Service development status in the maritime domain

EGNOS workshop 2021
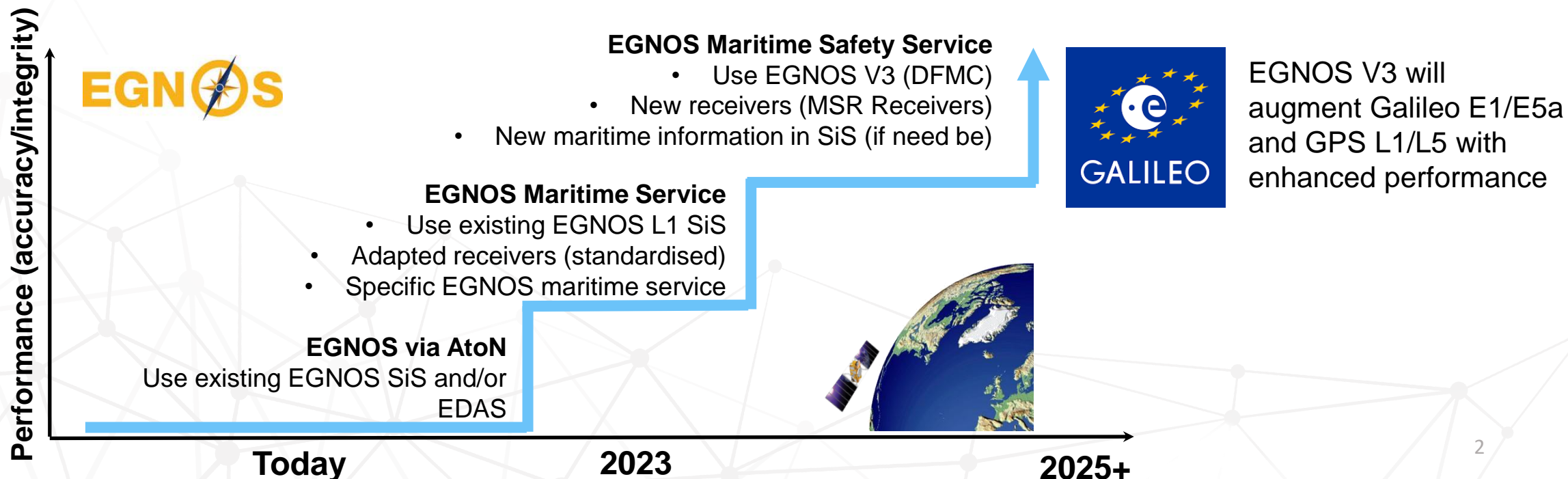
Manuel Lopez Martinez, Silvia Porfili

Maritime is relying more and more on GNSS for applications that are critical for sustainable economic growth, safety of life at sea and protection of the environment
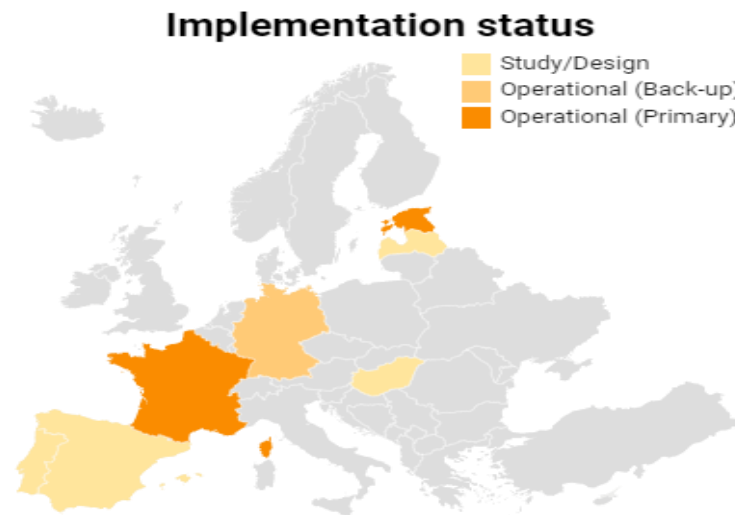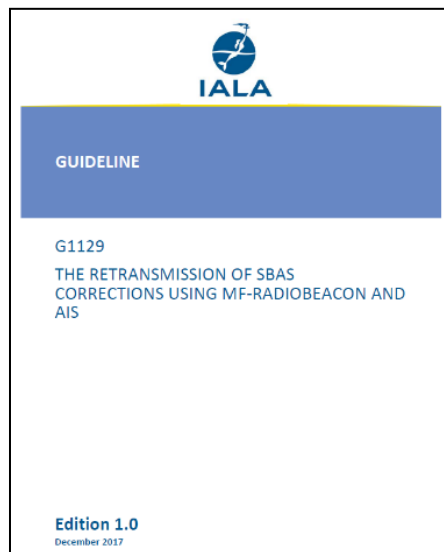
3 steps for EGNOS use:

1. Use of EGNOS corrections via existing AtoN

2. Adapt receivers to use EGNOS SiS directly i.e. maritime service

3. Maritime safety message in SiS (if need be) and multi-system shipborne radionavigation receiver (MSR)

Performance (accuracy/integrity)

EGNOS Maritime Safety Service
- Use EGNOS V3 (DFMC)
- New receivers (MSR Receivers)
- New maritime information in SiS (if need be)

EGNOS V3 will augment Galileo E1/E5a and GPS L1/L5 with enhanced performance

EGNOS Maritime Service
- Use existing EGNOS L1 SiS
- Adapted receivers (standardised)
- Specific EGNOS maritime service

EGNOS via AtoN
Use existing EGNOS SiS and/or EDAS

GALILEO

Today   **2023**   **2025+**

Step 1: SBAS-Based DGPS Corrections

Obsolescence

Few Manufacturers

High Costs (OPEX & CAPEX)

* Situation depends of each country

Option 1: EGNOS-based Virtual Reference Stations

Option 2: EDAS DGPS Corrections

✓ **Flexibility and scalability**

✓ **Transparent for users.**

✓ **Reduced infrastructure (→CAPEX/OPEX)**

Implementation status

- Study/Design
- Operational (Back-up)
- Operational (Primary)

Call for proposals in Acceleration of EGNOS Adoption in Transport

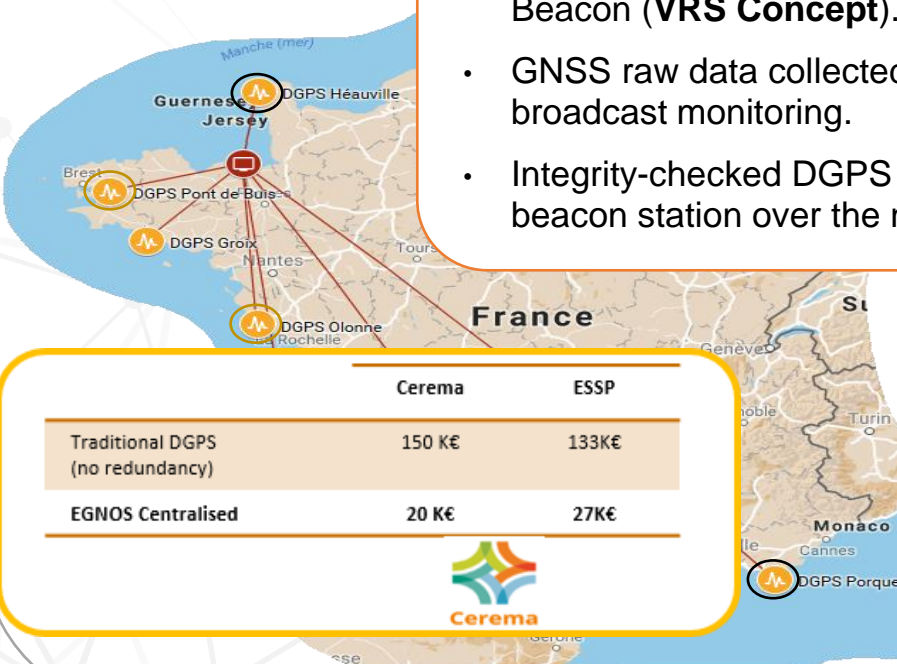| User Need*	Design & Feasibility	Implementation

EGNOS/EDAS Based DGPS Corrections: Operational Cases

Option 1

Central server

- DGPS corrections based on **EGNOS** for each IALA Beacon (**VRS Concept**).

- GNSS raw data collected at each beacon site for Pre-broadcast monitoring.

- Integrity-checked DGPS corrections sent to each beacon station over the network.

Beacon Station

- MSK Modulator

- GNSS Receiver collecting raw data

- Broadcast RF chain (transmitter, tuning unit, antenna...)

	Cerema	ESSP
Traditional DGPS (no redundancy)	150 K€	133K€
EGNOS Centralised	20 K€	27K€

Option 2

- **EDAS Ntrip** DGNSS corrections generated at **Laapeenranta** EGNOS stations feed **Narva-Jõesuu station**.

- **EDAS Ntrip** DGNSS messages are the **primary source of corrections**.

EGNOS Maritime Service Step 2 (1/2)
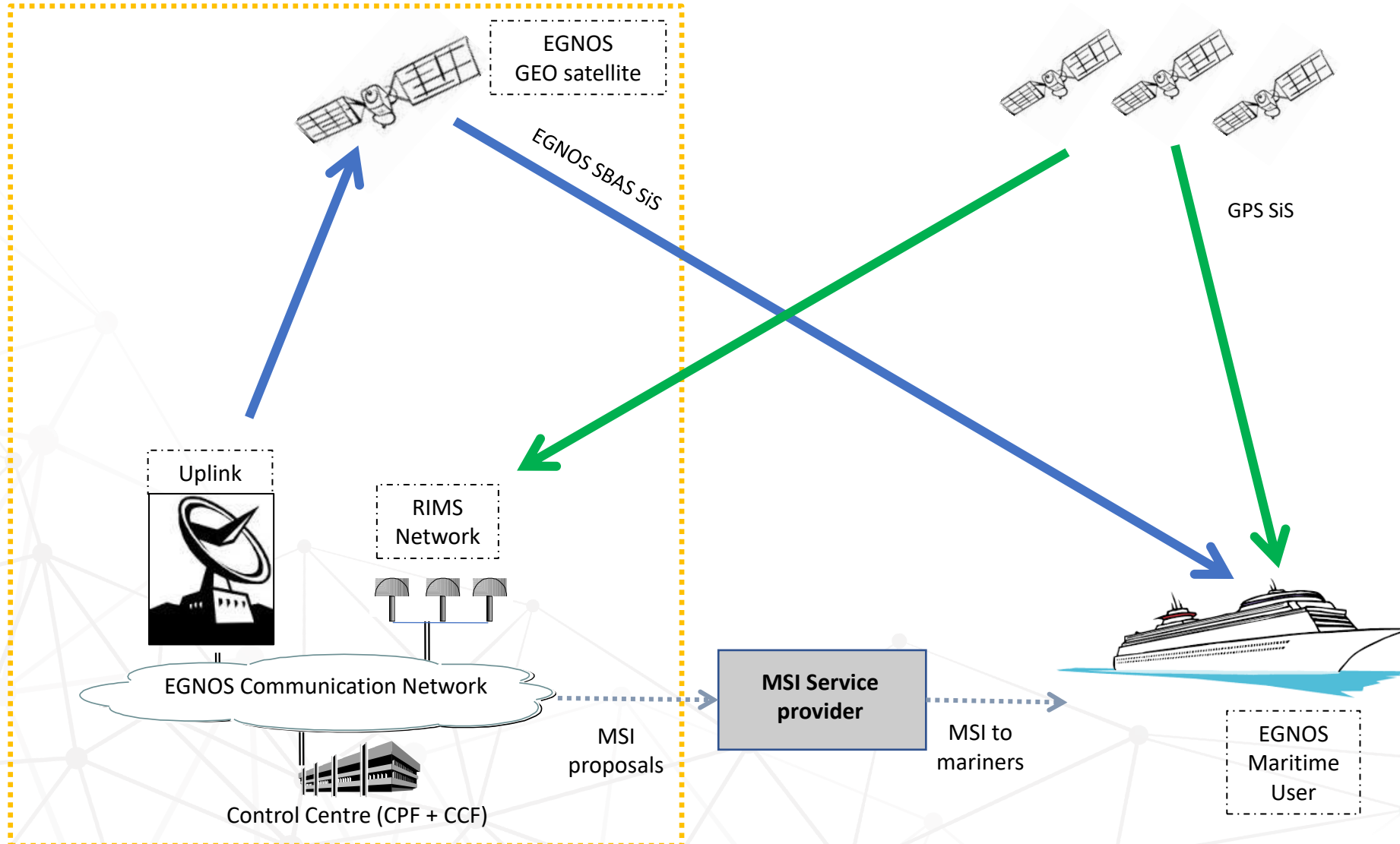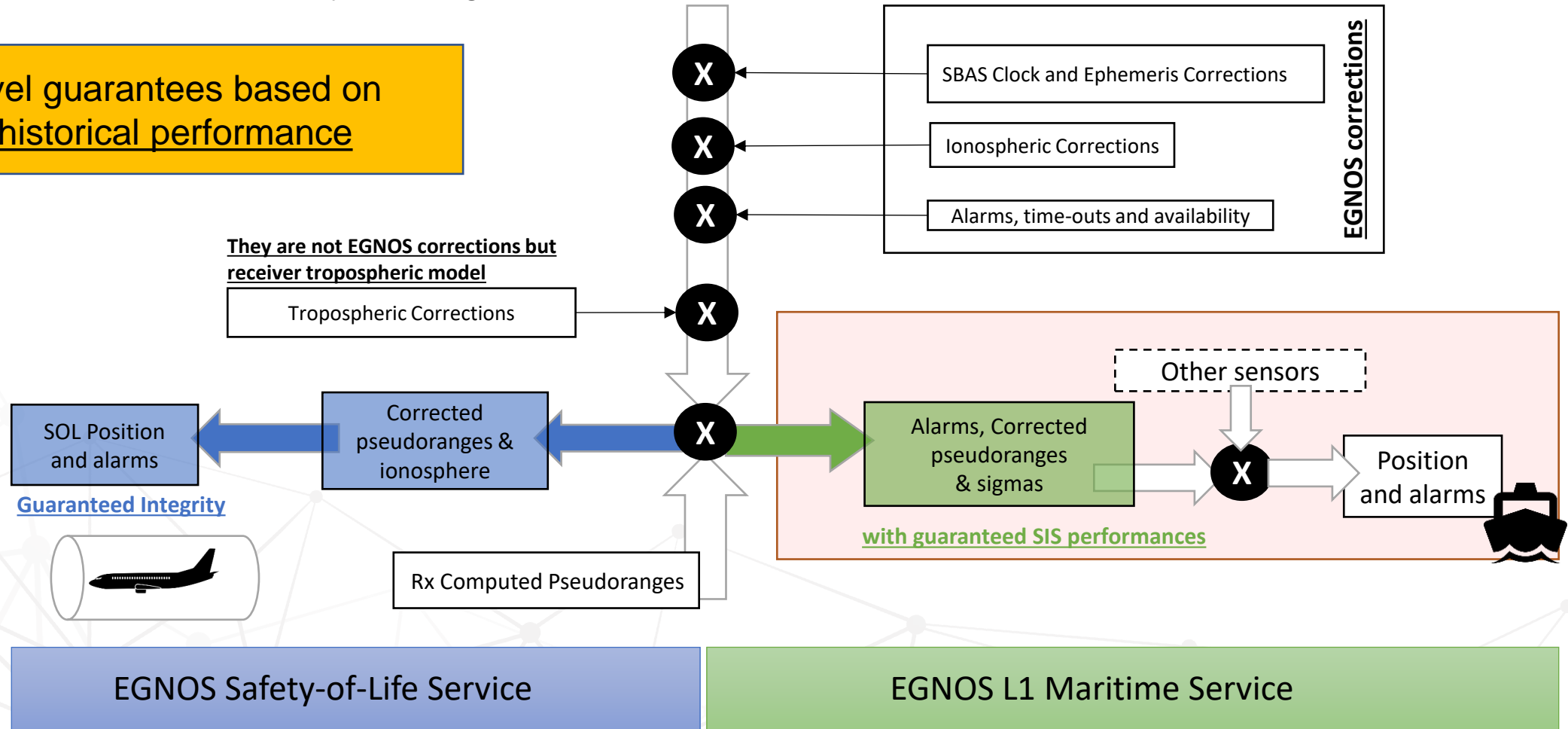
EGNOS Maritime Service Step 2 (2/2)

- Use current EGNOS L1 SiS

- Adapted receivers (standardised via International Electrotechnical Commission (IEC))

- EGNOS maritime service defined in the Service Definition Document (SDD) including:
    - EGNOS L1 Signal-in-Space performance based on analysis of 2 years of historical data of the EGNOS service
        - Satellite residual errors
        - Iono residual error
        - Expected range error overbounding
    - Alarms for error protection (note: these alerts are not specific for the maritime service)
    - Notification to mariners (MSI proposals) about predicted EGNOS unavailabilities
    - Indicative values of the scaling factors to derive real UDRE and GIVE EGNOS computed values based on EGNOS historical performance
    - Even if no commitment is taken on position domain performance, performance at user level (IMO 1046) will be assessed using representative error models for local environment (e.g. H2020 SEASOLAS and MARGOT studies). The objective is to show that EGNOS maritime service can support IMO 1046 applications.
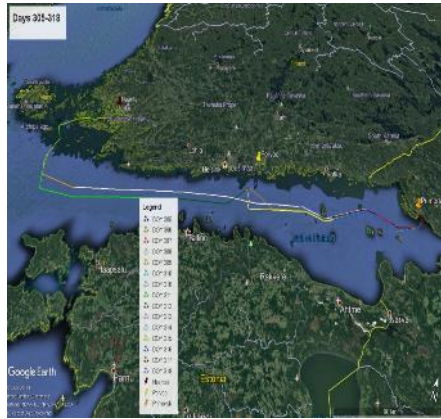
The EGNOS maritime service **does**:

- ☐ **not** make commitments on position domain performances
- ☐ **not** take responsibility for the user environment
- ☐ provide expected service performance at GNSS Signal In Space level
- ☐ **not** change the current EGNOS system/signal

Service level guarantees based on __EGNOS historical performance__

EGNOS corrections

- X ← SBAS Clock and Ephemeris Corrections
- X ← Ionospheric Corrections
- X ← Alarms, time-outs and availability

They are not EGNOS corrections but receiver tropospheric model

Tropospheric Corrections → X

SOL Position and alarms

Guaranteed Integrity

Corrected pseudoranges & ionosphere

Rx Computed Pseudoranges

Other sensors

Alarms, Corrected pseudoranges & sigmas

with guaranteed SIS performances

Position and alarms

EGNOS Safety-of-Life Service

EGNOS L1 Maritime Service

EGNOS complementing IALA Differential GNSS infrastructure (compliant with IMO Res. A1046)

2018/2019

2020

2021

2023

Users need and service concept agreed with stakeholders

Service concept consolidated

Receiver guidelines finalised

IEC receiver test performance standard finalised

Successful validation campaigns
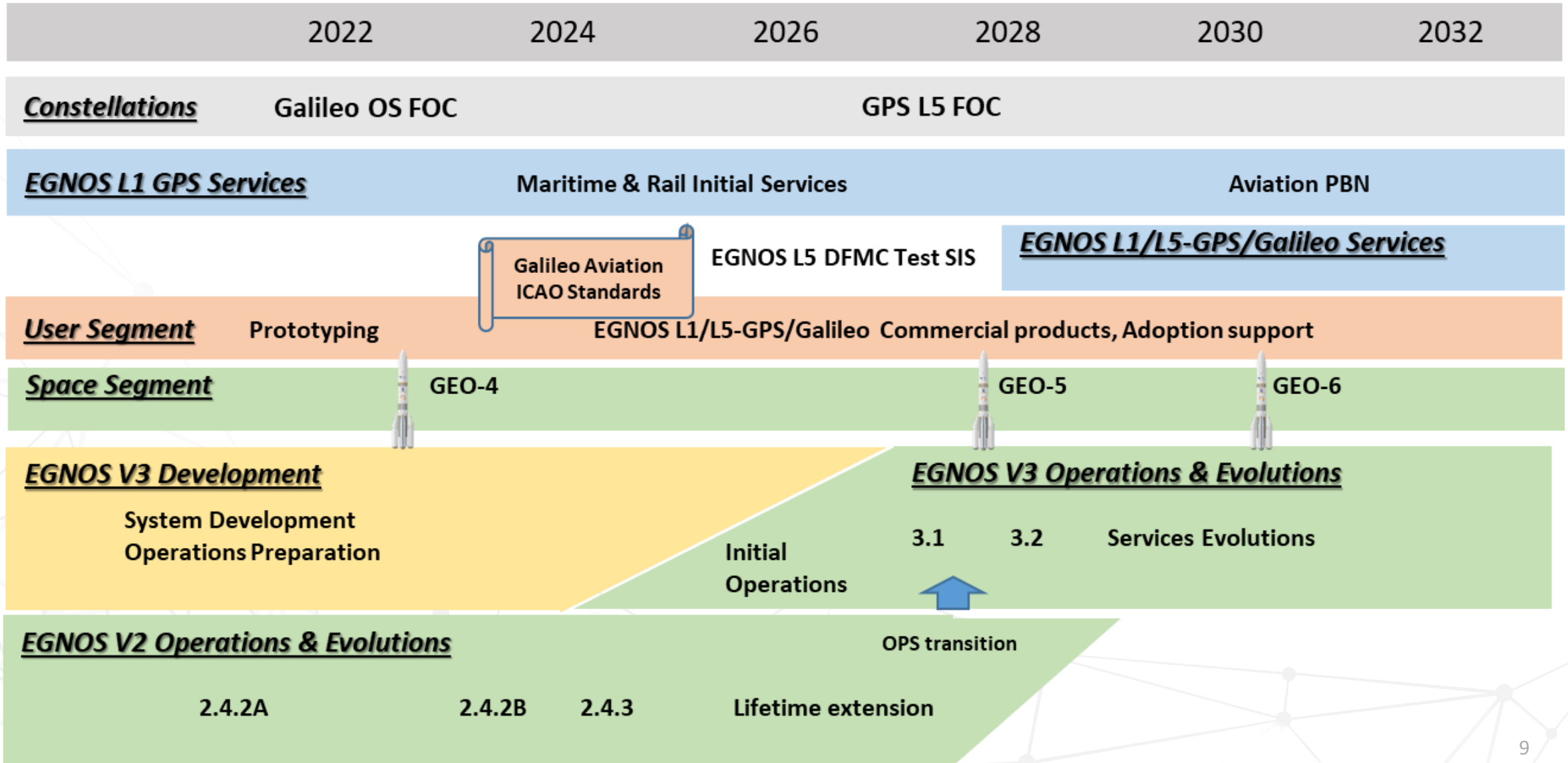
Prototype receiver

Guidelines implemented in receiver

Service declaration

Successful validation campaigns

Agreement with IHO on EGNOS Maritime Safety Information Service (MSI)

EGNOS Exploitation roadmap

	2022	2024	2026	2028	2030	2032
Constellations	Galileo OS FOC		GPS L5 FOC			
EGNOS L1 GPS Services		Maritime & Rail Initial Services			Aviation PBN	

EGNOS L1/L5-GPS/Galileo Services

EGNOS L5 DFMC Test SIS

Galileo Aviation ICAO Standards

User Segment — Prototyping — EGNOS L1/L5-GPS/Galileo Commercial products, Adoption support

Space Segment — GEO-4 — GEO-5 — GEO-6

EGNOS V3 Development

EGNOS V3 Operations & Evolutions

System Development
Operations Preparation

Initial Operations — 3.1 — 3.2 — Services Evolutions

EGNOS V2 Operations & Evolutions

OPS transition

2.4.2A — 2.4.2B — 2.4.3 — Lifetime extension

Any questions ?

- Offline questions are also welcome, please contact:

  Manuel.LOPEZMARTINEZ@gsa.europa.eu
  Silvia.PORFILI@gsa.europa.eu
  Javier.OSTOLAZA@gsa.europa.eu

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