

EGNOSHA

STUDY OF EGNOS HIGH ACCURACY SERVICE ANALYSIS

Workshop on Horizon 2020 EGNSS
Mission And Services



This presentation is based on
EGNOSHA Project results.
EGNOSHA is a EC funded project

February 16, 2022 – Brussels



OUTLINE

INTRODUCTION

EGNOSHA MAIN RESULTS AND CHALLENGES

CONCLUSIONS

INTRODUCTION

...

...

...

...

...

...

INTRODUCTION

Project Description

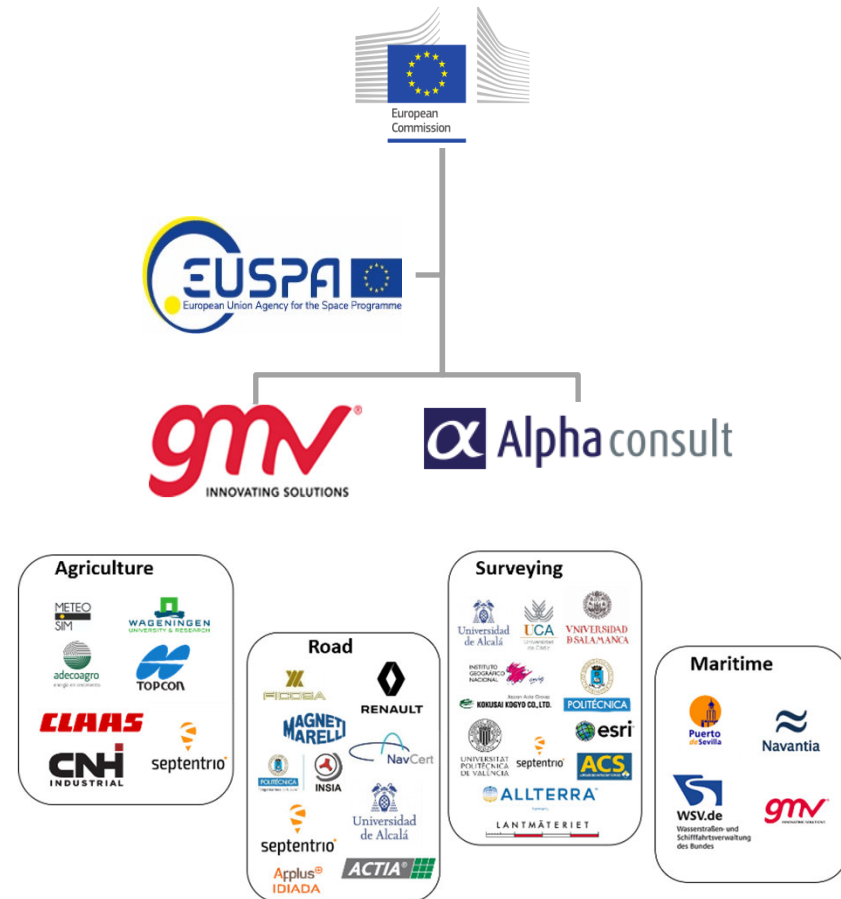
H2020 Mission and Service project (GMV + Alpha): KO in Feb 2018; FR in July 2019

Objective → Determine under what conditions it would be beneficial to implement a High Accuracy service using **EGNOS DFMC** (RIMS data, GEO broadcast, Galileo and GPS corrections)

Service area → European coverage, interoperable with other High-Accuracy Service providers

Timeframe → **after 2025**

Complementarity with Galileo High Accuracy Service
EGNOS infrastructure changes not analysed in this project



STAKEHOLDER CONSULTATION

INTRODUCTION

Main Tasks Accomplished

- **User needs and requirements identification based on users consultation**
- **Analysis of existing HA services**
- **Competitive and SWOT Analyses**
- **Service provision scheme definition based on user requirements**
- **Service/System requirements derivation**
- **Definition of an Implementation Roadmap**
- **Cost-Benefit Analysis for users and service providers**

MAIN RESULTS AND CHALLENGES

...

...

...

...

...

...

MAIN RESULTS AND CHALLENGES

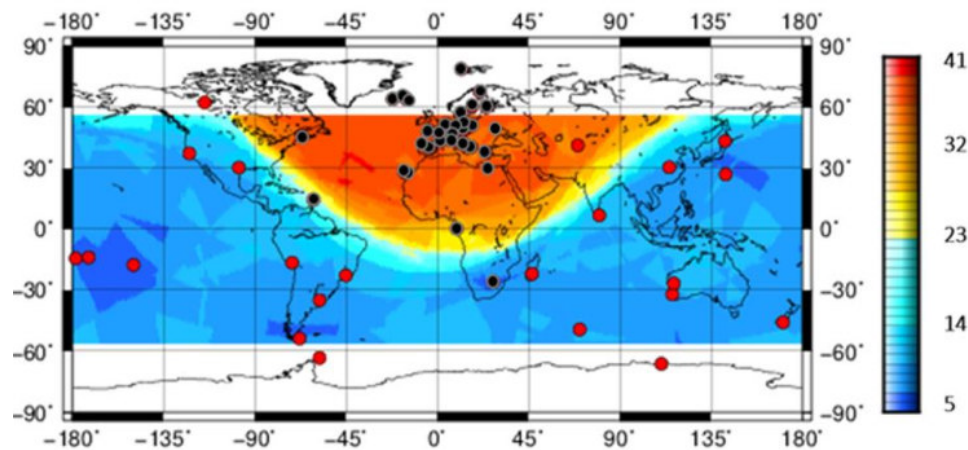
Service description

User Performance	Initial EGNOS HA Service (IOC)	Full Operational EGNOS HA Service (FOC)
Positioning Daily Accuracy	<30 cm (horizontal 95%) <50 cm (vertical 95%)	< 5cm (horizontal 95%) < 10 cm (vertical 95%)
Convergence Time	< 20 min (95%)	< 2 min (95%)
Daily Availability	> 97.5%	> 99.9%
Daily Continuity	95.0% to 99.0%	99.0% to 99.99%
Target Integrity Risk	10-3 per hour	10-7 per hour
Horizontal Alarm Limit	< 3 m	< 40 cm
Vertical Alarm Limit	-	< 80 cm
Start of the service	2027	2030
Constellations and frequencies	GPS (L1-L2) + Galileo (E1-E5a)	GPS (L1-L2-L5) + Galileo (E1-E5a-E5b)
Tentative System Technology	Real Time ODS providing Orbits, Clocks and Phase biases and ionospheric data. Integrity alerts	
Tentative User Technology	PPP-Integer Ambiguity Resolution + Atmospheric Information	PPP-Integer Ambiguity Resolution (3 frequencies)+Atmospheric Information
Dissemination Channel	Terrestrial link (EDAS) EGNOS E5b- 500bps FEC ½ (250bps)	
Liabilities	EGNOS HA service provider is responsible of the service when used under the following conditions: ■ The service in open sky conditions and with at least 8 augmented and monitored satellites being tracked. ■ Receiver and user-algorithm certified by the relevant competent authority. ■ The service in "In Operation" mode. ■ The service with the required authorisation/access control. ■ No Force Majeure event occurs. The Service provider disclaims any responsibility and liability derived from the use of the service when the previous conditions are not met. Liabilities are assumed by the EGNOS-HA service provider for a given user algorithm and assuming the proper reception and usage of the HA and Integrity data.	
Service Provider	■ Experienced HA Service Provider shared with Galileo HAS	
Commercialisation scheme	For Free	
Note that the feasibility of the integrity requirements will have to be assessed in a future step as part of the proposed activities in the EGNOSHA service roadmap.		

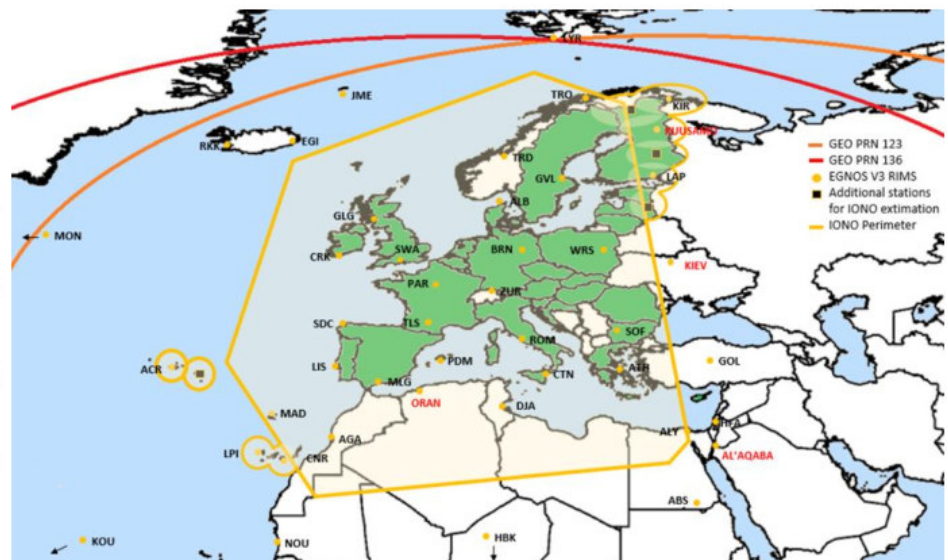
MAIN RESULTS AND CHALLENGES

Service area

Regional Network (black dots: 44 RIMS V3 + 4 extra stations)
Global Network (red dots)



Regional Network (V3 RIMS + 4 extra stations)










MAIN RESULTS AND CHALLENGES

Synergies with Galileo HA service

- **Integrity:** As resulting from the user consultation, integrity is one of the main requests from the users. Galileo HAS does not include this feature, hence having it in EGNOS HA is a key driver for the adoption and success of the service.
- **Improved performances:** Galileo HAS will provide a worldwide service in 2020+ with a good level of accuracy (<20 cm). in the timeframe 2025+, EGNOSHA would provide better accuracy performances than Galileo HAS but only over Europe thanks to the availability of a dense network of stations.
- **Service Area:** the service area and bandwidth is one of the main differentiators between both services. Galileo HAS will provide a worldwide service whilst EGNOSHA service area would be Europe.
- **Dissemination means:** The baseline dissemination means for EGNOS HA would be the GEO broadcast on E5b and an internet link. Galileo HAS will use MEO satellites broadcasting on E6 and an internet link. The use of different channels for EGNOS and Galileo would bring a good level of diversification which could serve different markets and/or provide good redundancy of High Accuracy services.
- **Other Synergies:** the consortium proposes some elements to consider to optimise Galileo HAS and the potential EGNOSHA service resources.
 - Common high accuracy correction generator (main drawback → potential common failures between the two systems).
 - Shared EGNOS and Galileo GNSS data collected by the sensor stations (20% less additional stations needed)

MAIN RESULTS AND CHALLENGES

Ranking of EGNOSHA by Domain

Domain	Application	EGNOSHA impact*	Domain	Application	EGNOSHA impact*
 Road	■ Automated driving	●	 Agriculture	■ Farm machinery guidance	●
 Rail	■ Command & Control (focus on Automatic Train Operations)	◐ ◑	 Surveying	■ Automatic steering	◐
 Maritime	■ Bridge collision-avoidance (IWW)	●	 LBS	■ VRA high	◐
	■ Autonomous vessels	◐		■ VRA low	◑
	■ Port operations/ automated docking	◐	 UAV	■ Construction – Machine Control	◐
				■ LBS applications for smart utilities	◐ ◑
				■ Goods delivery	◐

● Very High ◐ High ◑ Medium ◒ Low ◓ Very Low/ Null

*Average of ranking provided by the interviewees, incl. considerations related to the potential economic, technical and/or social impact of EGNOSHA on applications

A medium/high impact of EGNOSHA is expected in the majority of domains/ applications

MAIN RESULTS AND CHALLENGES

Main User Performances of EGNOSHA

It makes the service reliable

TARGET
INTEGRITY

DAILY
AVAILABILITY

It provides confidence to the users

Too large errors mean low economic attractiveness

POSITION
ACCURACY

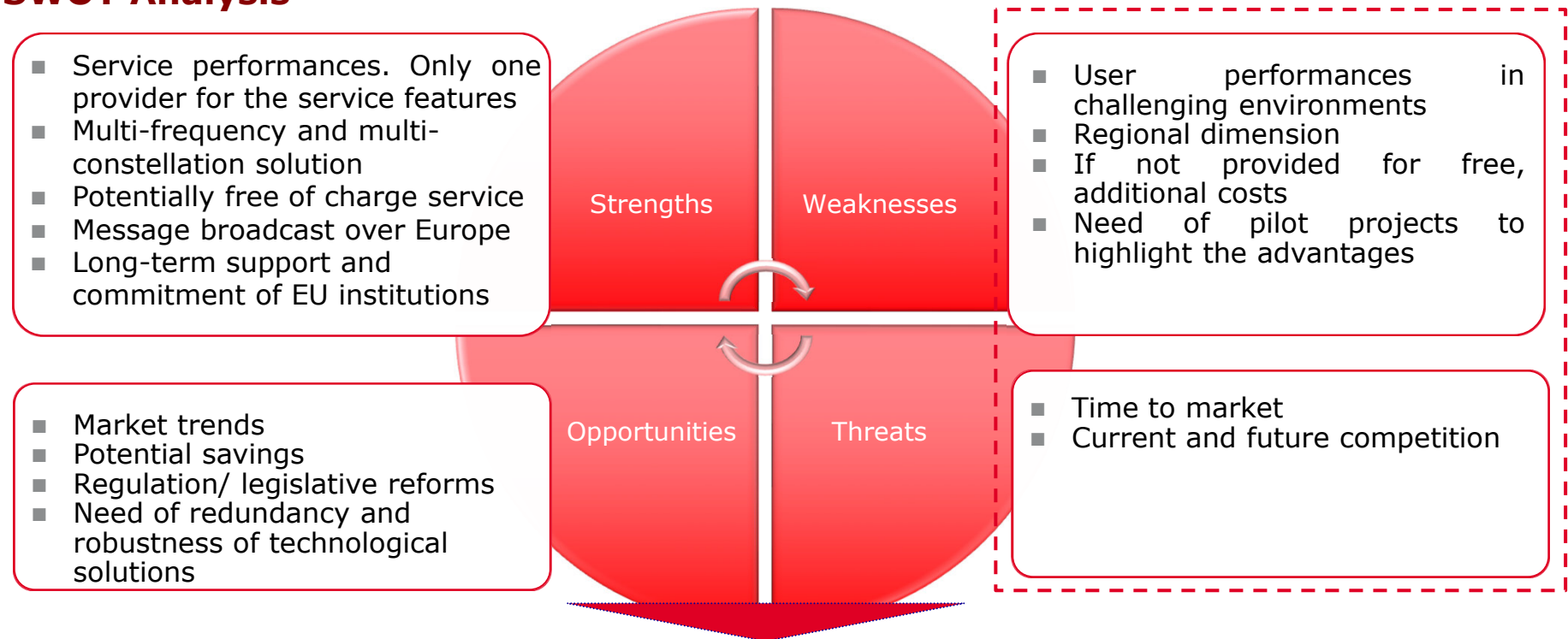
CONVERGENCE
TIME

Too long convergence time could mean the service will not be used

Even if less mentioned, alarm limit is also considered a core feature. The possibility to have these performances in one solution (and one provider) is seen as a key added value of EGNOSHA

MAIN RESULTS AND CHALLENGES








SWOT Analysis



HA services with similar performances and, in some cases, provided for free are expected to enter in the market before 2027, creating a main threat for EGNOSHA adoption

MAIN RESULTS AND CHALLENGES

CBA

Domain	Application	Potential benefits	Domain	Application	Potential Benefits
 Road	■ Automated driving	●	 Agriculture	■ Farm machinery guidance	●
 Rail	■ Command & Control (focus on Automatic Train Operations)	●	 Surveying	■ Automatic steering	●
 Maritime	■ Bridge collision-avoidance (IWW)	●	 LBS	■ VRA high	●
	■ Autonomous vessels	●		■ VRA low	●
	■ Port operations/ automated docking	●	 UAV	■ Construction – Machine Control	●
				■ LBS applications for smart utilities	●
				■ Goods delivery	●

● Very High ● High ● Medium ● Low ● Very Low/ Null

* Gross benefits

EGNOSHA could bring medium/ high economic benefits to the majority of the domains. However, different considerations drive the CBAs for the selected applications, especially regarding the cost of the equipment

MAIN RESULTS AND CHALLENGES

Main Challenges

- ❑ **Demanding User performance requirements X Ubiquitous Service.**
Hybridisation of different systems and sensors is a possible solution to explore to reach the most demanding integrity requirements.

- ❑ **Specific standardisation activities at service and user level**
These activities are needed to solve relevant open points: lack of harmonisation among standards, lack of certifying bodies on targeted sectors, unclear split of liabilities between the service provider (committed performance) and the user (standardised receiver)

CONCLUSIONS

...

...

...

...

...

...

CONCLUSIONS

Overall Presentation of Final Report

OUTLINE OF THE CONTENT

- Definition of user segment and Receivers standardisation and certification
- Service Implementation Roadmap
 - Implementation Plan
 - Risk Analysis
 - Critical Path
- Cost-Benefit Analysis
- Expressions of interest
- EGNOS HA User Needs (2025+)
- EGNOS HA Service Concept
 - Service Requirements:
 - Service Levels
 - Service Area
 - HA Processing Facility definition
 - Dissemination channels definition
 - Responsibilities and Liabilities:
 - User level
 - Service provider
 - Liability disclaimer definition
 - Service Provider option
 - Service synergies with Galileo HA Service

https://ec.europa.eu/defence-industry-space/calls-tenders/egnoshha-egnosh-high-accuracy-service-analysis_en



Thank you

EGNOSHA Team

© GMV Property – 2022 - All rights reserved



CBA

CBA RESULTS (1/2)

CBA
(focus by
domain)

- **Road:** automated driving could strongly benefit by the use of EGNOSHA. The proposed service can answer to the need of estimating the absolute positioning of vehicles
- **Rail:** automatic train operations could be enhanced by EGNOSHA. Stakeholders suggest to consider the Command & Control application as entry point for the future service adoption
- **Maritime:**
 - EGNOSHA could provide an added-value for the end-users if adopted first of all for autonomous vessels and port operations-automated docking
 - For port operations, pilots and port authorities are good candidates to foster the adoption of EGNOSHA service as an aftermarket solution
- **LBS:** EGNOSHA could support the growth of LBS applications for smart utilities, even if these applications do not need high accuracy levels

CBA

CBA RESULTS (2/2)

CBA
(focus by
domain)

- **Agriculture:**
 - EGNOSHA could provide a concrete economic added-value for the end-users if adopted for farm machinery guidance
 - Even with the device equipment provided for free for:
 - VRA-high, the benefits expected for this application do not overcome the costs that the end-users should support
 - VRA-low, today's EGNOS seems enough for this application, therefore an added-value brought by EGNOSHA here is not expected
- **Surveying:**
 - EGNOS-HA could improve the construction-machine control application, allowing savings thanks to an automatization of the activities
 - Even if not in the scope of this analysis, also other applications (e.g. cadastral surveying) could benefit by the proposed service
 - EGNOSHA is seen by some users mainly as a back-up service under specific conditions (e.g. unavailability of alternatives).
- **UAV:** EGNOS-HA could improve the good delivery within the UAV domain, allowing savings thanks to a more effective delivery process. Considerations related to the cost of the equipment will be fundamental for this domain