Puertos del Estado

GOBIERNO DE ESPAÑA
MINISTERIO DE FOMENTO

SPANISH IALA DGPS NETWORK UPGRADE BASED ON EGNOS/EDAS

ARGUL, Francisco Javier
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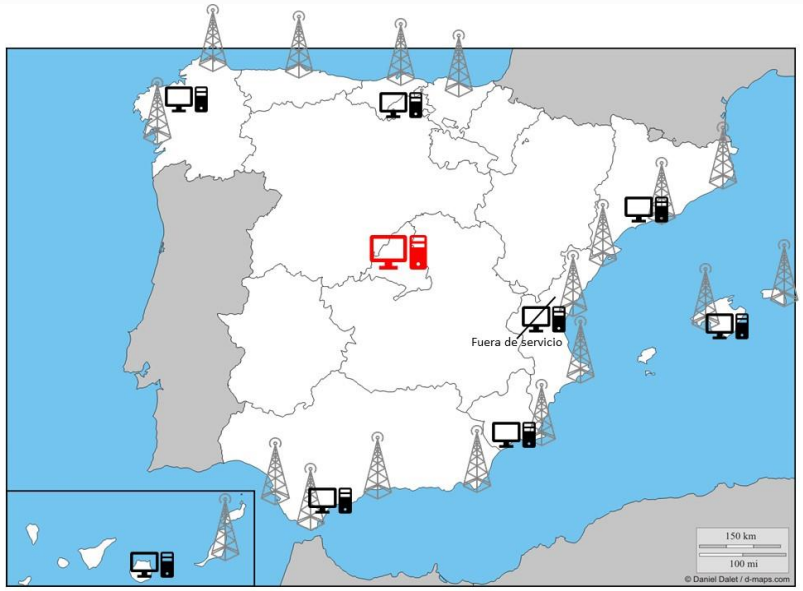
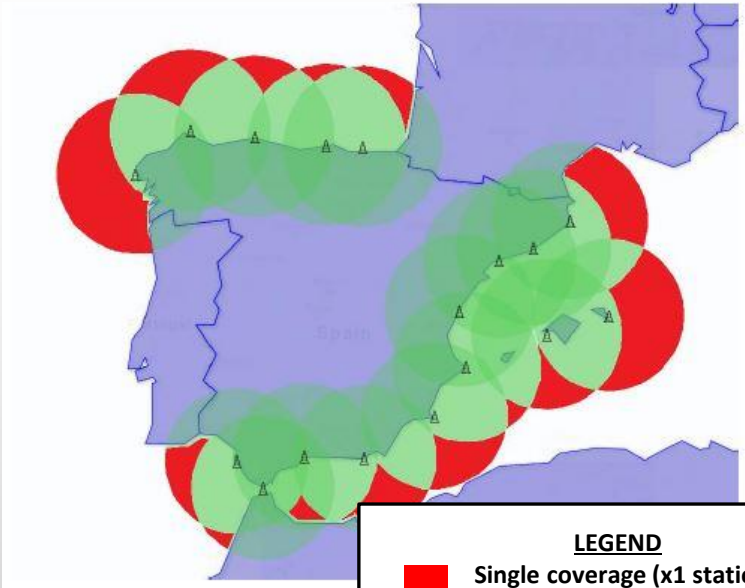
THE SPANISH DGPS NETWORK (I)



TRANSMITTING STATION RS+IM+TX

REMOTE DGPS RECEIVER+COM.

NATIONAL COORDINATION CENTER (CCN)



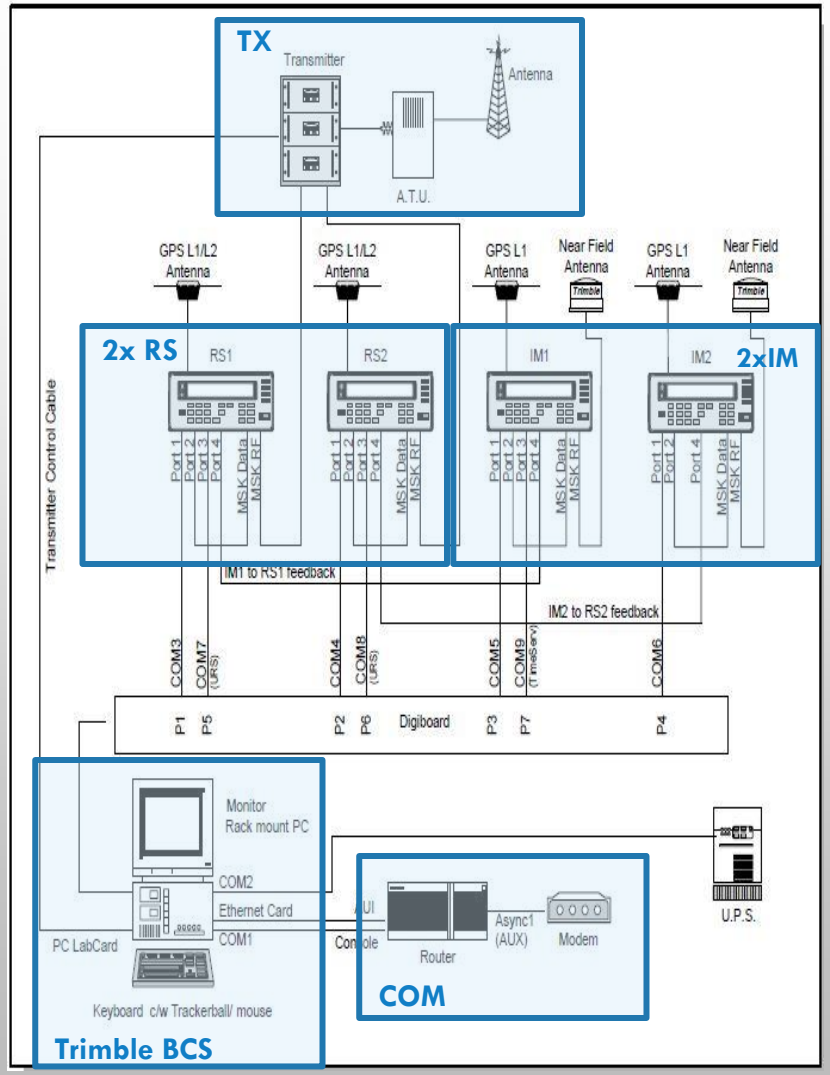
LEGEND

- Single coverage (x1 station)
- Redundant coverage (x2 stations)
- Redundant coverage (x3 stations)

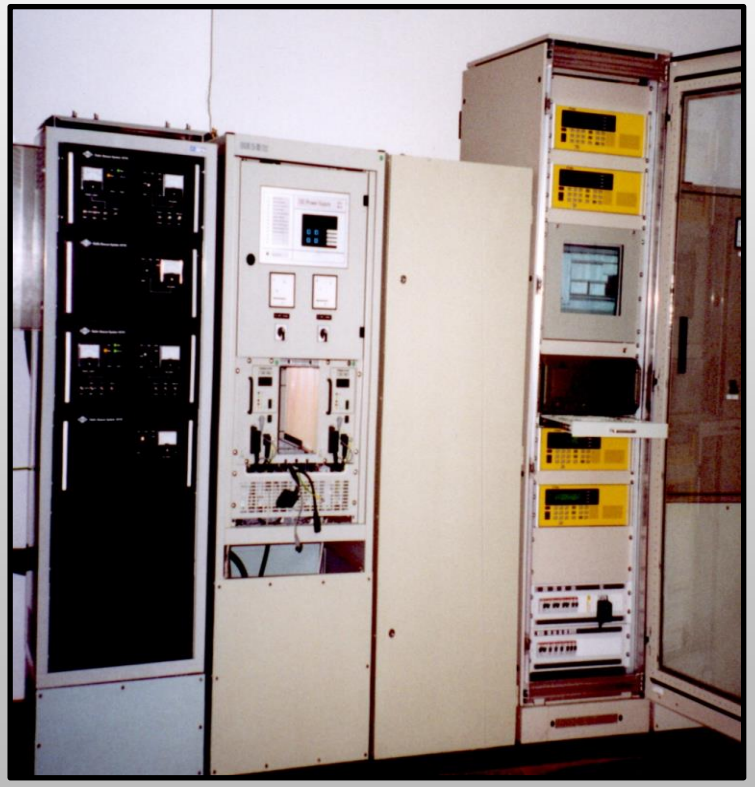
- 18 DGPS stations installed in the late 1990s. About 20 years of continuous service now.
- Service commitment:
  - Full coastal coverage (Range: 100 km).
  - Accuracy: 10 meters (95%). Fullfils IMO requirements for coastal navigation and port approach.
  - Integrity.
  - Overlapping stations (up to 3 different ones).
- Initial investment: 4 M€. Accrued operational costs for the period 2000 – 2018: 1,8 M€.
- De-centralized architecture.

THE SPANISH DGPS NETWORK (II)

THE SPANISH DGPS NETWORK (III)



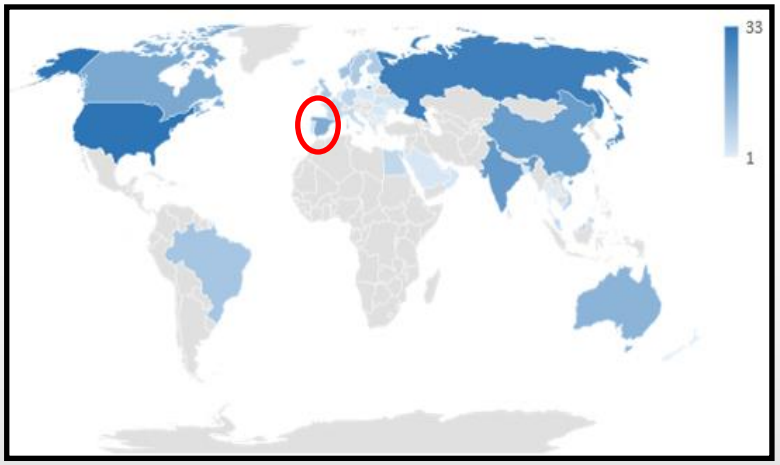
- 2 Fully redundant DGPS chains:
- 2 RS and 2 IM (Trimble 4000 series).
- 2 Radiobeacon transmitters (Amplidan).
- 1 ATU + Antenna + UPS + Batteries.
- Trimble BCS software + PC.
- VPN and comms.



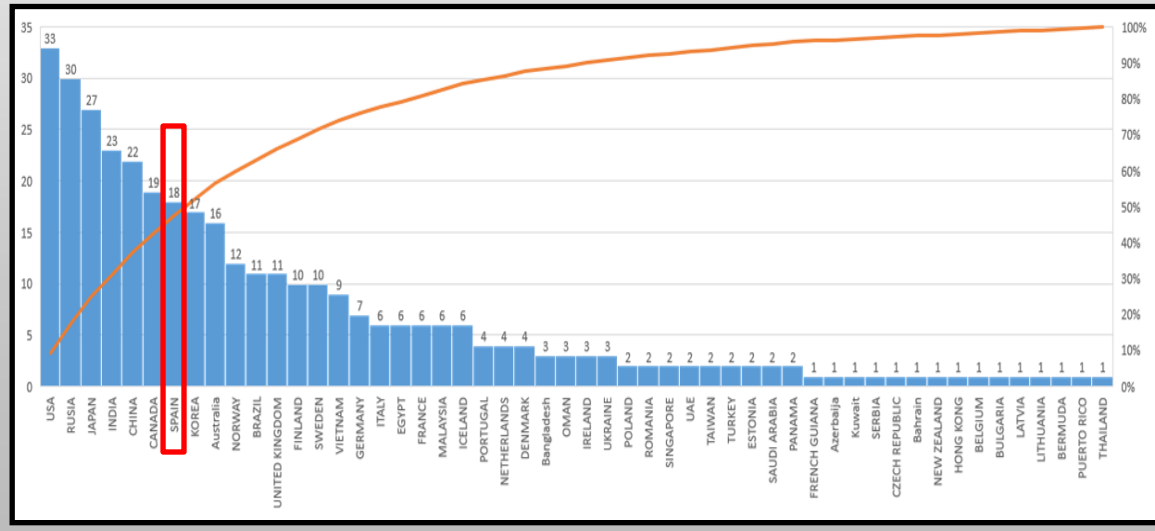
THE SPANISH DGPS NETWORK (IV)

Spanish DGPS network: current situation

- HW obsolescence
- No HW/SW manufacturer support
- No Spare Parts available
- No redundancy
- Some stations out of service



IALA DGPS stations worldwide (Source: IALA, March 2019)



To keep the DGNSS service as an AtoN

Re-engineering Project required (EGNOS)

RE-ENGINEERING PROJECT / SC-24 PILOT PROJECT

GSA/OP/07/13/SC24 "SUPPORT TO MARITIME SERVICE PROVIDERS FOR THE TRANSMISSION OF EGNOS CORRECTIONS VIA IALA BEACONS AND AIS"

European Global Navigation Satellite Systems Agency

SCOPE OF ACTIVITIES

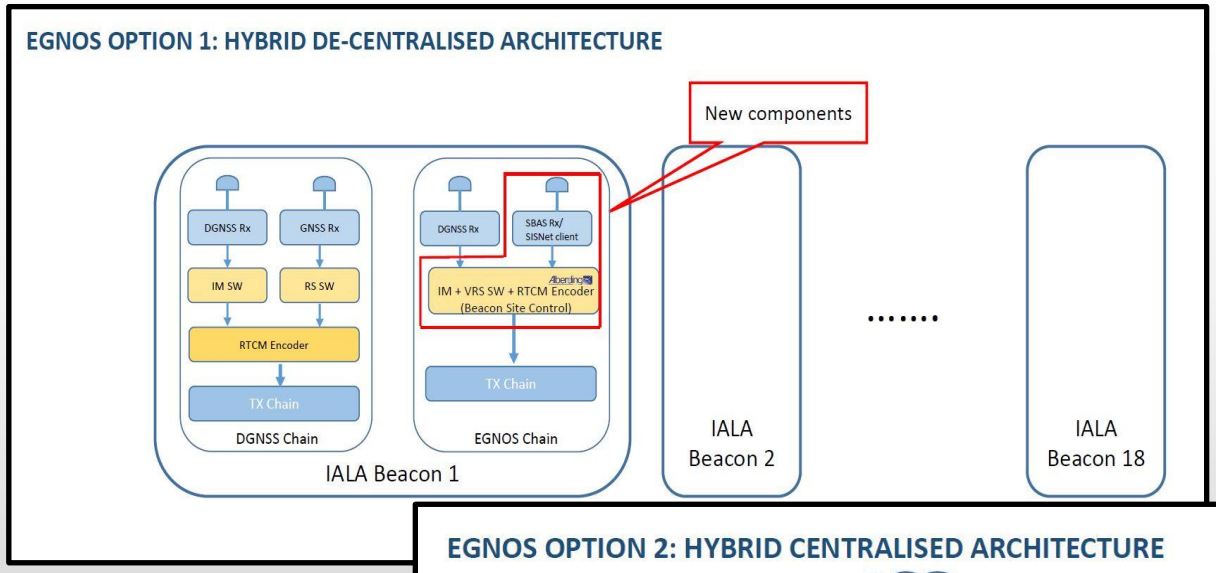
- Analysis of different architectures to transmit EGNOS corrections via IALA beacons and AIS/VDES stations.
- Both centralised and de-centralised approach.
- Different integrity monitoring schemes (pre and post broadcasting)
- SELECTED PILOT PROJECTS: **Spain,** Germany, Hungary and Latvia.
- Technical and economic feasibility of the solutions proposed.
- Performance verification (availability, continuity, integrity, accuracy).

ALG by Indra · indra · ESSP · Alberding

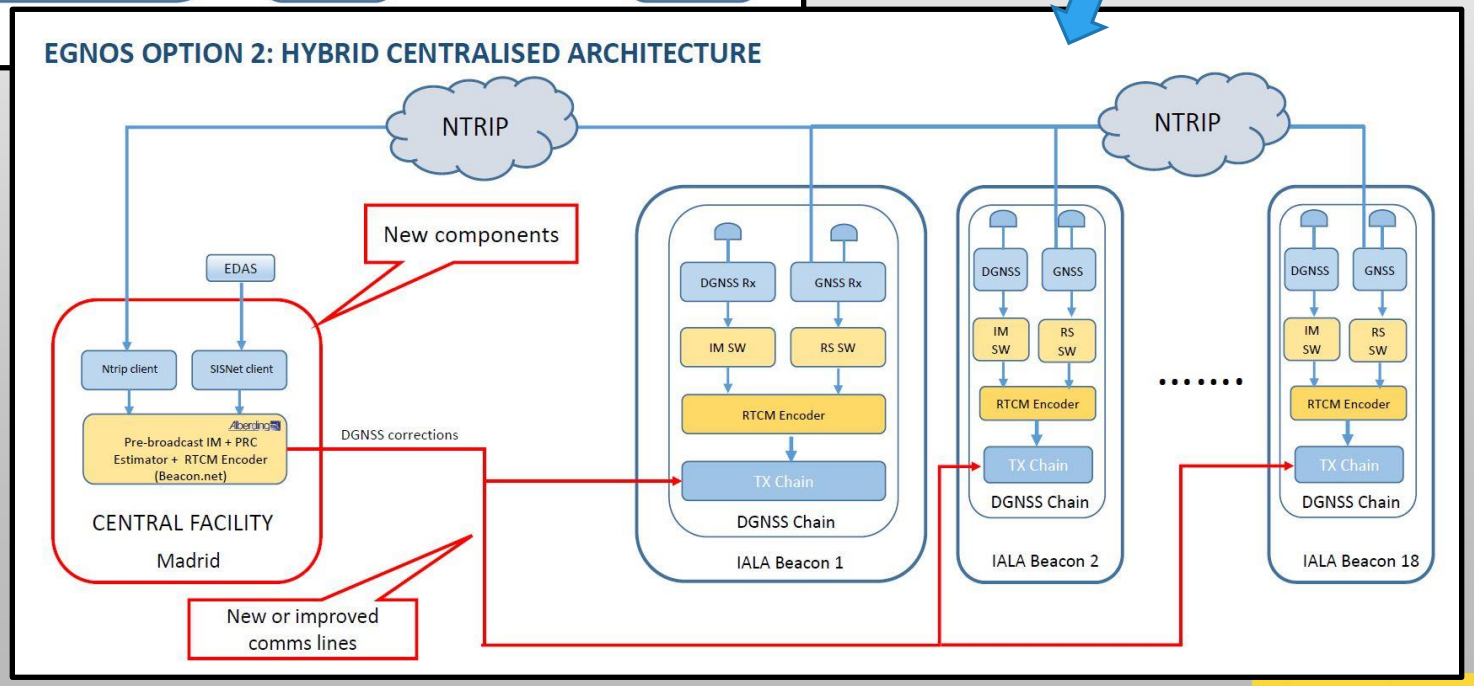
Advisory Board

European Global Navigation Satellite Systems Agency

RE-ENGINEERING PROJECT / SC-24 PILOT PROJECT



Selected option for Spain



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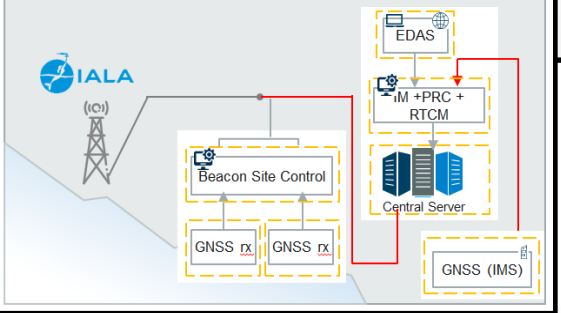
RE-ENGINEERING PROJECT / SC-24 PILOT PROJECT

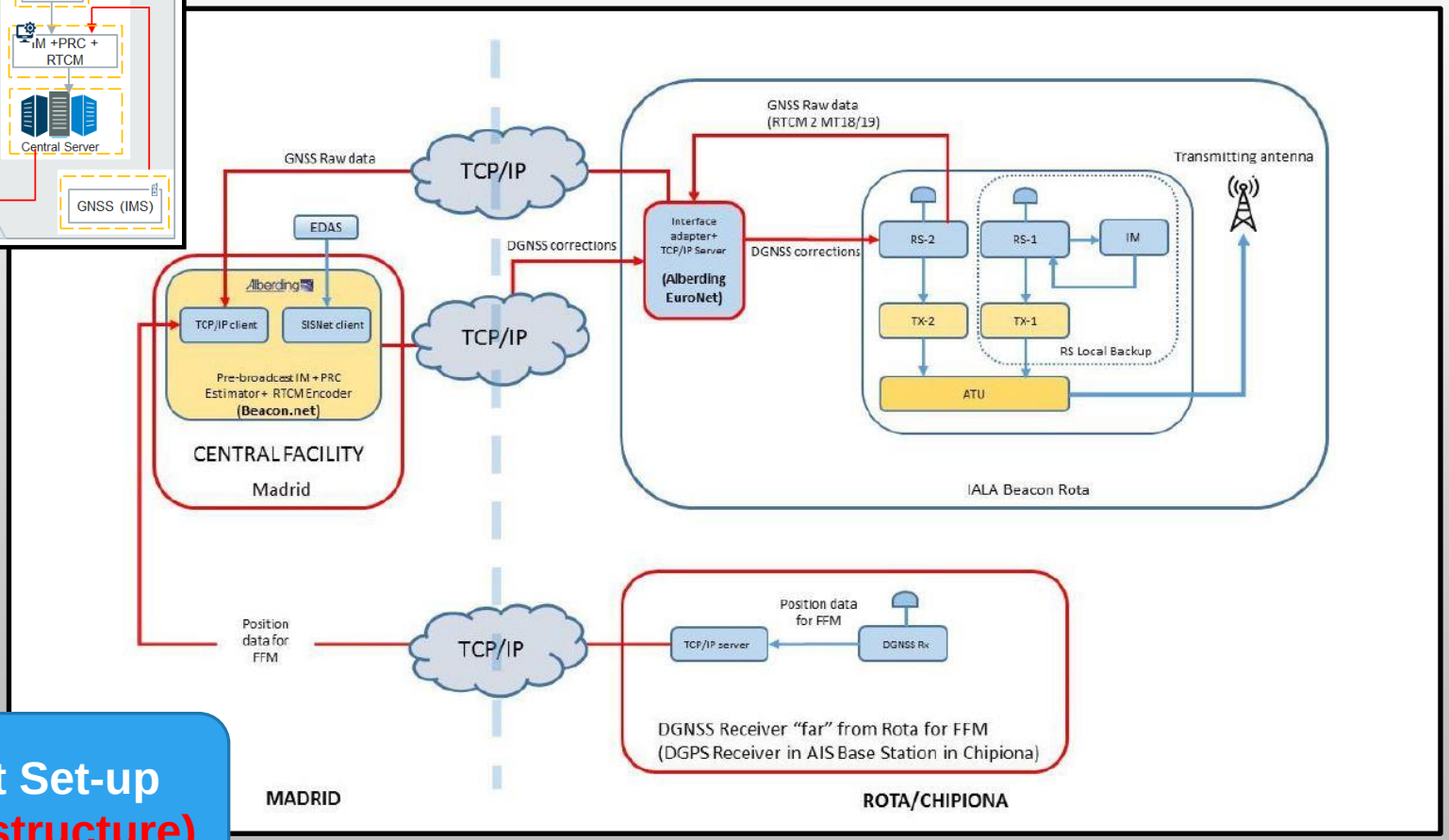
EGNOS based option Spain

Spain
Rota

Central server *Yes*

Architecture
1 - Maritime IALA hybrid centralised





Pilot Project Set-up
(Project Infrastructure)

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RE-ENGINEERING PROJECT / SC-24 PILOT PROJECT

- The EGNOS SiS combined availability and the EDAS SISNeT availability was 100%.
- The **availability of the (non-integrity checked) EGNOS-based DGPS corrections was 99.998%**. The **availability of the integrity-checked** corrections /switched output) **was 99.98%**.
- The service availability was 99.97% (computed at the Rota DGPS receiver).
- The system availability was 96.23% (computed at the FFM receiver).
- The continuity computed at the Rota DGPS and the Chipiona FFM receiver was 99.4% and 94.8% respectively (continuity strongly affected by data communications delays and the data age issues observed in the FFM receiver - not due to degraded quality of the corrections).
- The accuracy (95%) of the EGNOS-based differential solution measured at the FFM station was 0.69 m
- There were no position or pseudorange integrity events.

Excellent EGNOS-based solution performance during Pilot Tests.

	Performance Measured	
	Rota DGPS	Chipiona FFM
Corrections Availability	99.98	
Availability	99.97% (service availability)	96.23% (system availability)
Continuity	99.4%	94.8%
Accuracy (95%)	1.37 m	0.65m
Integrity	No integrity events detected	

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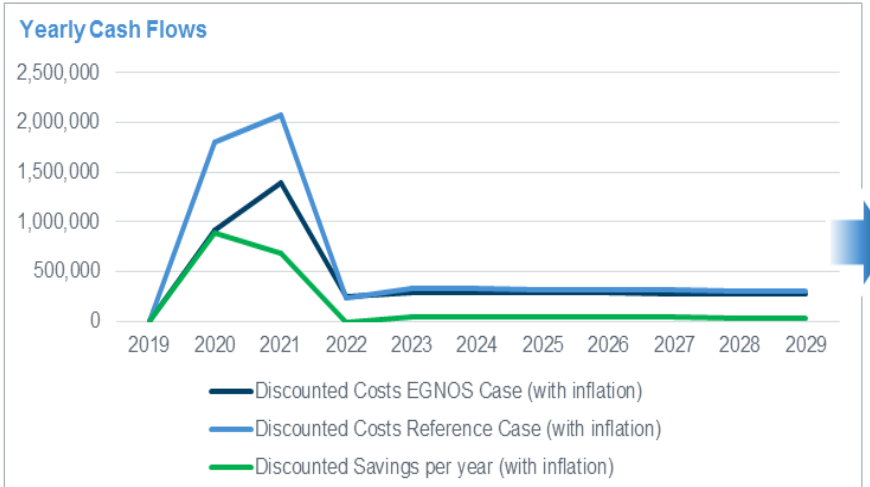
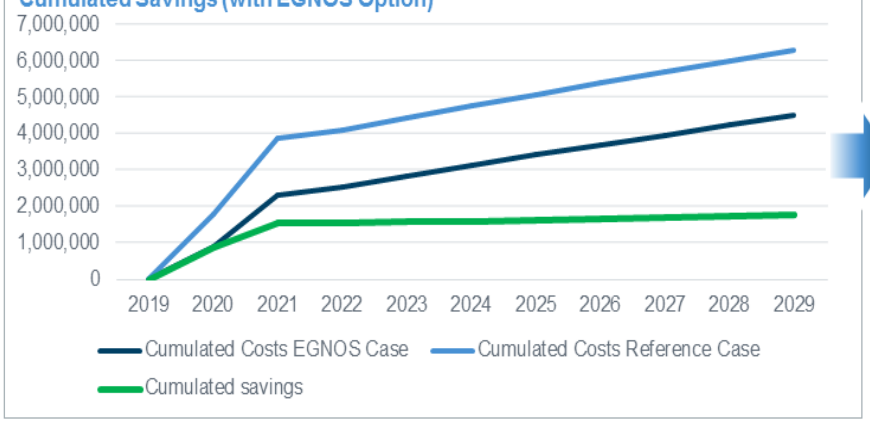
RE-ENGINEERING PROJECT / SC-24 PILOT PROJECT

High NPV and savings with EGNOS centralised Option.



- EGNOS Option foresees high savings in CAPEX (mainly RS/IM Stations) in comparison to the Reference Scenario
- EGNOS Option also generates savings in OPEX (mainly in Maintenance and warranty)

	Reference Scenario	EGNOS Option	EGNOS Option Savings
Total CAPEX	3.656.725 €	2.055.175 €	44 %
Total OPEX	2.644.993 €	2.456.255 €	7 %



- Overall results of Spanish scenario are promising in terms of costs savings with a centralised solution
- CAPEX in EGNOS centralised options is far lower than in Reference Scenario, and also OPEX is reduced

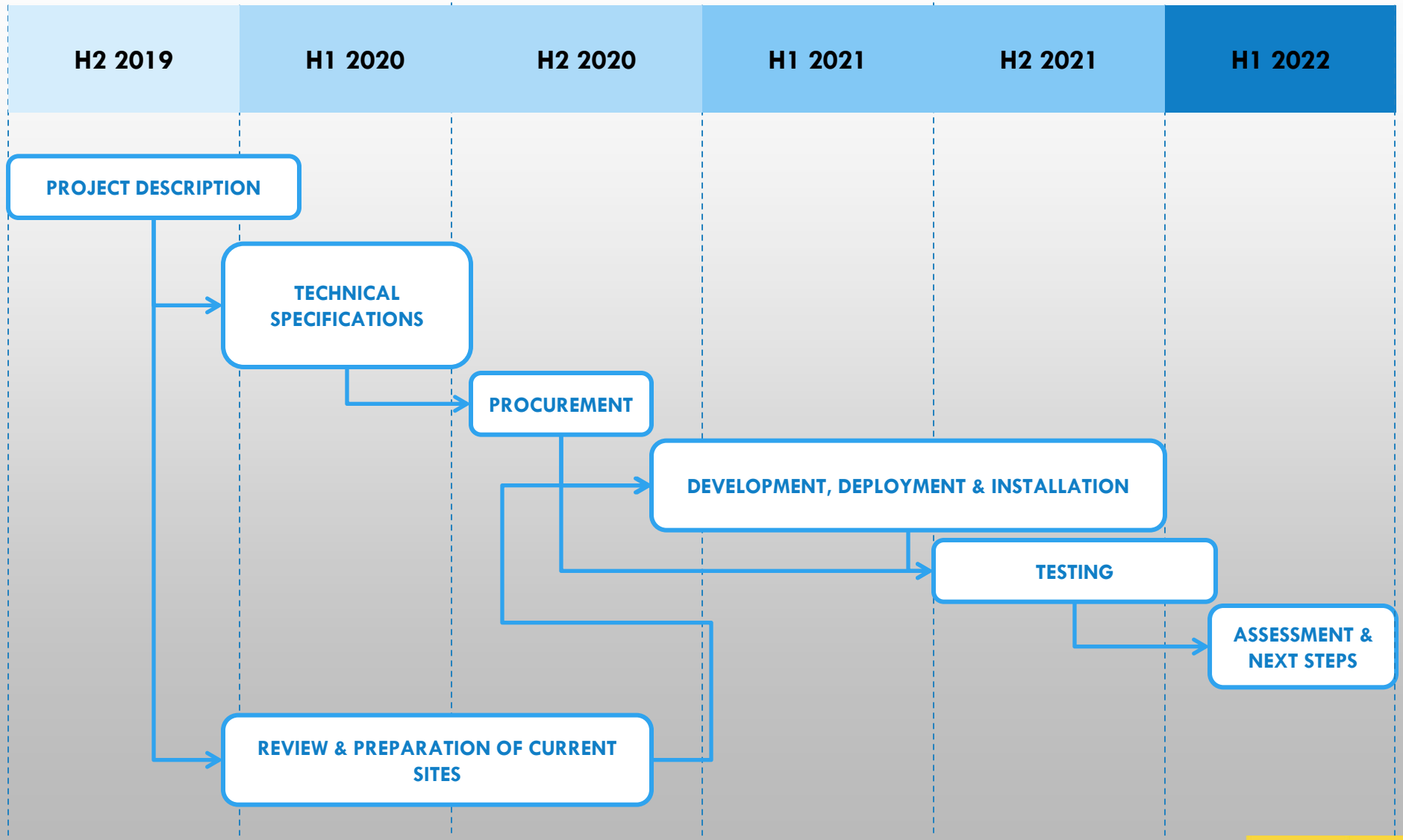
Spanish IALA CBA – Global Results of EGNOS-Based Option (Hybrid Centralised)	
NPV	1,8 M€
Savings percentage EGNOS Option vs Reference Scenario	28 %

RE-ENGINEERING PROJECT / SC-24 PILOT PROJECT

LESSONS LEARNED

- **High quality of the EGNOS-based VRS corrections.** On short baselines, EGNOS can provide Sub-meter level horizontal position accuracy.
- Full scale tests confirm the capability of **centralized solution based on EGNOS/EDAS to fulfil requirements** for coastal navigation in real operation conditions.
- **Architecture selected for Spain: EGNOS/EDAS Centralized.**
  - Redundancy: Clasical DGNSS local chains (critical stations only).
- **Significant cost savings** provided by the EGNOS/EDAS centralized solution.
- Communications: use of local redundant chains for remote sites with poor communications. For the others, two alternatives:
  - Potential use of a national high-quality communications backbone.
  - External service providers: Operation costs vs. service quality.

SPANISH DGPS NETWORK – UPGRADE PLAN



CONCLUSIONS

- **Specific studies** conducted, supported by GSA, to assess the adequacy of the EGNOS/EDAS based solution for the Spanish operational scenario lead to **positive technical (e.g. performance) and cost related conclusions.**
- **Centralized solution based on EGNOS/EDAS selected by Puertos del Estado** to upgrade the Spanish DGPS network:
  - Implementation roadmap defined and budget available.
- **Open issues** before the "go-ahead":
  - International currrent situation: Decommissioning of IALA beacons DGPS in some countries:
    - IALA workshop on the future of DGNSS (UK, late 2019).
  - At EU level: Interest to have a harmonized approach (ERNP) for DGPS networks capitalization and the future of DGNSS in the multi-constellation/multi-frequency GNSS environment. (EMRF meeting, 29–30 October 2019, Madrid).

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THANK YOU

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