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Centre d'études et d'expertise sur les risques, l'environnement, la mobilité et l'aménagement

Test Campaign EGNOS/EDAS Based DGPS corrections

Author: Etienne LEROY

Date : 28/09/2016

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1.Context

✓ DGNSS guidelines and recommendations (IALA, IMO...) defines main performance to be achieved

✓ French DGPS network becoming outdated therefore has to be replaced

✓ Recommandation IALA-R135 : *« on the future of DGNSS »* clearly identify SBAS as potential source of maritime differential correction .

✓ GSA works closely with stakeholders (EMRF, IALA…) in the frame of EGNOS maritime certification

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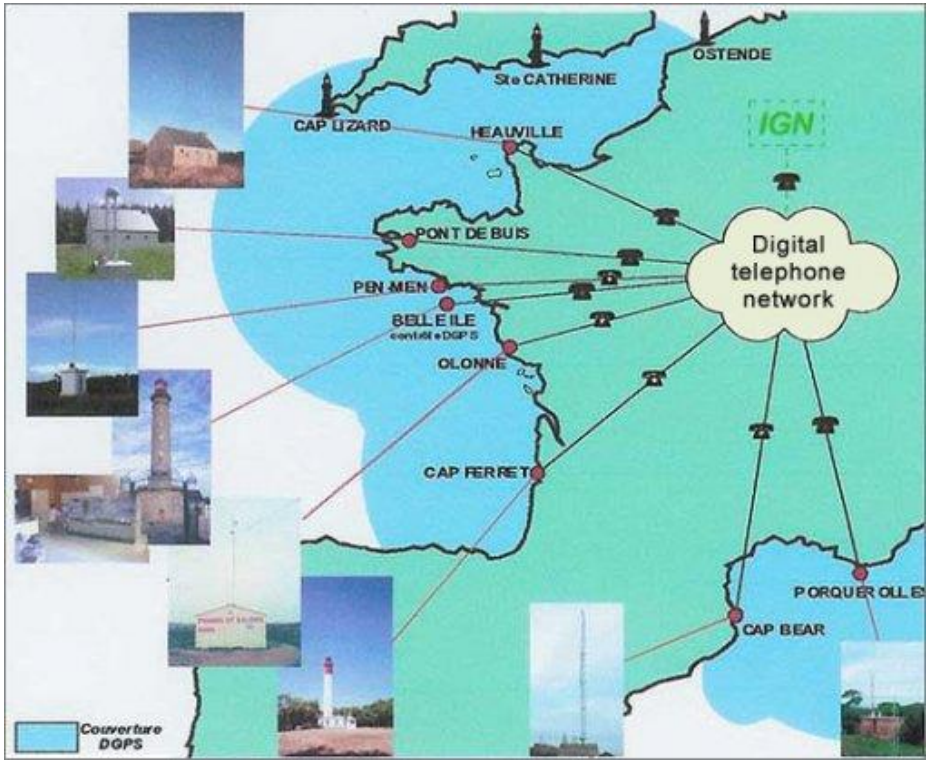
1.Context

7 stations metropolitan france and 1 station overseas (Guyane)



- ✓ Deployment about 15 years ago
- ✓ Central control station at Belle-île (Far-field monitoring)
- ✓ Remote control and survey using ISDN network
- ✓ Integrity-monitor at station allows only Post-Broadcast monitoring

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1.Context

DGPS Issues

- ✓ No redundancy (One couple RS/IM per station)
- ✓ Equipments are obsolete (regular failures)
- ✓ Lack of pre-broadcast integrity
- ✓ Service requirement no longer achieved (availability)

- ✓ EGNOS (Sis broadcast option) Maritime certification is foreseen for 2020
- ✓ French Maritime Authorities instructed CEREMA to propose a short-term and low cost solution for DGPS service maintenance

May an EGNOS based design be suitable for that purpose ?

2.EGNOS/EDAS for DGPS : Analysis

Egnos benefits :

- ✓ EGNOS access is free of charge → **Saving Costs**
- ✓ Two different signal sources are available (Signal In Space and EDAS) → **Redundancy**
- ✓ Virtual Reference Station Concept → **Allowing Centralized architecture**

Technical issues :

- ✓ Egnos data conversion to RTCM SC104 has to be done → **Alberding software**
- ✓ Real-time GNSS data access for Pre-broadcast and far field monitoring → **Local receivers**

Costs :

DGPS Stations with current architecture	EGNOS Based Centralized architecture
≈ 1300 K€	≈ 210 K€

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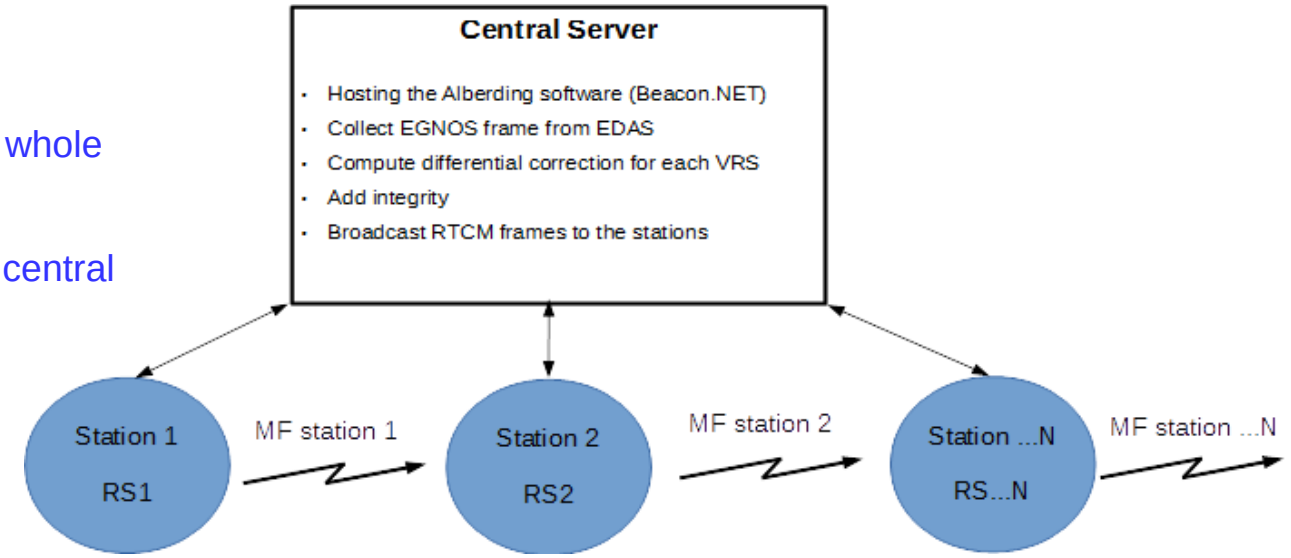
3.EGNOS/EDAS based DGPS architecture

EGNOS VRS CONCEPT :

- ✓ EDAS flow contains data for the whole coverage area
- ✓ Remotly generation of RTCM at central server for each DGPS stations



Achieve Integrity → Real time GNSS data network:

- ✓ GPS Raw data for Pre-Broadcast monitoring → A GNSS network is created using one local reference station at each station.
- ✓ DGPS position computed using MF of each station for Far-field monitoring → One station ensures the far-field monitoring of the nearby station

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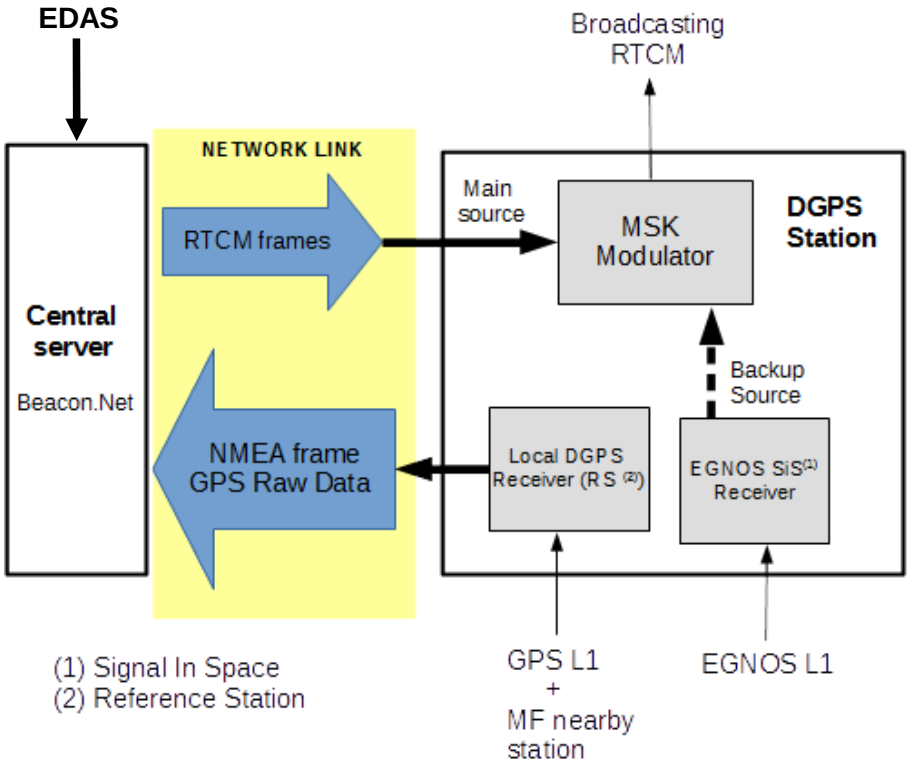
3. EGNOS/EDAS based DGPS architecture



- ✓ Egnos Sis Receiver at the station as a backup source of RTCM.
- ✓ Local DGPS Receiver and EGNOS SiS Receiver should be a single receiver to limit equipments costs
- ✓ A specific software development has to be done to control the switching from main to backup RTCM Source
- ✓ A high-availability network has to be deploy between the central server and stations (to replace ISDN network)

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4.Test campaign

Schedule :

Task	Description	Status / Dead-Line
[1]	Preliminary tests	Done
[2]	Install beacon.Net central server (2 stations licence)	In progress
[3]	Tests of VRS networking concept for two DGPS stations without broadcasting	Dec.2016
[4]	Specific hardware and software developpement for EGNOS/DGPS station	In progress
[5]	Supply two DGPS stations with required equipments	Apr. 17
[6]	Real-Scale Tests with networking, broadcasting and backup	Oct.17

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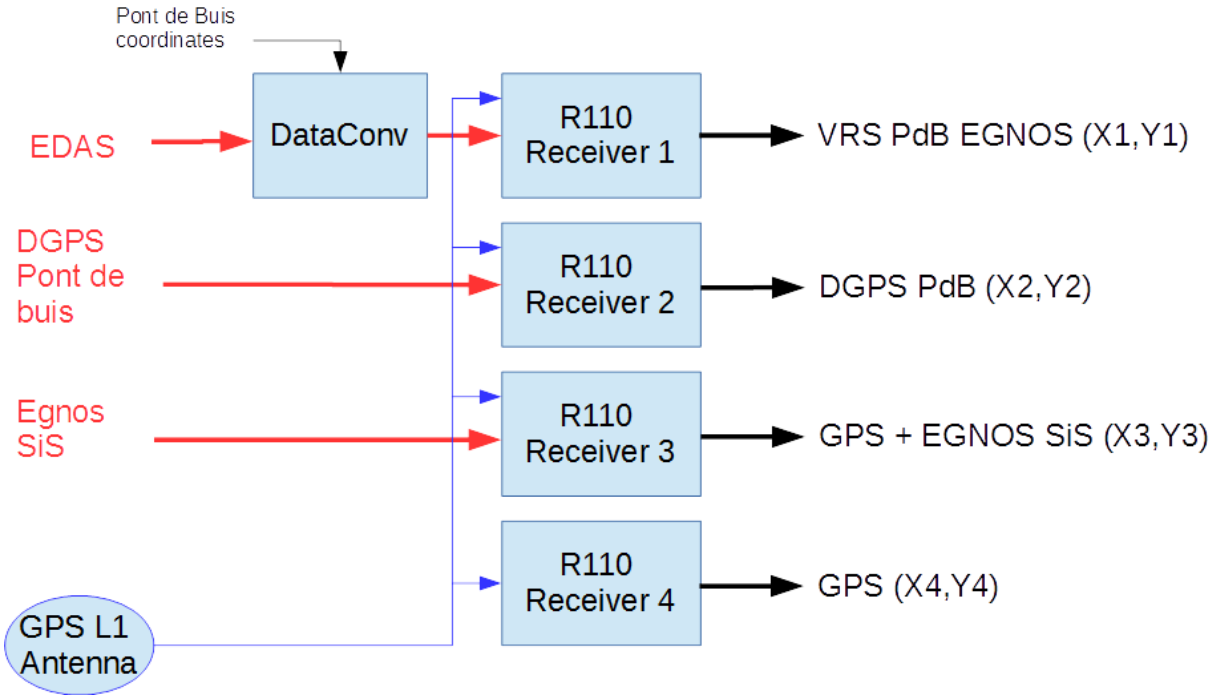
4. Test campaign

[1] Preliminary tests (Plouzané) :

Main objectives :

- ✓ Deal with EGNOS/EDAS flow and convert it to RTCM using Alberding solution (DataConv)
- ✓ Compute position solution from that RTCM and assess the performance



- ✓ Same antenna was used for the four receivers
- ✓ The four receiver are identical
- ✓ The position solution are logged at 1Hz rate
- ✓ Distance rover/Pont de Buis = 41 Km (22 NM)

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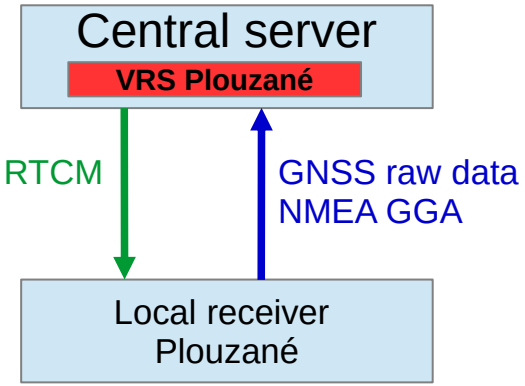
4. Test campaign

[2] Beacon.Net installation on the central server
[3] Test of VRS networking concept without broadcasting :

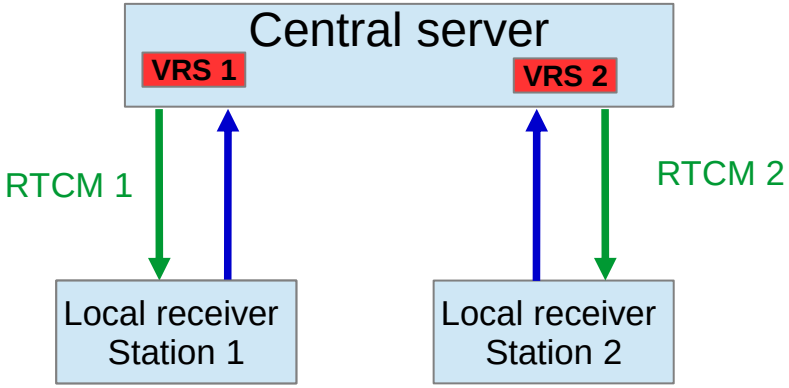
Main objectives :

- ✓ Validate the beacon.net software installation on the central server
- ✓ Assess the communication link reliability between the central server and remote stations
- ✓ Using beacon.Net to compute VRS corrections, ensure integrity (Pre-broadcast)
- ✓ Apply correction on a receiver at remote station to assess performance

Step 1 : Central Server/Plouzané



Step 2 : Central Server/two DGPS Stations



TEST OUTPUT

Performance ?

Integrity ?

Availability ?

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4. Test campaign

[4] Specific hardware and software development for EGNOS DGPS stations

Main objectives :

- ✓ To specify the technical requirements according to international guidelines and standards (In progress)
- ✓ Gather costs and technical offers and select a company
- ✓ Following developement
- ✓ Perform laboratory tests

TEST OUTPUT

Development Validation ?

Supply equipments

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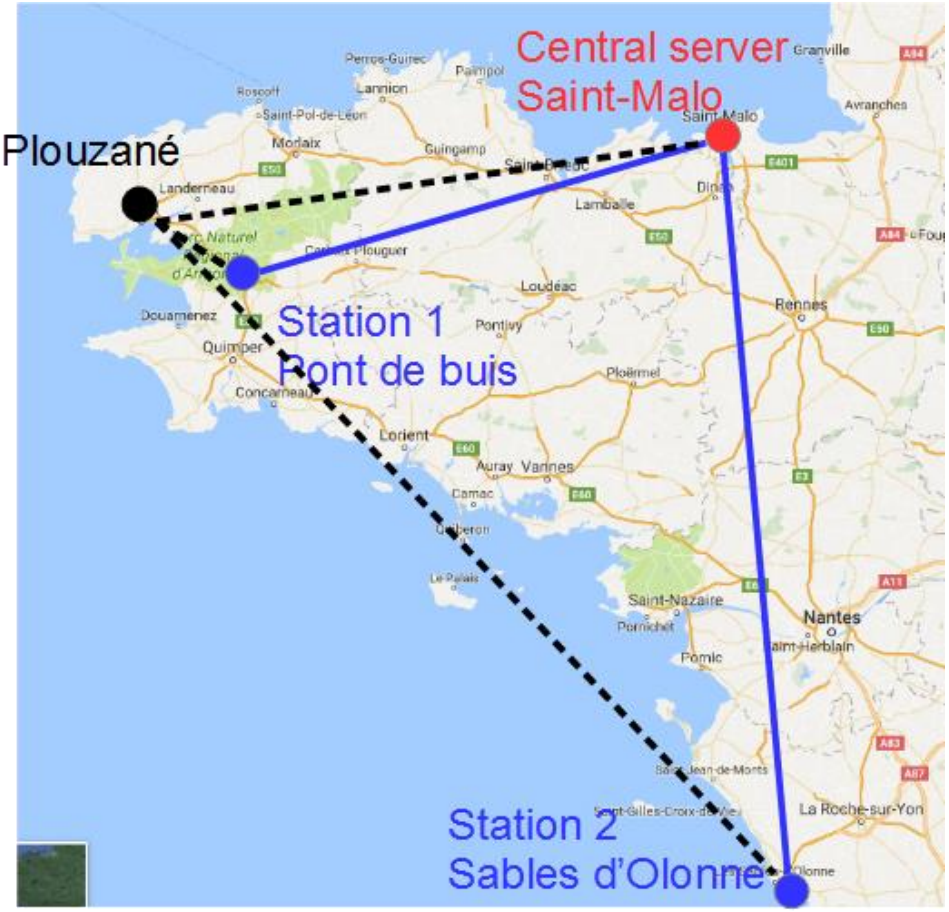
4. Test campaign

[5] Supply two DGPS stations with required equipments
[6] Real-Scale Tests with networking, broadcasting and backup:

Main objectives :

- ✓ Validate *in-situ* the hardware and software development done on the task [4]
- ✓ Broadcasting corrections using MF airwaves
- ✓ Validate the far-field monitoring by nearby station concept
- ✓ Perform failure scenarios to test the backup solution
- ✓ Remote control of central server and stations

TEST OUTPUT
Validation of the design ?



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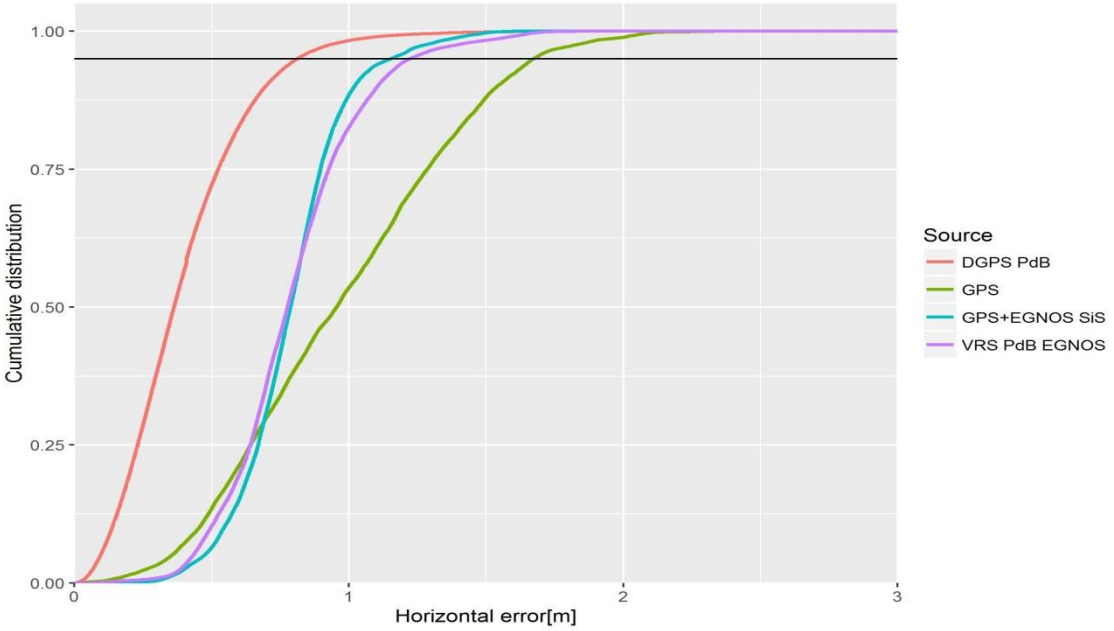
5. Results

Preliminary tests (task [1]) results :



✓ Duration → 3 days

✓ Accuracy (95%) :

- DGPS 0,8m
- GPS + EGNOS Sis : 1,2m
- VRS PdB EGNOS : 1,2 m
- GPS : 1,7 m

✓ DGPS remains the more accurate method (Only short rover/station baseline is studied)

✓ Similar performance of EGNOS VRS at rover level or EGNOS VRS with a 41 km baseline.

✓ EGNOS VRS methods and DGPS measurement well fulfill the requirements for coastal navigation (<10m)

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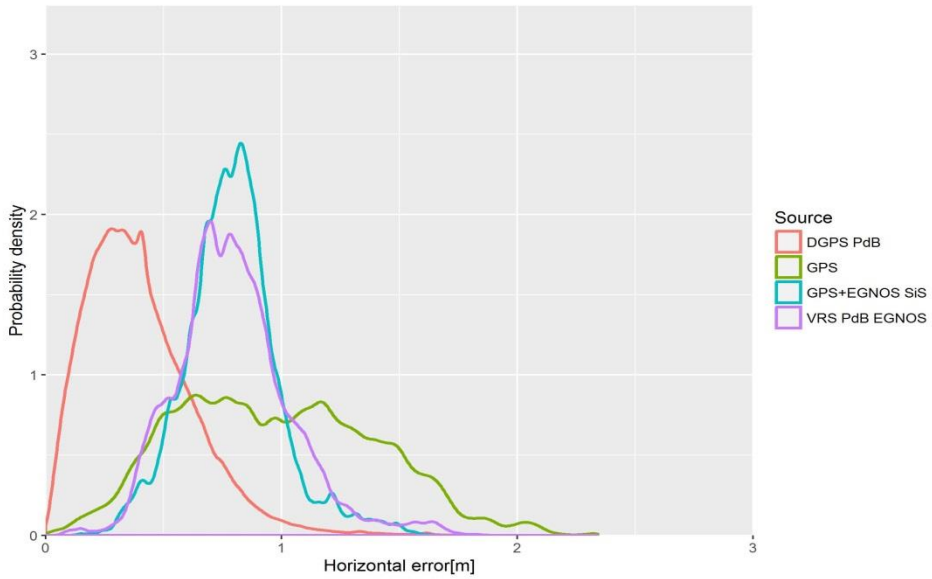
5. Results

Preliminary tests (task [1]) results :



- ✓ Narrowest shapes are obtained for EGNOS based results
- ✓ The horizontal error offset is less important for DGPS.

5. Results

Conclusion :

- ✓ Preliminary tests performed by cerema showed 1,2m of horizontal error for an EDAS VRS station with 41 km baseline distance to the rover.

- ✓ Review of few similar studies, for instance driven by ESSP, showed slightly better performances below 1m of horizontal error.

- ✓ Regarding the whole results, EDAS VRS station concept would be a promising way for DGPS corrections provisionning for coastal navigation (<10m 95%).

6.Prospects

- ✓ Following the foreseen schedule in order to better assess the performance of EDAS/EGNOS based DGPS stations.
- ✓ Sharing interests and results with foreign stakeholders
- ✓ Deployment the entire DGPS stations is expected before end of 2018 if trials results fullfill the requirements