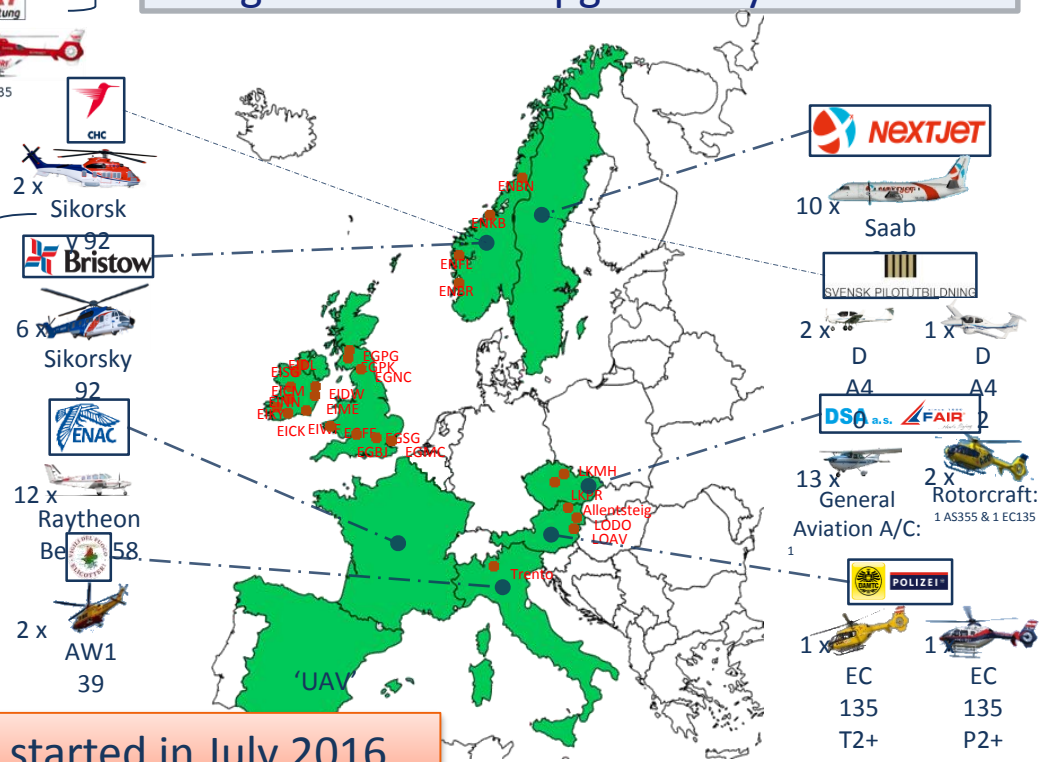
EGNOS enabled network with GSA call for funding

1st Call implementation started in Sept 2015

67 EGNOS based procedures at **35** airports by 2018
8 PinS at **7** helipads by 2017
68 aircraft/rotorcraft retrofit by 5 operators by 2018
3 Flight simulators upgrades by 2017

- **41** EGNOS based procedures in **19** airports
- **15*** PinS at **15** helipads
- **52** aircraft/rotorcraft retrofit by **10** operators

*as minimum



2nd Call implementation started in July 2016

Aviation Grants: Example of French operator upgrading to LPV capabilities

HOP! Fleet

41 Embraer

from 50 to 100 seats

23 ATR

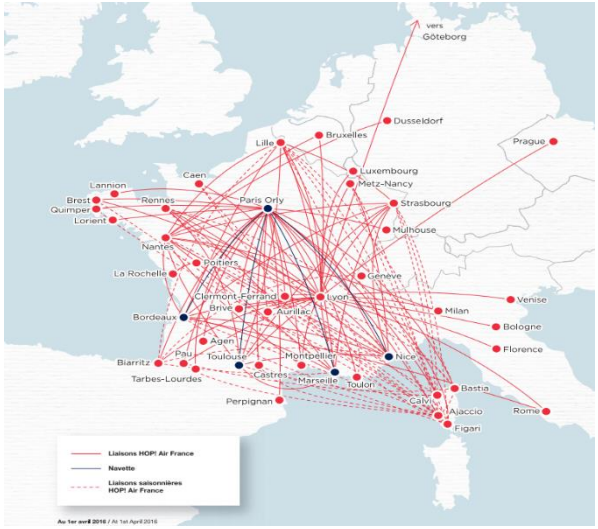
from 48 to 72 seats

25 CRJ

from 70 to 100 seats

13 ATR42-500 aircraft of HOP! will get an upgrade to install and certifcy LPV capabilities

HOP! network



Project duration: 36 months
EC contribution: 1,531,061 €

Impact:

- 8 Regional French airports served by Hop! ATR 42-500 fleet will lose ILS cat I capability, replaced by LPV
- +-6000 LPV approaches per year serving will be flown once A/C upgrades finalized
- +-200.000 Hop! passengers per year will benefit from the project

Technical scope:

- 'ILS look a like' installation
- CMC avionics installation – STC development by AKKA aeroconseil

Status:

- Prototype aircraft has been retrofitted
- Ground tests have been done
- Flight tests in January 2017

Next steps:

- EASA STC certification
- Upgrade of remaining aircraft during regular maintenance checks

QUESTION TIME

Thank You

Gian Gherardo Calini
Head of Market Development Department