Algerian SBAS system based on ALCOMSAT-1 : characteristics and preliminary performance tests

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International Committee on Global Navigation Satellite Systems

United Nations International Meeting on the Applications of Global Navigation Satellite Systems,
5 - 9 December 2022, Vienna, Austria

INTRODUCTION

GNSS (GPS, GLONASS, GALILEO, Beidou) : **Positioning in a general terrestrial referential**

NEEDS: GNSS applications developed in Algeria

- Isolated Localization (accuracy: dm < σ <m)
- **Geodesy** (National network, Cadastral Network, Urban Networks, ..)
- Industrial Risks: Auscultation of Dams, Ponts, Tanks storage of GNL.....
- Public Works (Roads, Rail Infrastructure. ...)
- Scientific applications: crustal deformations, atmospheric modelling (TEC), Climate Change (IVW),...
- **Navigation:** Terrestrial, Maritime, Aviation : positioning and navigation in real time (Position, Cap, Speed, ..)

PROBLEMS : Accuracy in Real Time insufficient + **Integrity** $\Rightarrow$ Satellite Based Augmentation System (SBAS)

SBAS is an augmentation system that transmit the complementary information to correct errors of measurements to improve positioning performance and to ensure integrity.

Satellite Based augmentation systems : SBAS

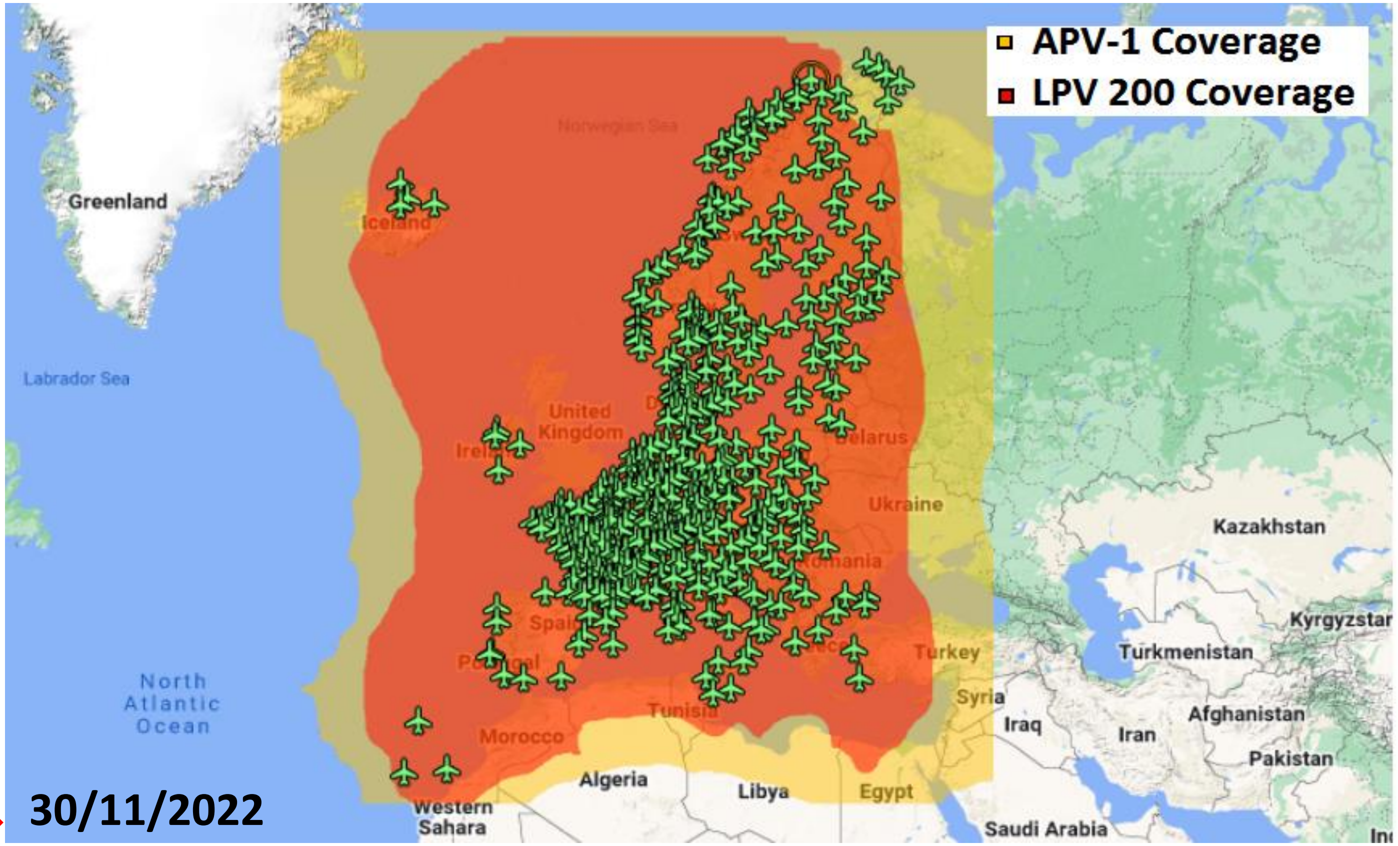
→ Principal objectives:

- Improve the **accuracy** of GNSS systems (differential correction message);
- To inform users about GNSS malfunctions (integrity message)/ **integrity** is means providing the user information on the reliability of the GPS in the form of confidence levels and alarms in case of anomalies

→ SBAS can provide:

- Responds to the needs of civil aviation by providing accurate positioning and integrity.
- APproach and landing operations with Vertical guidance **(APV).**
- **Precision approach** service

Service for EGNOS based procedure in Europe



https://egnos-user-support.essp-sas.eu

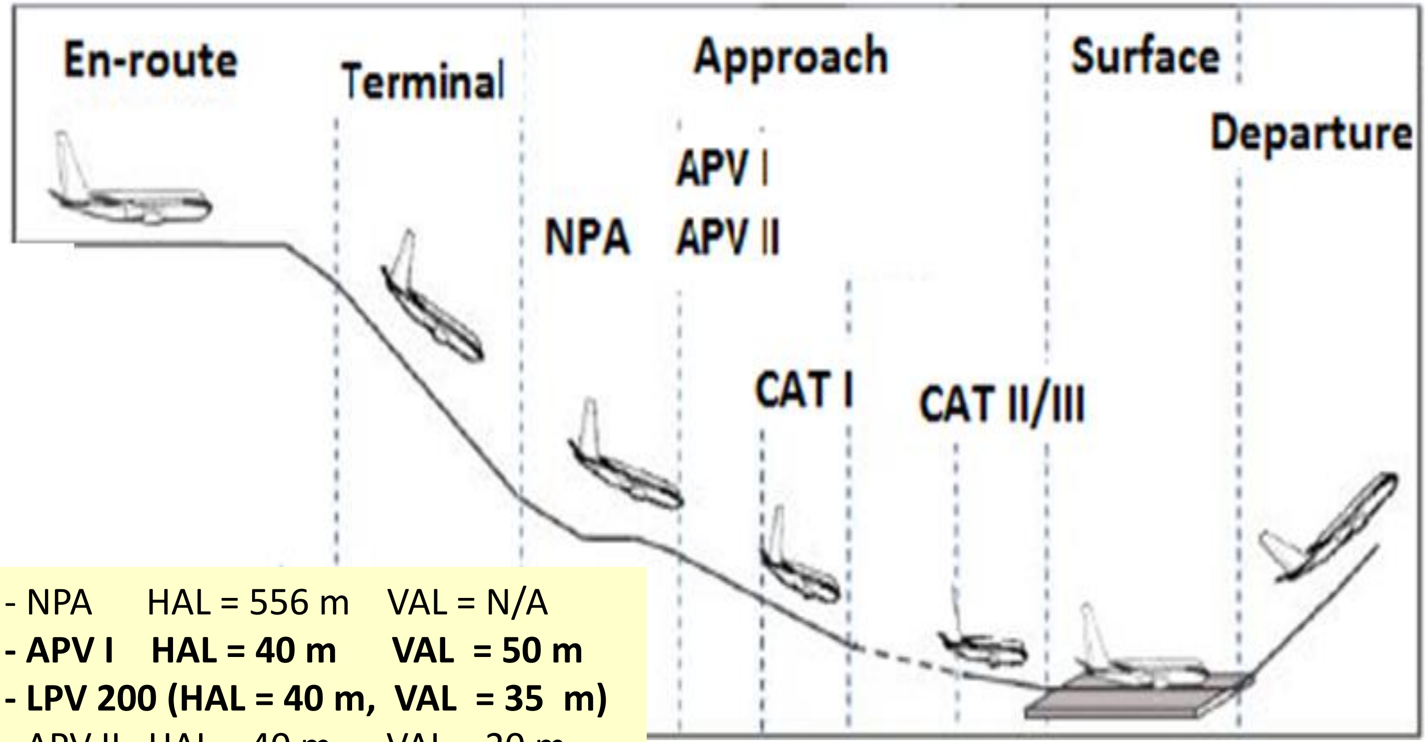
Performances: ICAO Requirements

1. Accuracy : Calculated position/true position

2. Integrity :
  - Integrity risk
  - Maximum tolerable error
  - Time to alert

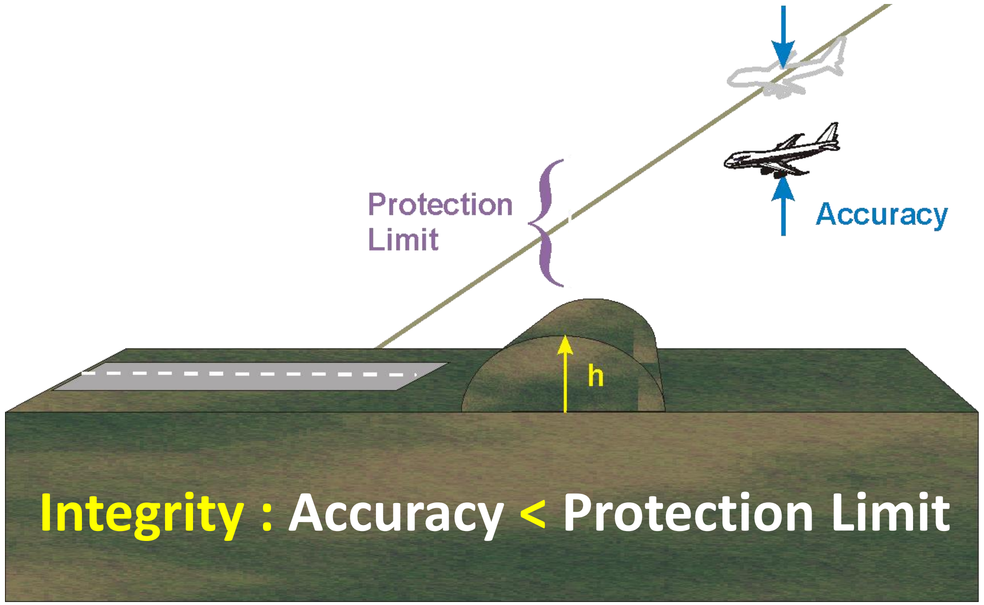
3. Continuity : Limit risk of losing the service unexpectedly

4. Availability : Fraction of time that one has accuracy + integrity + continuity



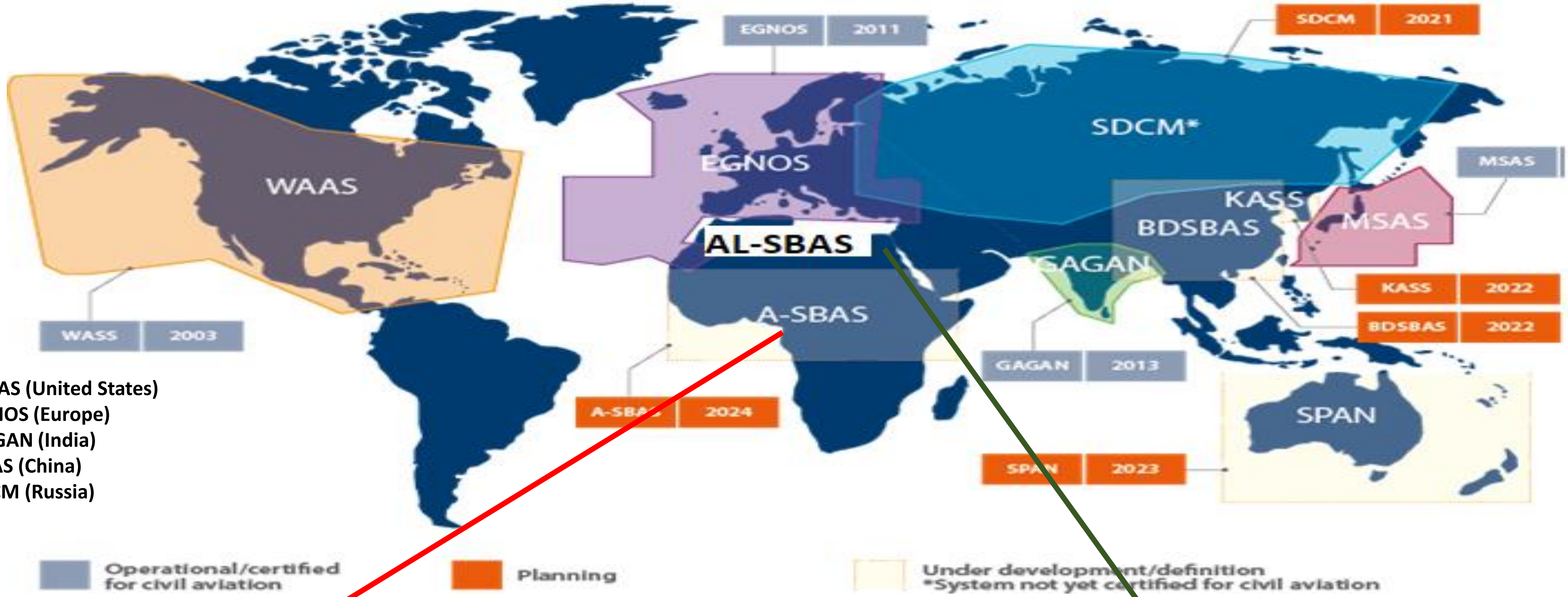
- NPA HAL = 556 m VAL = N/A
- **APV I HAL = 40 m VAL = 50 m**
- **LPV 200 (HAL = 40 m, VAL = 35 m)**
- APV II HAL = 40 m VAL = 20 m
- Cat I HAL = 40 m VAL = 12 m

HAL : Horizontal Alarm Limit



Satellite Based Augmentation Systems : SBAS

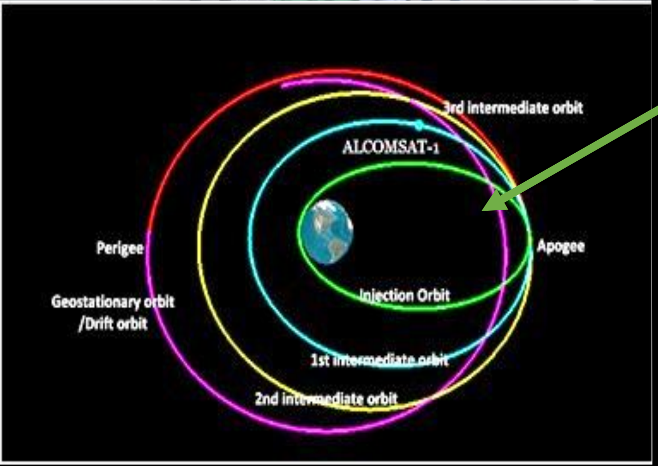
⇒ **SBAS** : geostationary satellites (2-3) + reference stations network



WAAS (United States)
EGNOS (Europe)
GAGAN (India)
SNAS (China)
SDCM (Russia)

SBAS for Africa & Indian Ocean
(ASECNA-NIGCOMSAT-THALES)

Algerian SBAS: Alcomsat-1, launched in December 11, 2017 (PRN 148).



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- ❑ **Introduction (SBAS, ICAO Requirements…….)**
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  - Architecture and function of AL-SBAS
  - Messages transmited by AL-SBAS
- ❑ **Preliminary performance tests of AL-SBAS**
  - Précision
  - Integrity
  - Ionospheric grid
- ❑ **Conclusions & Perspectives**

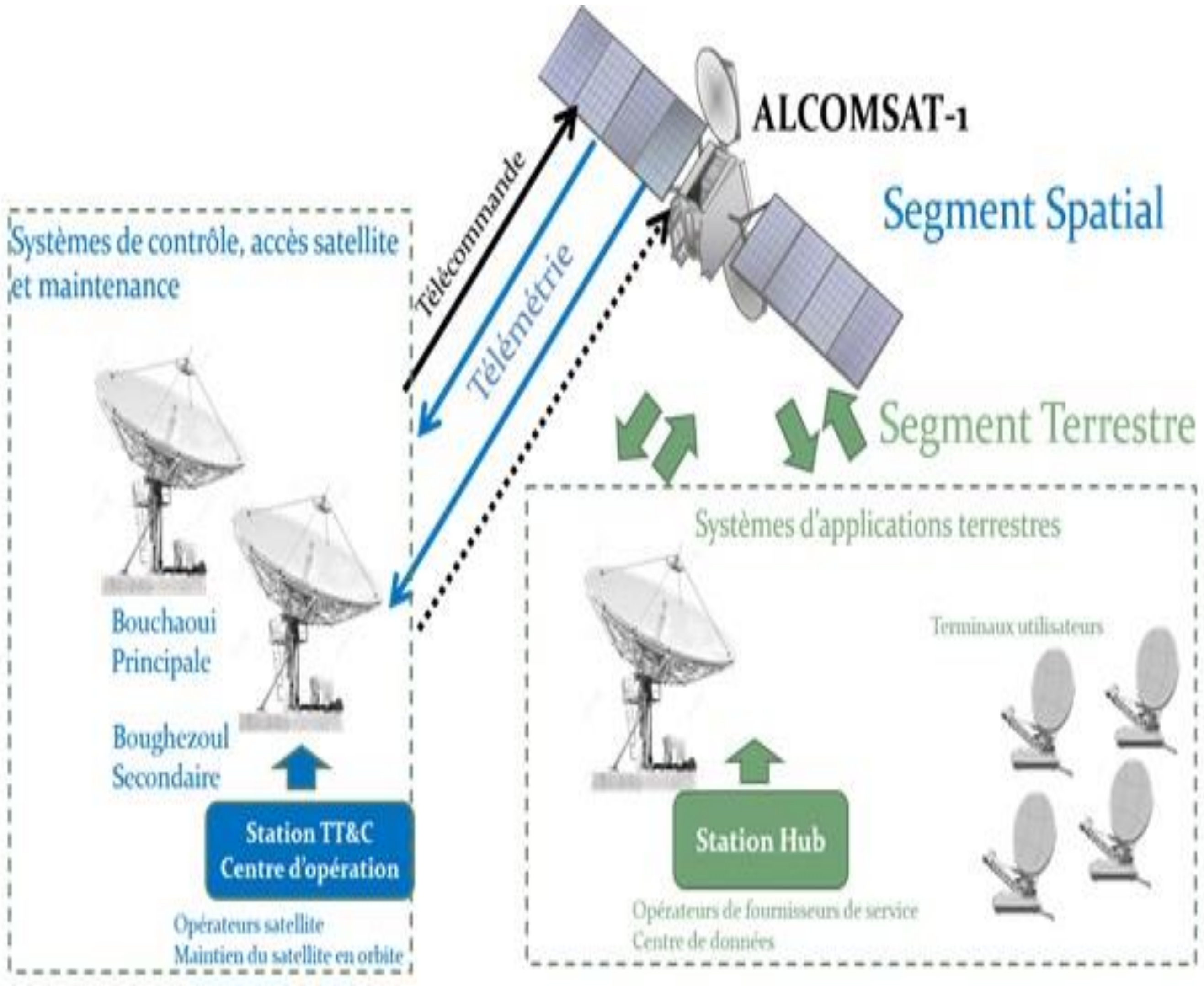
Alcomsat-1 communications satellite

- → **Alcomsat-1** communications satellite was launching on December 11, 2017, and is located at **24.8° W** in a geostationary orbit. The coverage of Alcomsat-1 includes whole Africa, South America and part of Europe.
- → **Alcomsat-1** is equipped with 33 transponders, including L1 & L5 signals navigation augmentation, the other bands are Ku and Ka.

Overview of the Alcomsat-1 satellite

Alcomsat-1 Telecommunications Control and Exploitation Centre

Alcomsat-1 satellite communication system



Alcomsat-1 satellite system control and operating engineers.

Alcomsat-1 services and applications

1- Broadcasting service

Ku Bande(BSS) : 9 transponders

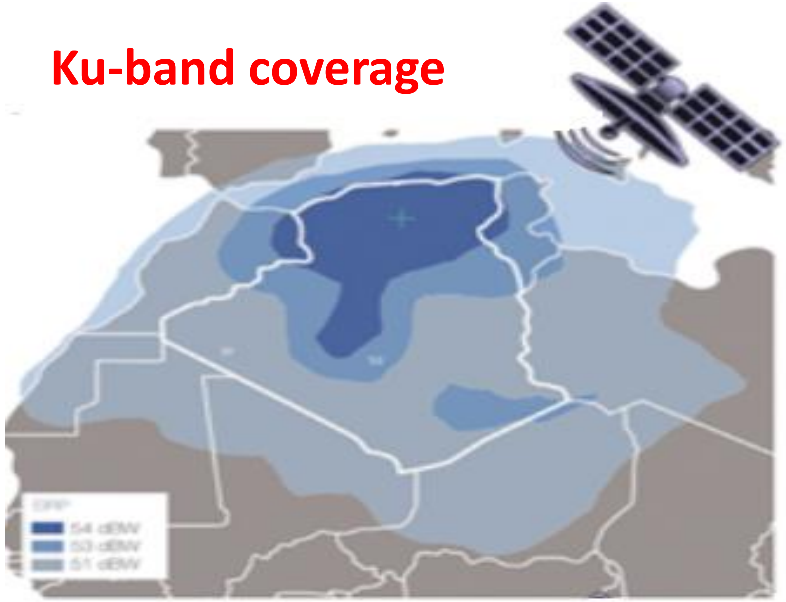
2- Fix service

Ku Bande(FSS): 10 transponders

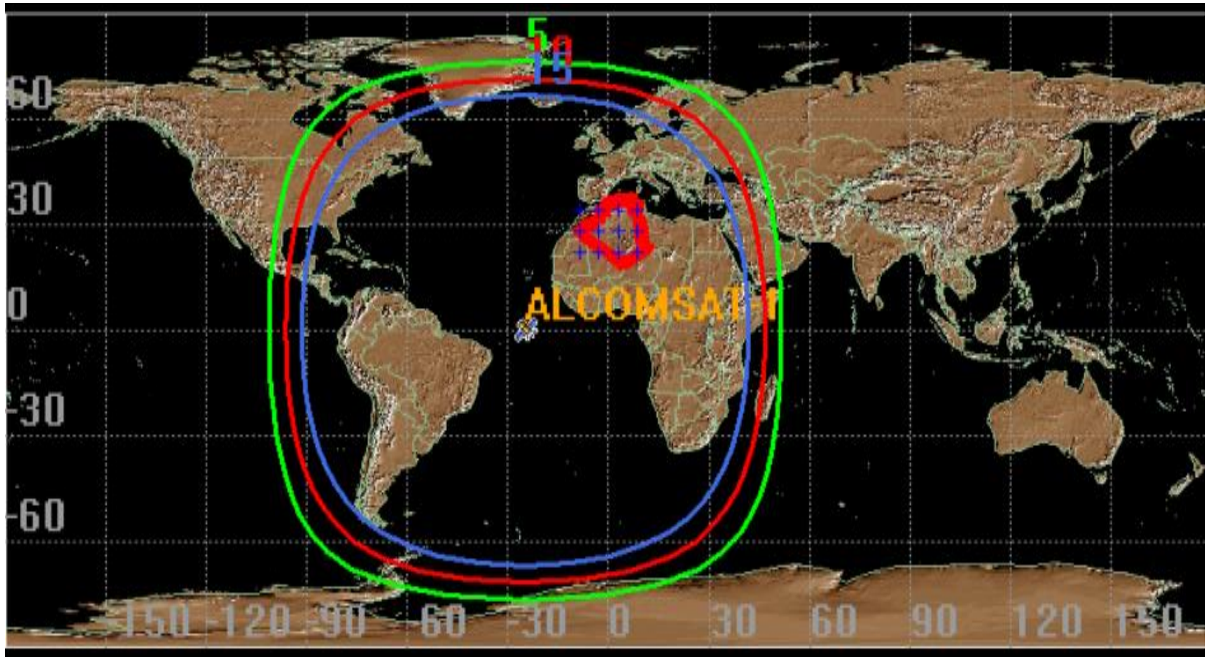
3- Fixed high bandwidth service

Ka Bande(FSS): 10 transponders

Ku-band coverage



Ka-band coverage



4 - SBAS service: L Bande (2 transponders)

- C1/L1 band (Tx : 6695.42 – 6699.42 MHz
  Rx : 1573.42 – 1577.42 MHz)
- C5/L5 band (Tx : 6630.45 – 6650.45 MHz
  Rx : 1166.45 – 1186.45 MHz)

AL-SBAS Code PRN for SBAS

AL-SBAS has been assigned by the U.S. Space Force PRN codes, **namely PRN148:** codes are required for the broadcast through the GEO satellites of the SBAS signal-in-space.

In October 2020, Nigerian SBAS (NSAS: Nigerian Satellite Augmentation System) exists with **code PRN 147** (orbit slot at 42.5° E), but in June 2021 this code is assigned to ASECNA (orbit slots at 5° W and 45° E) with another **code PRN 120**.

June 2021 Edition

L1 C/A PRN CODE ASSIGNMENTS

PRN Code Number	G2 Delay (Chips)	Initial G2 Setting (Octal)[i]	First 10 Chips (Octal)[i]	PRN Allocations System (Satellite)	Orbital Slot	Effective Through (Month Year)
145	211	1560	0217	Unallocated	---	---
146	121	0035	1742	Unallocated	---	---
147	118	0355	1422	ASECNA (A-SBAS)	5 W -45 E	**Nov 2024**
148	163	0335	1442	ASAL (ALCOMSAT-1)	24.8 W	Jan 2022
149	628	1254	0523	Unallocated	---	---
150	853	1041	0736	EGNOS	---	**May 2031**
151	484	0142	1635	Unallocated	---	---
152	289	1641	0136	Unallocated	---	---
153	811	1504	0273	Unallocated	---	---
154	202	0751	1026	Unallocated	---	---
155	1021	1774	0003	Unallocated	---	---
156	463	0107	1670	Unallocated	---	---
157	568	1153	0624	Unallocated	---	---
158	904	1542	0235	Unallocated	---	---

https://www.gps.gov/technical/prn-codes/L1-CA-PRN-code-assignments-2021-Jun.pdf

PRN codes 120-158 are designated for use by SBASs compliant with ICAO Standards and Recommended Practices (SARPs)

AL-SBAS Code PRN for SBAS

Here are the PRN assignment for each SBAS system in the June 2021 version, these systems are included, although some are not currently operational (***https://www.gps.gov/technical/prn-codes/L1-CA-PRN-code-assignments-2021-Jun.pdf)*** :

ASAL (Algeria) – Algerian Space Agency **→ PRN 148**
ASECNA (Africa & Indian Ocean) – Agency for Aerial Navigation Safety in Africa and Madagascar → PRN 120 and **147**

EGNOS (Europe) – European Geostationary Navigation Overlay Service → PRN 121, 123, 126, 136,150

BDSBAS (China) – BeiDou Satellite-Based Augmentation System → PRN 130, 143, 144
GAGAN (India)– GPS-Aided Geo-Augmented Navigation → PRN 127,128, 132

KASS (Korea) – Korean Augmentation Satellite System → PRN 134
MSAS (Japan)– Michibiki Satellite Augmentation System → PRN 129, 137, 139
SDCM (Russia) – System of Differential Correction and Monitoring → PRN 125, 140, 141

SPAN (Australia and New Zealand) – Southern Positioning Augmentation Network (AUS-NZ) → PRN 122
WAAS (United States) – Wide Area Augmentation System → PRN 131,133, 135, 138

Algeria through its Algerian Space Agency (ASAL) is developing ”The Algerian Satellite Augmentation System (AL-SBAS)” in collaboration with China (SSTC). The overall AL-SBAS service delivery strategy is to meet user needs with an incremental approach in terms of coverage and performance, while considering scalability to the next generations (Multi Frequency and Constellation).

Code PRN for SBAS

PRN codes 120-158 are designated for use by SBASs compliant with ICAO Standards and Recommended Practices (SARPs). Applicants requesting PRNs 120-158 must meet the following requirements **(https://www.gps.gov/technical/prn-codes/).**

1. SBAS Service Provider ID. The subject system must be recognized by the ICAO Navigation Systems Panel (NSP) as an Operational or Planned SBAS. The ICAO SBAS Service Provider ID must be indicated on the application.

2, Letter from Civil Aviation Authority. The applicant must submit a letter from the Civil Aviation Authority (CAA) or Aviation Safety Body confirming compliance with ICAO SARPs.

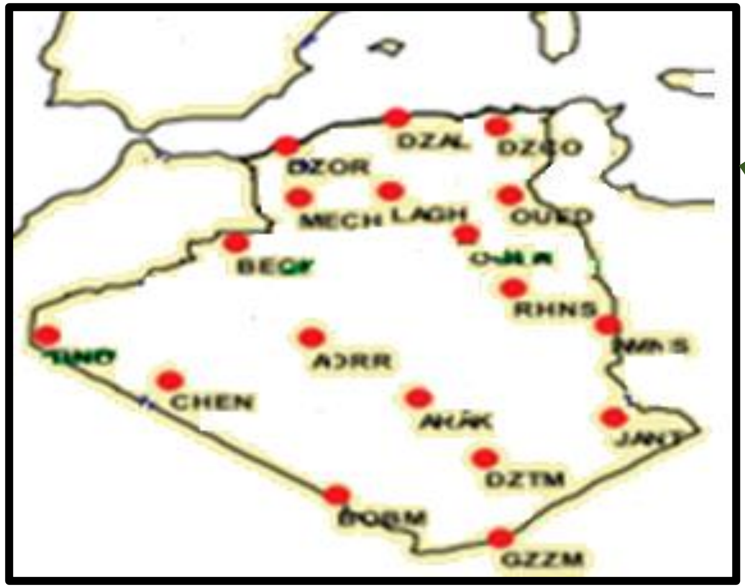
For Temporary assignments, the letter must include the expected date of operational service for certified aviation. For Final assignments, the letter must include confirmation that the system is operational and certified for aviation.

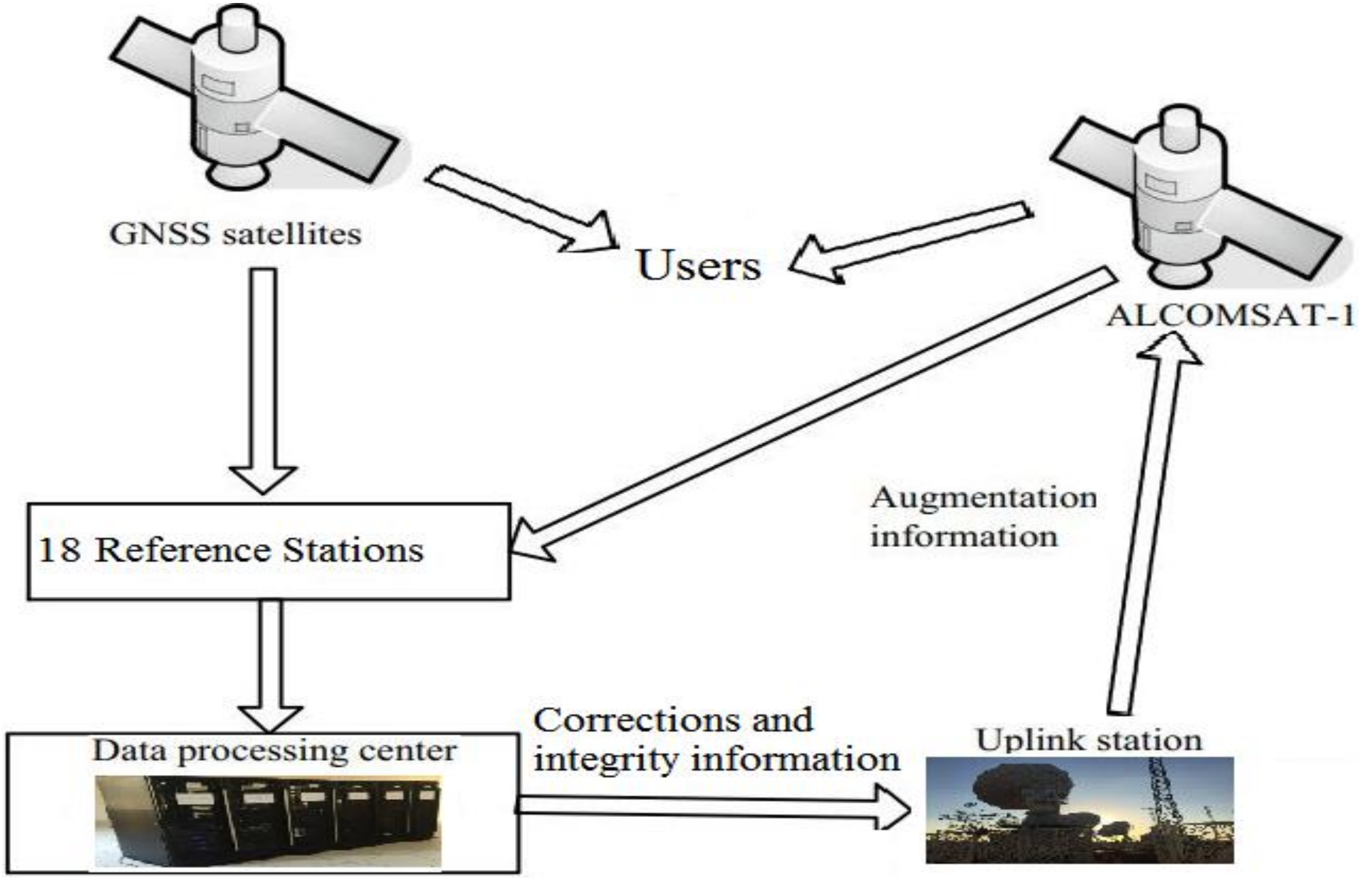
Note: The requesting or endorsing CAA may reside in a different state from where the SBAS service provider is licensed in accordance with respective national regulations.

Architecture and function of AL-SBAS

AL-SBAS :

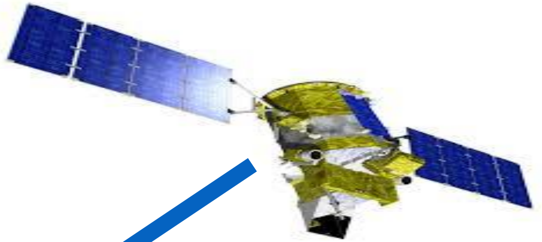
- **18** ground Reference Stations (RS),
- 03 Augmented Reference Stations (ARS),
- 01 Data Process Center (DPC),
- 01 Ground UpLink Station (GULS),
- Alcomsat-1 navigation transponders,
- User terminals.

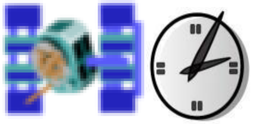




The AL-SBAS system architecture is defined, and the preliminary design of the system is completed in compliance.

AL-SBAS Corrections





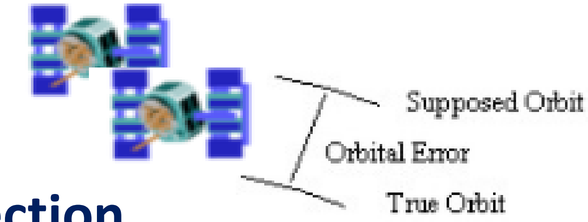
Clock Correction

- Same contribution to any user location;
- Not a function of location;
- Fast Correction **(FC).**

Ionospheric Correction

- Function of user location;
- Up to 100 meters;
- Vertical structure is modelled as a thin shell;
- Ionospheric Correction **(IC).**

L1



Orbit Correction

- Different contribution to different user location;
- Not a function of user location; but a function of line-of-sight direction;
- Long-Term Correction **(LTC).**

Ionosphere

$$l_{corr}(t) = l_{mes}(t) + RC_{fast}(t) + RC_{clock}(t) - RC_{iono}(t) + RC_{tropo}(t)$$

FC, LTC and IC are calculated from AL-SBAS transmitted messages.

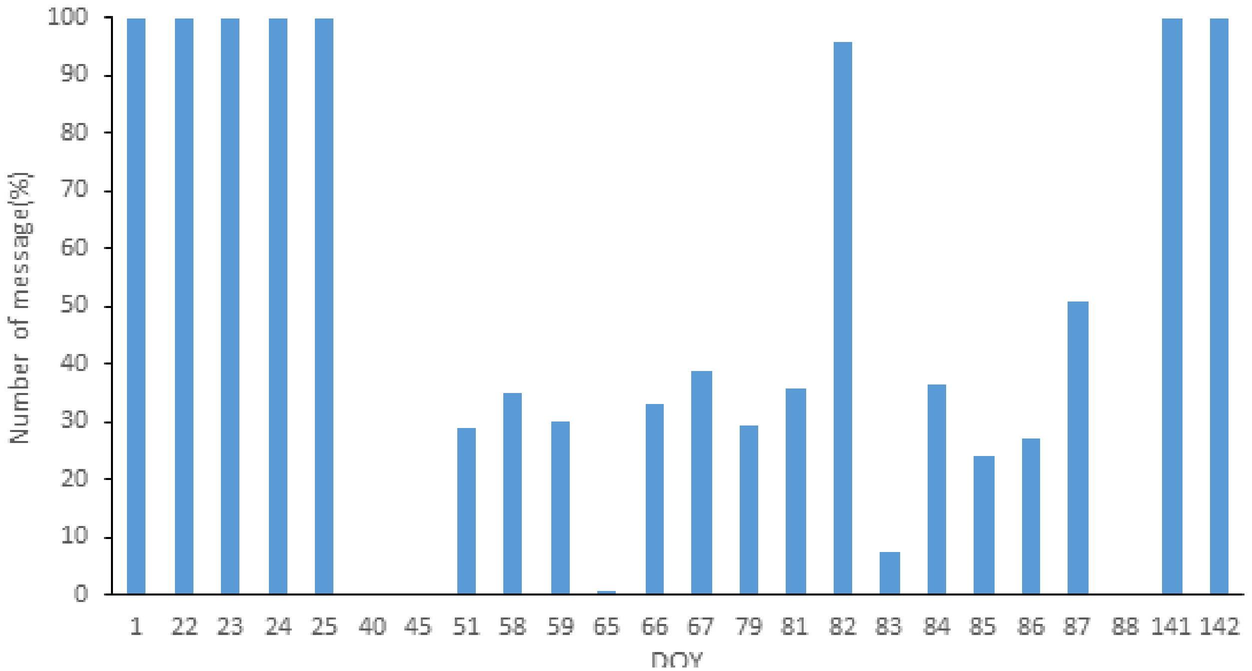
Tropospheric Correction: Corrected by a fixed model (Tropospheric Correction; **TC**).

- Function of user location, especially height of user;
- Up to 20 meters.

AL-SBAS transmission

The test transmission of AL-SBAS with a PRN 148 on Alcomsat-1 geostationary satellite was starting **in July 20, 2020.**

→ In test period, AL-SBAS transmission is not permanently available for each day and during daytime **until 21 may 2021 (day 142).**



Availability and number of messages transmitted by AL-SBAS (DOY 2021). The Histogram is based on data from DPC (and CNES site)

REPUBLIQUE ALGERIENNE DEMOCRATIQUE ET POPULAIRE

AGENCE NATIONALE DES FREQUENCES

DIRECTION GENERALE

الوكالة الوطنية للذبذبات
Agence Nationale des Fréquences

الجمهورية الجزائرية الديمقراطية الشعبية

الوكالة الوطنية للذبذبات

المديرية العامة

Réf N° : 6954 DG/ANF/2019 .... : المرجع

Alger, le 19 SEP 2019 الجزائر، في

To **All administrations on the list provided by the BR per 11 a) of the Terms of Reference adopted by Resolution 609 (Rev. WRC-07) Consultation Meeting**

Cc **Director, Radiocommunication Bureau, ITU**

Subject: Submission of Information for Alcomsat-24.8W satellite network.

Reference: Resolution 609 (Rev. WRC-07) Consultation Meeting Terms of Reference (MOD, Geneva, September 2011).

Alcomsat-24.8W is an Algerian GSO satellite network located at 24.8W, which was successfully launched on December 11th, 2017 and was brought into use on December 18th, 2017.

Alcomsat-24.8W is occupying one active navigation channel in the band 1164 – 1215 MHz for SBAS for GPS. The transponder operating in this band is still under test and the expected time for it to be operational is by mid-2020. The test of the ground application system is almost accomplished and requires for its completeness the availability of the whole necessary ground reference stations in the service area in Algeria.

Best regards.

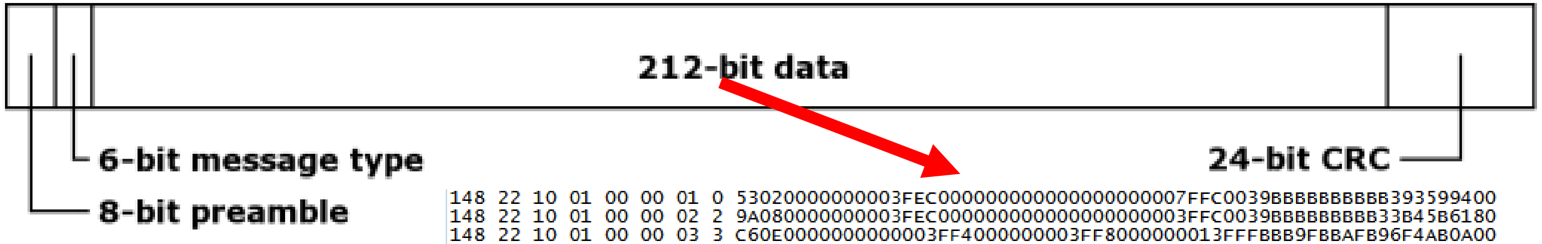
Directeur Général de l'Agence Nationale des Fréquences

Sid Ahmed MESBAH

04, Bd Krim Belkacem, les sept merveilles - BP 146 - 16000 ☎ 021 719 206 021 718 693 / Site Web : www.anf.dz

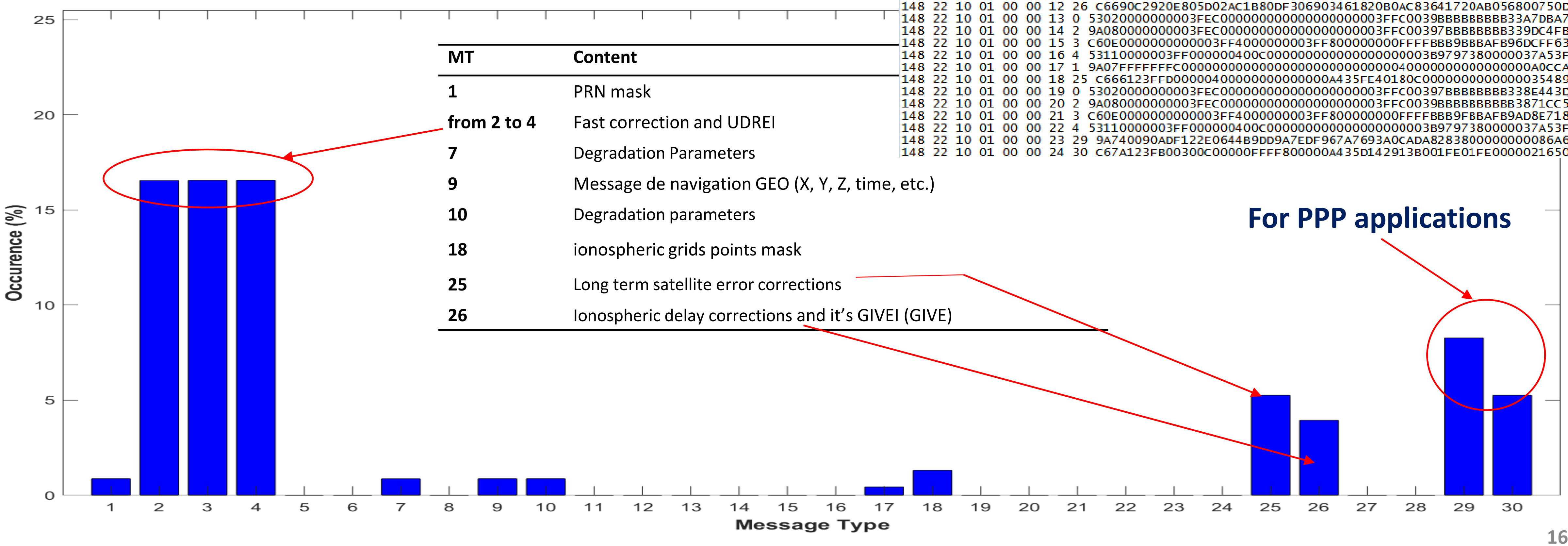
AL-SBAS Signal-in-Space : Structure & message types

Navigation augmentation information compiling: L1 of AL-SBAS coding is based **on RTCA -DO-229**; AL-SBAS transmit a navigation message containing 250 bits of information.




```
148 22 10 01 00 00 01 0  53020000000003FEC00000000000000000000007FFC0039BBBBBBBBB393599400
148 22 10 01 00 00 02 2  9A080000000003FEC00000000000000000000003FFC0039BBBBBBBBB33B45B6180
148 22 10 01 00 00 03 3  C60E0000000000003FF4000000003FF800000013FFFBBB9FBBAFB96F4AB0A00
148 22 10 01 00 00 04 4  53110000003FF000000800C000000000000000000003B979738000000D39CCC0
148 22 10 01 00 00 05 26 9A690431812C06602B415A0AF28F107461A22C0C503AC1980CC06E8038A2CEC0
148 22 10 01 00 00 06 26 C6690801E58E2068BB043414A06C83281B80DD06F95F483A30C1050003723CC0
148 22 10 01 00 00 07 0  53020000000003FEC00000000000000000000003FFC0039BBBBBBBBB33A7DBA740
148 22 10 01 00 00 08 2  9A080000000003FEC00000000000000000000003FFC0039BBBBBBBBB33B45B6180
148 22 10 01 00 00 09 3  C60E0000000000003FF4000000003FF800000013FFFBBB9FBBAFB96F4AB0A00
148 22 10 01 00 00 10 4  53110000003FF000000800C000000000000000000003B979738000000D39CCC0
148 22 10 01 00 00 11 29 9A7400A0ADED22EB644B1DD9C7EE0967A0693A0CAE082860BA4200000CEB7040
148 22 10 01 00 00 12 26 C6690C2920E805D02AC1B80DF306903461820B0AC83641720AB056800750D480
148 22 10 01 00 00 13 0  53020000000003FEC00000000000000000000003FFC0039BBBBBBBBB33A7DBA740
148 22 10 01 00 00 14 2  9A080000000003FEC00000000000000000000003FFC00397BBBBBBBB339DC4FB00
148 22 10 01 00 00 15 3  C60E0000000000003FF4000000003FF800000000FFFFBBB9BBBAFB96DCFF6340
148 22 10 01 00 00 16 4  53110000003FF000000400C000000000000000000003B97973800000037A53F00
148 22 10 01 00 00 17 1  9A07FFFFFFFC0000000000000000000000000040000000000000000A0CCA00
148 22 10 01 00 00 18 25 C666123FFD00000400000000000000000A435FE40180C00000000000000035489DC0
148 22 10 01 00 00 19 0  53020000000003FEC00000000000000000000003FFC00397BBBBBBBB338E443DC0
148 22 10 01 00 00 20 2  9A080000000003FEC00000000000000000000003FFC0039BBBBBBBBB3871CC580
148 22 10 01 00 00 21 3  C60E0000000000003FF4000000003FF800000000FFFFBBB9FBBAFB9AD8E71840
148 22 10 01 00 00 22 4  53110000003FF000000400C000000000000000000003B97973800000037A53F00
148 22 10 01 00 00 23 29 9A740090ADF122E0644B9DD9A7EDF967A7693A0CADA8283800000000086A6080
148 22 10 01 00 00 24 30 C67A123FB00300C00000FFFF800000A435D142913B001FE01FE000002165028
```

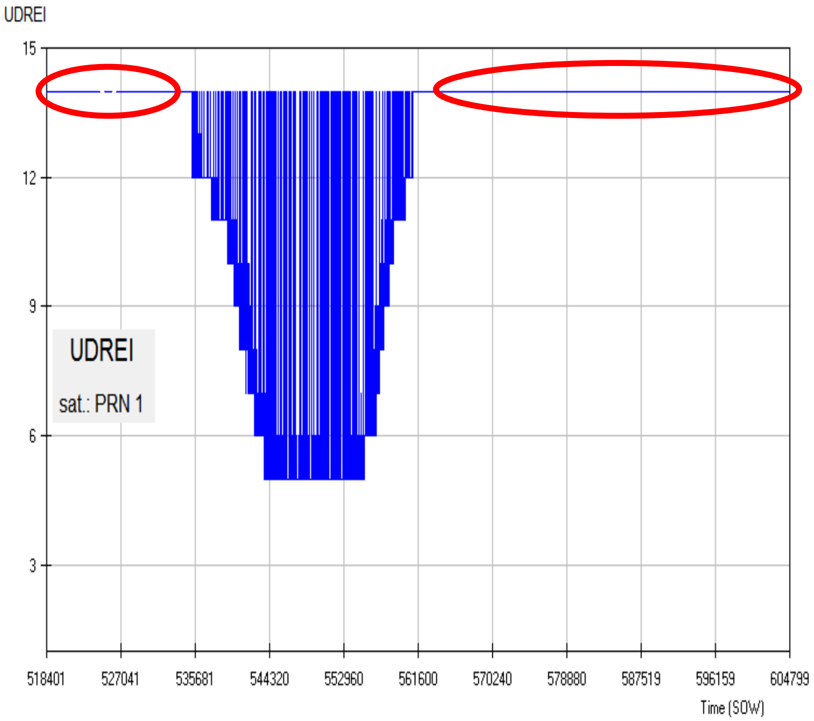
MT	Content
1	PRN mask
from 2 to 4	Fast correction and UDREI
7	Degradation Parameters
9	Message de navigation GEO (X, Y, Z, time, etc.)
10	Degradation parameters
18	ionospheric grids points mask
25	Long term satellite error corrections
26	Ionospheric delay corrections and it's GIVEI (GIVE)

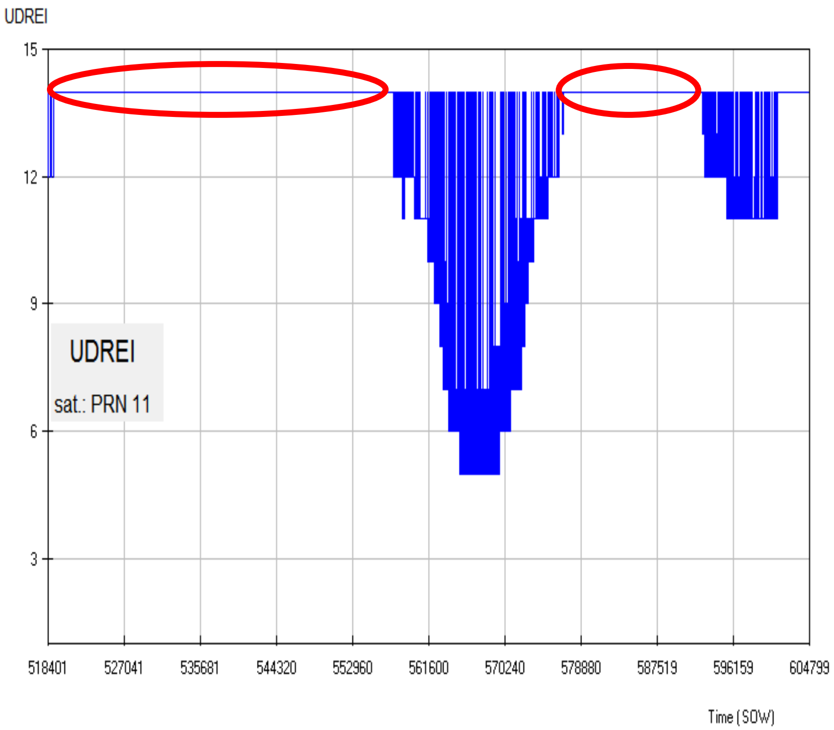


Status of GPS satellites transmited by AL-SBAS

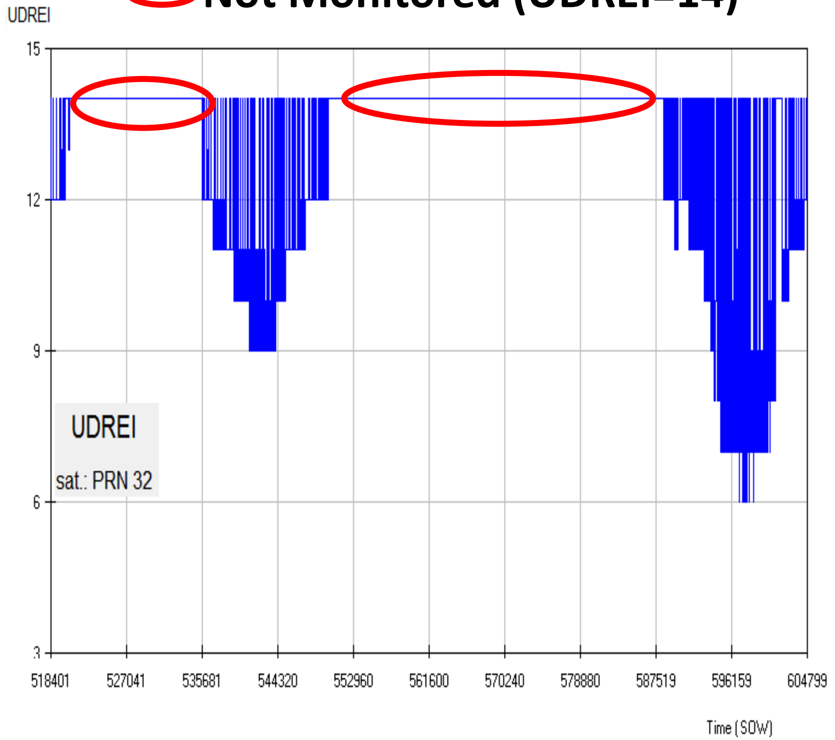
The status of each satellite(User Differential Range Error Indicator)→ (UDREI : 0-15)

- **Use (UDREI = 0 -13)** indicates that the satellite is usable.
- **Not Monitored (UDREI=14)** indicates that the satellite does not appear in the mask or even appearing there are not corrections or UDRE values available for it.
- **Don't Use (UDREI=15)** indicates that an inconsistency has been found for this satellite (alarm situation) or the estimated fast correction is greater than 256.0 m.





Not Monitored (UDREI=14)



Grid Ionospheric points broadcast by AL-SBAS

Index de ftp://serenad-public.cnes.fr/SERENAD0/FROM_NTMFV2/MSG/2022/274/

Vers un rép. de plus haut niveau

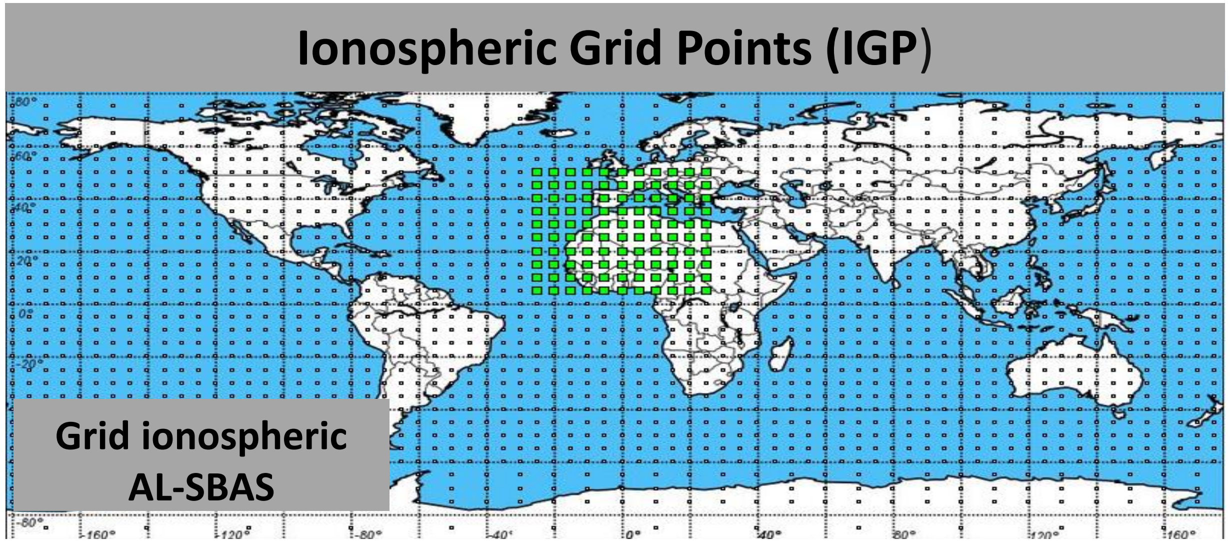
1 October 2022 (doy 274)

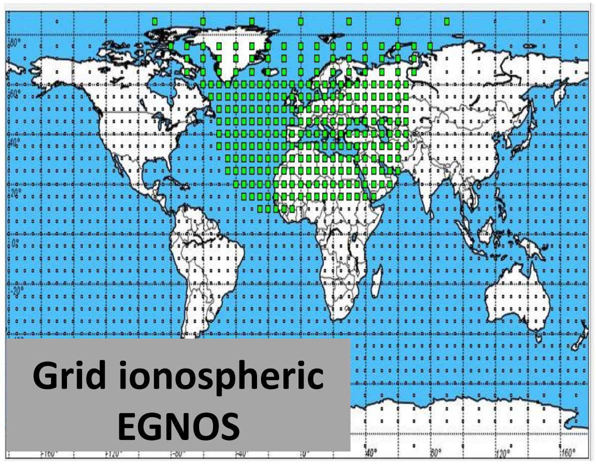
Nom	Taille	Dernière modification	
F1232740.22b.Z	2074 KB	06/10/2022	03:07:00
F1262740.22b.Z	1893 KB	06/10/2022	03:07:00
F1272740.22b.Z	2150 KB	06/10/2022	03:07:00
F1362740.22b.Z	2081 KB	06/10/2022	03:07:00
G1312740.22b.Z	2486 KB	06/10/2022	03:07:00
G1332740.22b.Z	2486 KB	06/10/2022	03:07:00
L1_SBAS-msg-count_221001.txt	1 KB	06/11/2022	03:05:00
L5_SBAS-msg-count_221001.txt	1 KB	06/10/2022	03:07:00
M1222740.22b.Z	2320 KB	06/10/2022	03:07:00
M1232740.22b.Z	2065 KB	06/10/2022	03:07:00
M1262740.22b.Z	1890 KB	06/10/2022	03:07:00
M1272740.22b.Z	2137 KB	06/10/2022	03:07:00
M1282740.22b.Z	2132 KB	06/10/2022	03:07:00
M1302740.22b.Z	1655 KB	06/10/2022	03:07:00
M1312740.22b.Z	2481 KB	06/10/2022	03:07:00
M1322740.22b.Z	1984 KB	06/10/2022	03:07:00
M1332740.22b.Z	2476 KB	06/10/2022	03:07:00
M1352740.22b.Z	2484 KB	06/10/2022	03:07:00
M1362740.22b.Z	2069 KB	06/10/2022	03:07:00
M1372740.22b.Z	1772 KB	06/10/2022	03:07:00
M1402740.22b.Z	2511 KB	06/10/2022	03:07:00
M1412740.22b.Z	2493 KB	06/11/2022	03:05:00
M1432740.22b.Z	1652 KB	06/10/2022	03:07:00
M1442740.22b.Z	1660 KB	06/10/2022	03:07:00
M1482740.22b.Z	1900 KB	06/10/2022	03:07:00
M1582740.22b.Z	2180 KB	06/10/2022	03:07:00
N1222740.22b.Z	34 KB	06/10/2022	03:07:00
N1302740.22b.Z	1434 KB	06/10/2022	03:07:00
N1352740.22b.Z	598 KB	06/10/2022	03:07:00
N1432740.22b.Z	1434 KB	06/10/2022	03:07:00
N1442740.22b.Z	1435 KB	06/10/2022	03:07:00

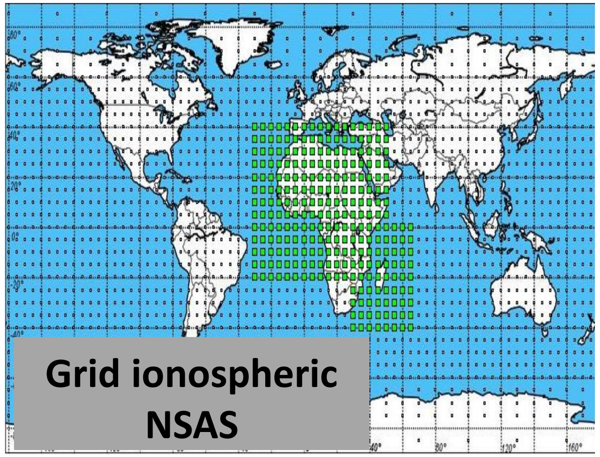
EGNOS

AL-SBAS

Coverage area of AL-SBAS : Algeria → Ionosphere correction: Ø Coverage area: 19°~ 37°N, 9°W~12°E; Ø, Grid resolution: 5°x 5 °.

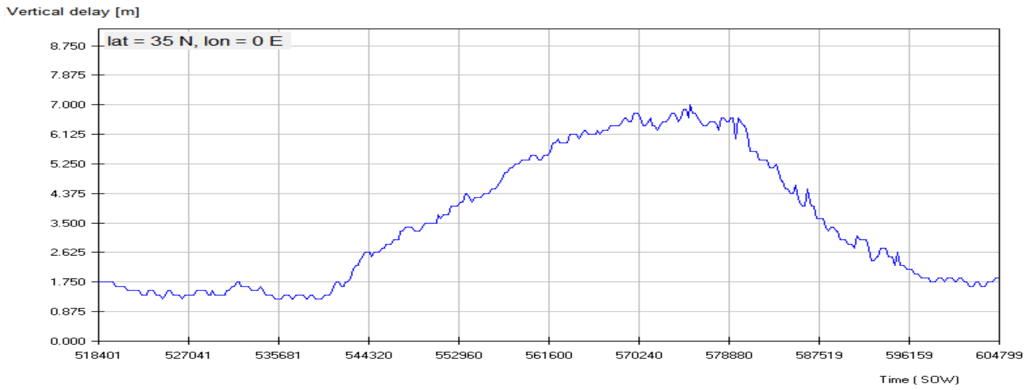


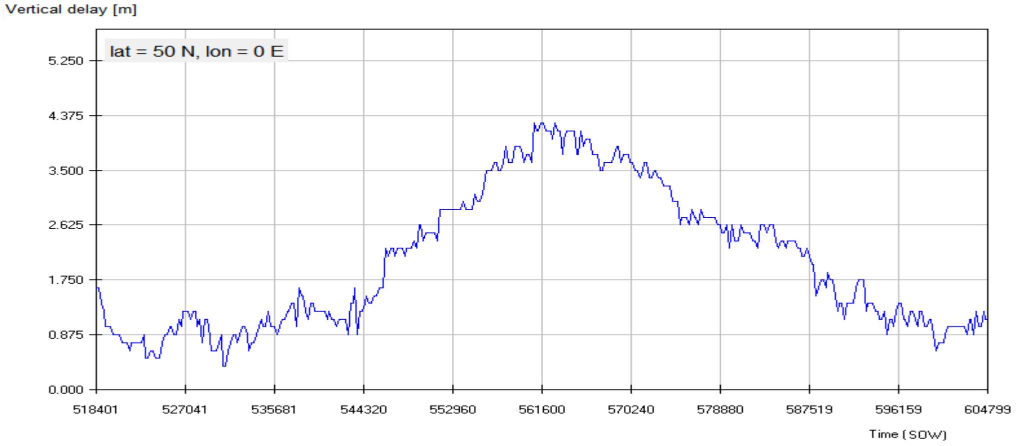


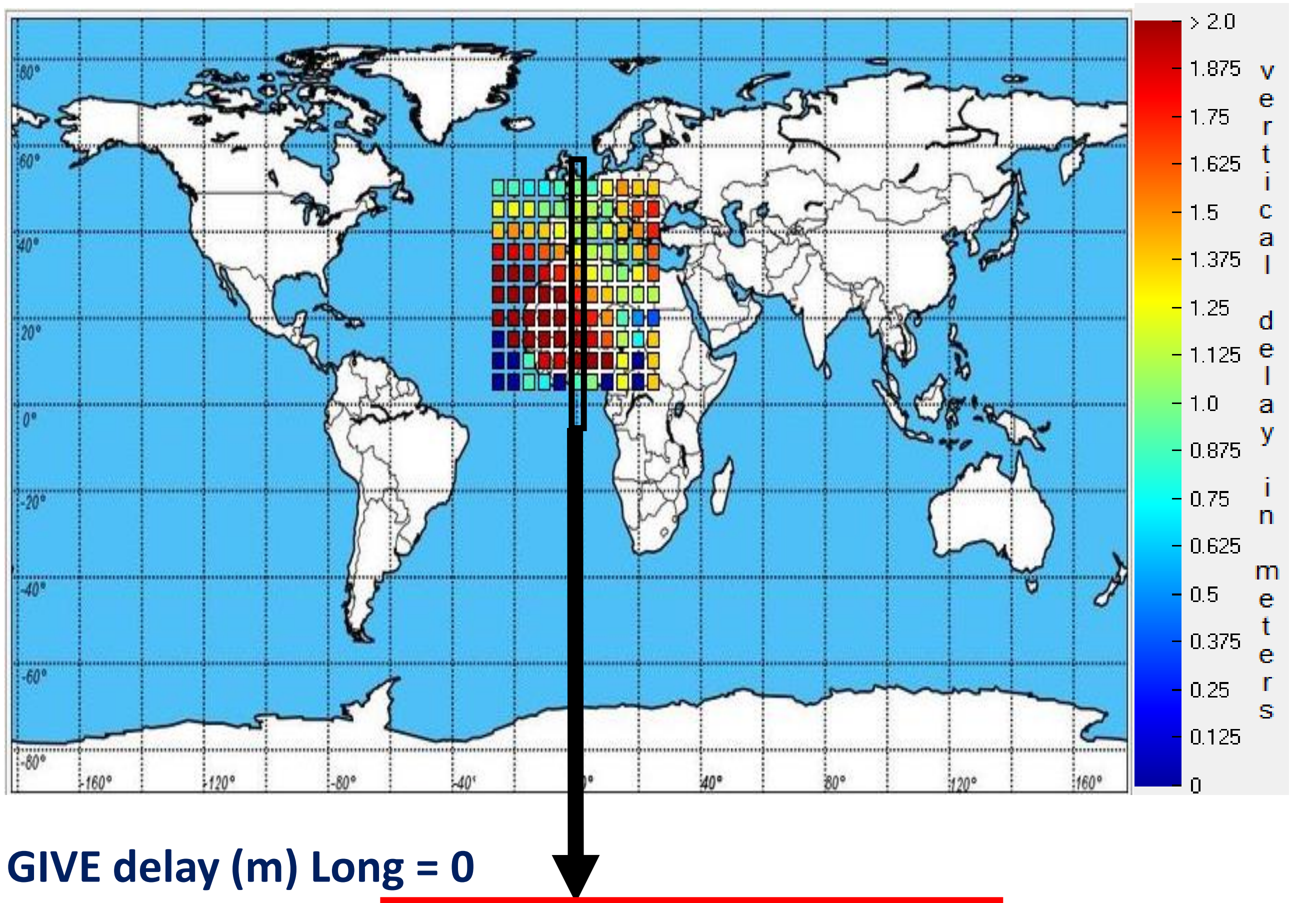


GIVE delay broadcast by AL-SBAS

MT 26 provide the Ionospheric Delay Corrections (GIVD) and their accuracy in terms of GIVEI (GIVE Indicators) for the IGPs that are configured in the mask.







GIVE delay (m) Long = 0

IGP(lat)	50°	45°	40°	35°	30°	25°	20°	15°	10°	5°
Min	0.38	0.75	1.00	1.25	1.38	1.75	1.88	2.13	0.88	0.38
Max	4.25	4.50	5.38	7.00	10.75	14.50	20.50	25.88	23.75	16.88

GIVE : Grid Ionospheric Vertical Error *IGP: Ionospheric Grid Point*

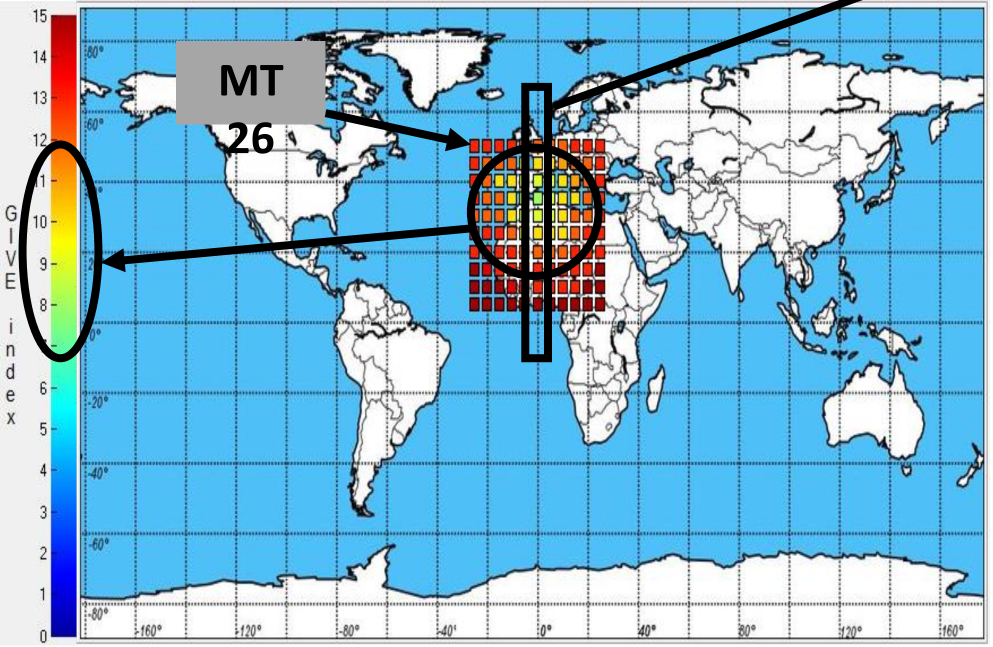
Grid Ionospheric Vertical Error Indicator (GIVEi)

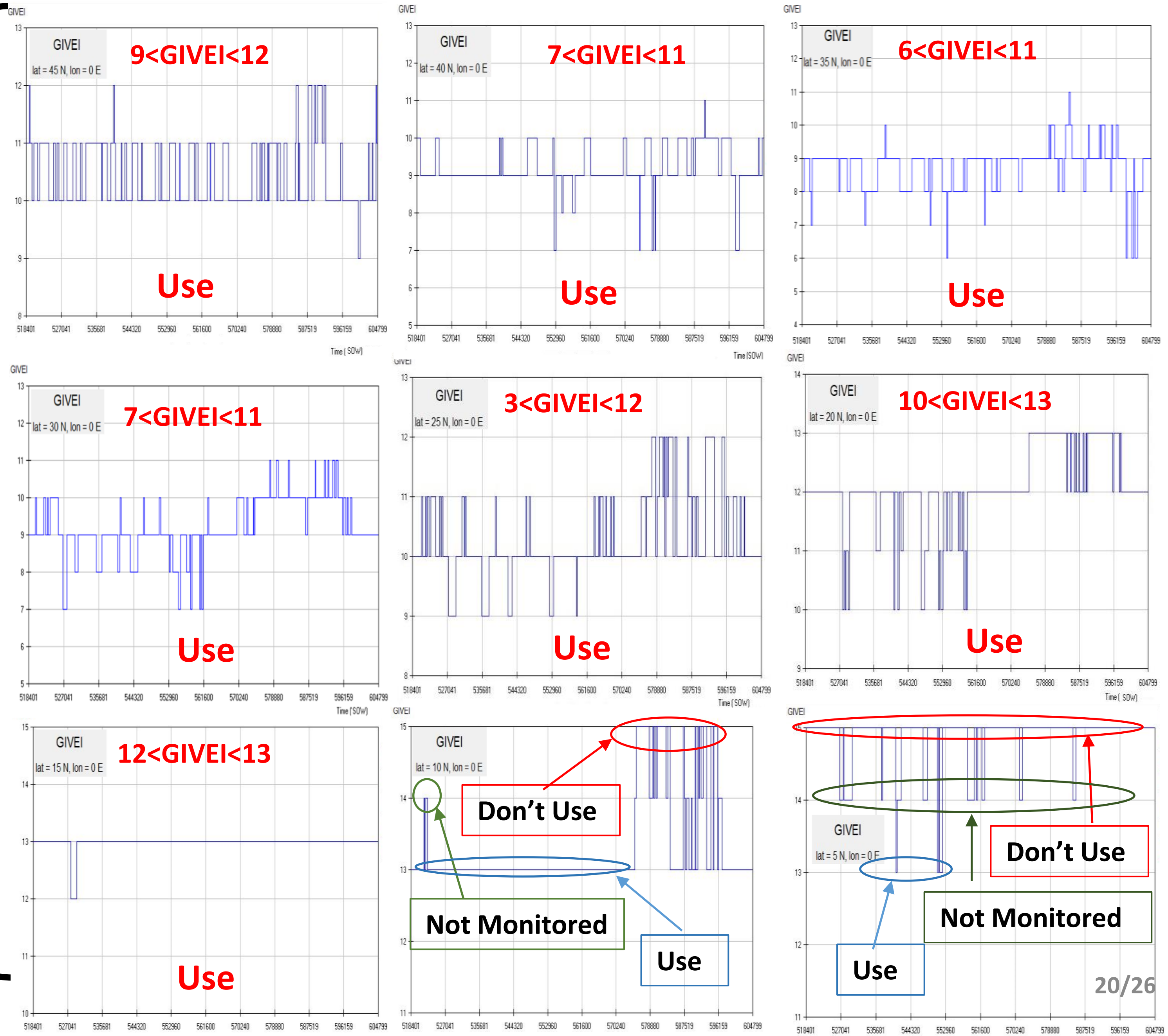
The status of an IGP (GIVEi : 0-15)

- **Use (GIVEI= 0-13):** There are available IGP delay estimate and GIVEI.

- **Not Monitored (GIVEi =14)** : IGP does not appear in mask or even appearing in mask there is not available delay estimate.

- **Don't Use (GIVEi = 15)** : An inconsistency is found for this IGP or the GIVE delay is greater than 63.750 m.

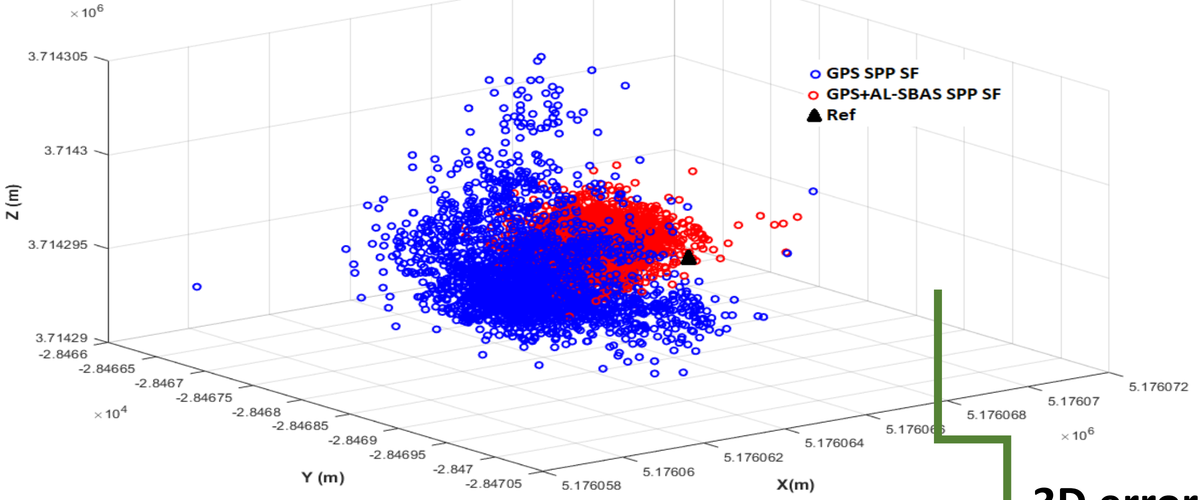




Preliminary performance tests (precision) : October 2022

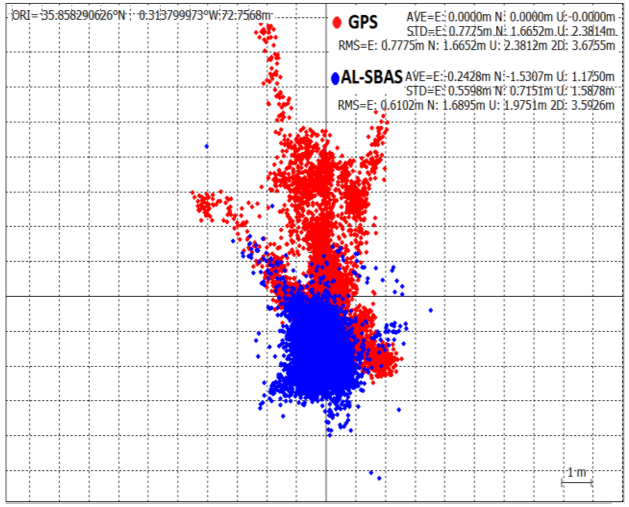
	GNSS	HPE(95°)	VPE(95°)	3D RMS
1 octobre	GPS	9.81	6.21	5.89
	GPS+EGNOS	1.84	1.43	1.55
	GPS+AL-SBAS	2.00	2.91	2.01
2 octobre	GPS	8.47	5.68	5.11
	GPS+EGNOS	1.83	1.43	1.53
	GPS+AL-SBAS	2.05	2.84	1.95
3octobre	GPS	7.49	6.39	5.01
	GPS+EGNOS	1.92	1.52	1.53
	GPS+AL-SBAS	2.22	2.67	1.94
4octobre	GPS	11.65	7.70	7.01
	GPS+EGNOS	1.89	1.54	1.54
	GPS+AL-SBAS	2.41	2.82	2.38
5 octobre	GPS	5.96	6.34	4.64
	GPS+EGNOS	1.69	1.41	1.39
	GPS+AL-SBAS	2.11	2.70	1.89

X, Y and Z coordinates calculated by GPS SPP SF and GPS+AL-SBAS SPP SF (Oran : long = 0.31°W, Lat = 35°N).

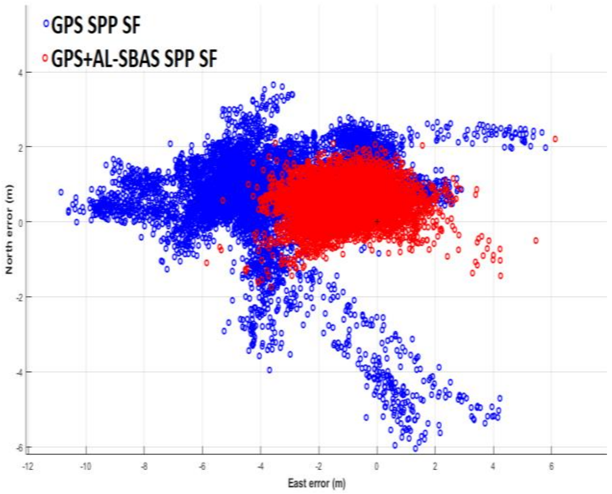


3D error

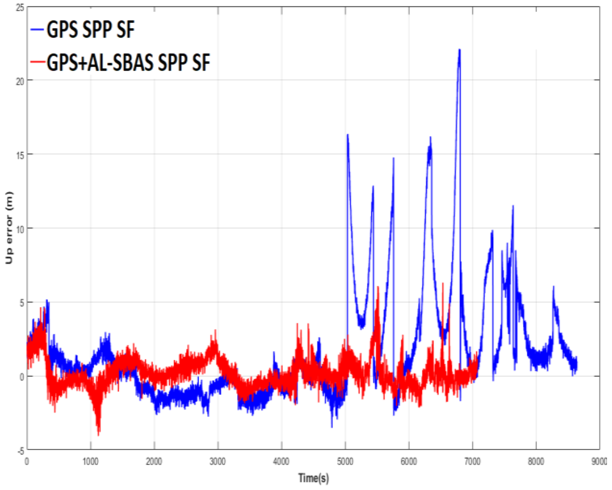
East/North error→ mean

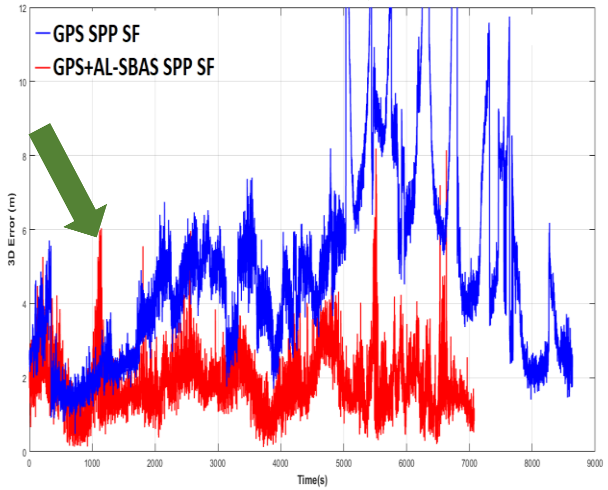


East/North error→ exact position



UP error → exact position





Preliminary performance tests (Integrity) : October 2022

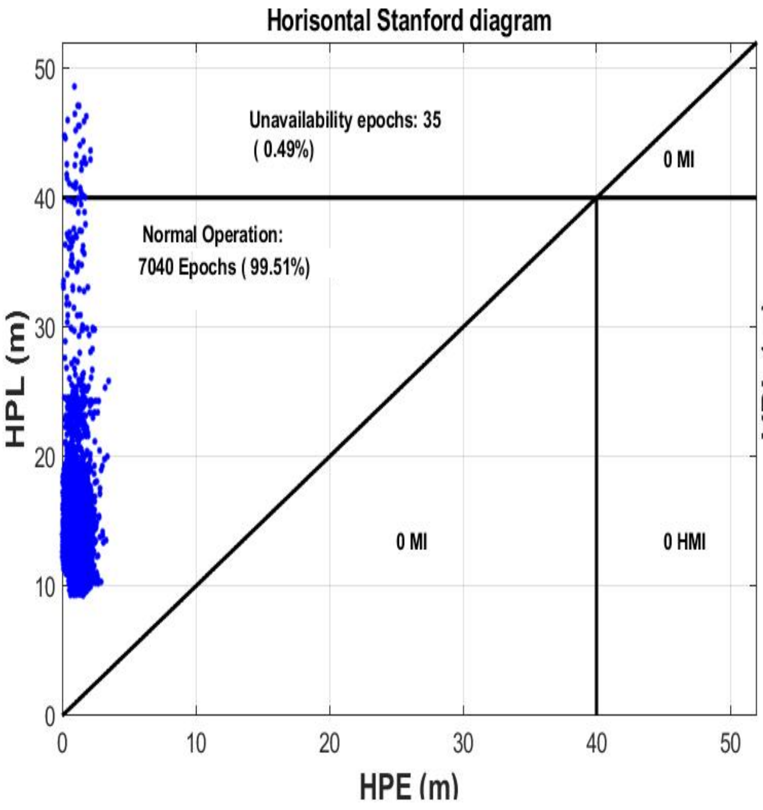
Integrity is an essential concept for safety that comes from the aviation

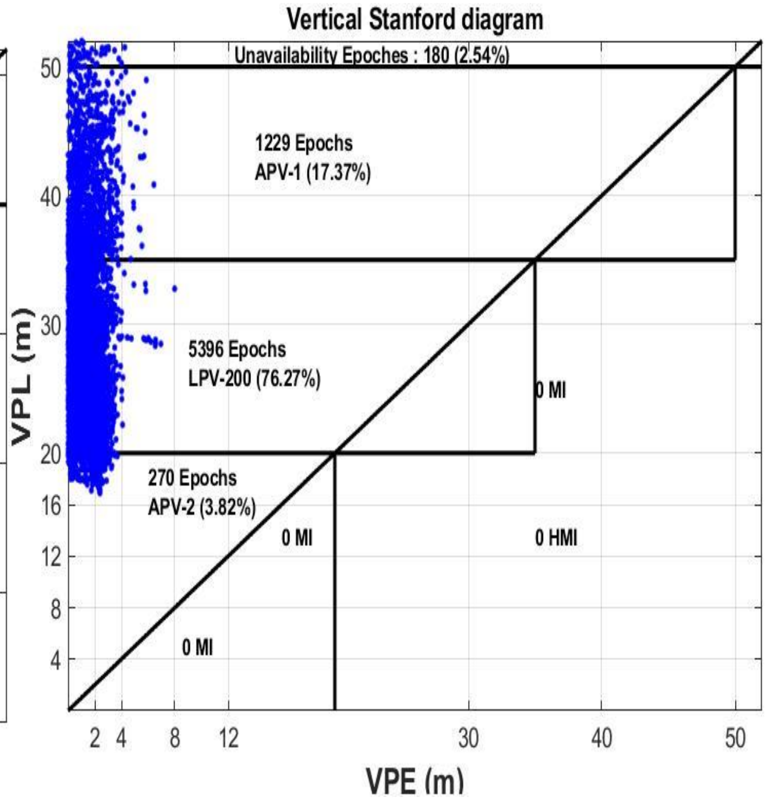
Safety Case of SBAS:

→ In order to ensure complete safety, position error must be protected by the associate PL and PL must be < than AL;

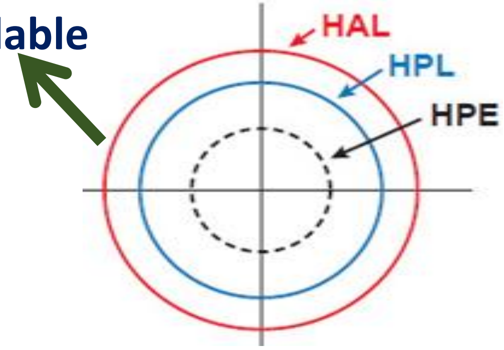
→ ESA proposed this chart; Computing for all possible combinations of visible satellites improves integrity.

Date	GNSS	Availability APV-1
1 octobre	GPS+EGNOS	100 %
	GPS+AL-SBAS	98.49 %
2 octobre	GPS+EGNOS	100 %
	GPS+AL-SBAS	98.19 %
3 octobre	GPS+EGNOS	100 %
	GPS+AL-SBAS	98.17%
4 octobre	GPS+EGNOS	100%
	GPS+AL-SBAS	97.49%
5 octobre	GPS+EGNOS	100 %
	GPS+AL-SBAS	98.05



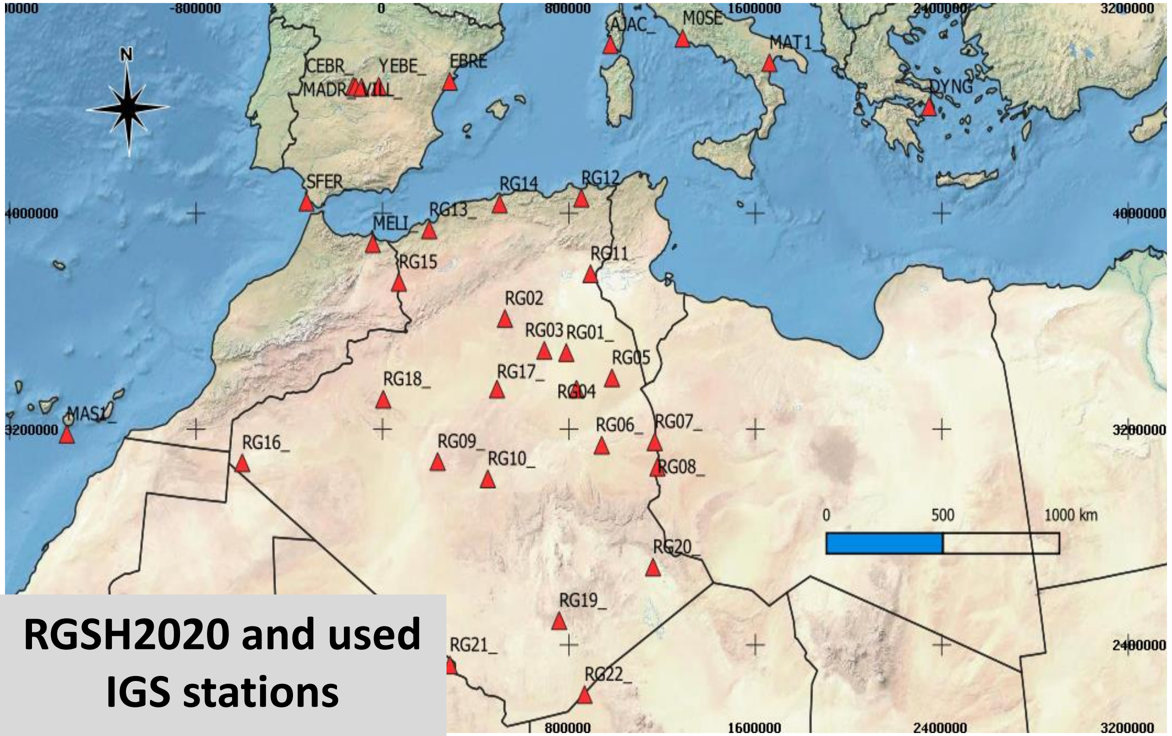


System available



***HPE** : Horizontal Position Error,*
***HPL** : Horizontal Protection Level*
***HAL** : Horizontal Alarm Limit*

Perspective : use Geodetic network (RGSH’2020) to evaluate AL-SBAS



RGSH2020 and used IGS stations

- **22** RGSH’2020 Benchmarks (primary network) covering the Algerian territory (2.4 M km2).
- **16** IGS stations.
- **Baselines :** from **300** km to **1450** km.
- **194** Benchmarks for the **secondary** network : **GPS + GLONASS** observations.
- **02** continuous GPS measurement sessions (3 and 4 days): in February and March **2020** in static mode.
- **05** points among the 22 points are common to both sessions → Guarantee better network consistency.
- Software processing (**Bernese**, TBC, TEQC, etc.)

IGS Quality Indicators :

1. RMS (Root Mean Square) values of individual solutions,
2. Percentage of resolved ambiguities (> 75%),
3. Difference between fixed and float solutions,
4. Repeatability values,
5. Verification of fiducial stations.

IGS Quality Indicators of RGSH’2020 obtained results :

- The RGSH2020 is determined with millimeter accuracy (σ<1 cm) : **Accuracy of horizontal coordinates : Submillimeter, Heights accuracy ≤ 2 mm.**
- Percentage **(%)** of fixed ambiguities **is superior than 76.9.**
- The RGSH2020 is linked to the **IGS14** (≈ITRF14) **reference system** (consistent with the IGS14 at the time of observation : on February 24, 2020).
- Verification of fiducial stations (7 IGS stations) : **rms** (N,E,U) of accepted stations **6 to 8 mm**

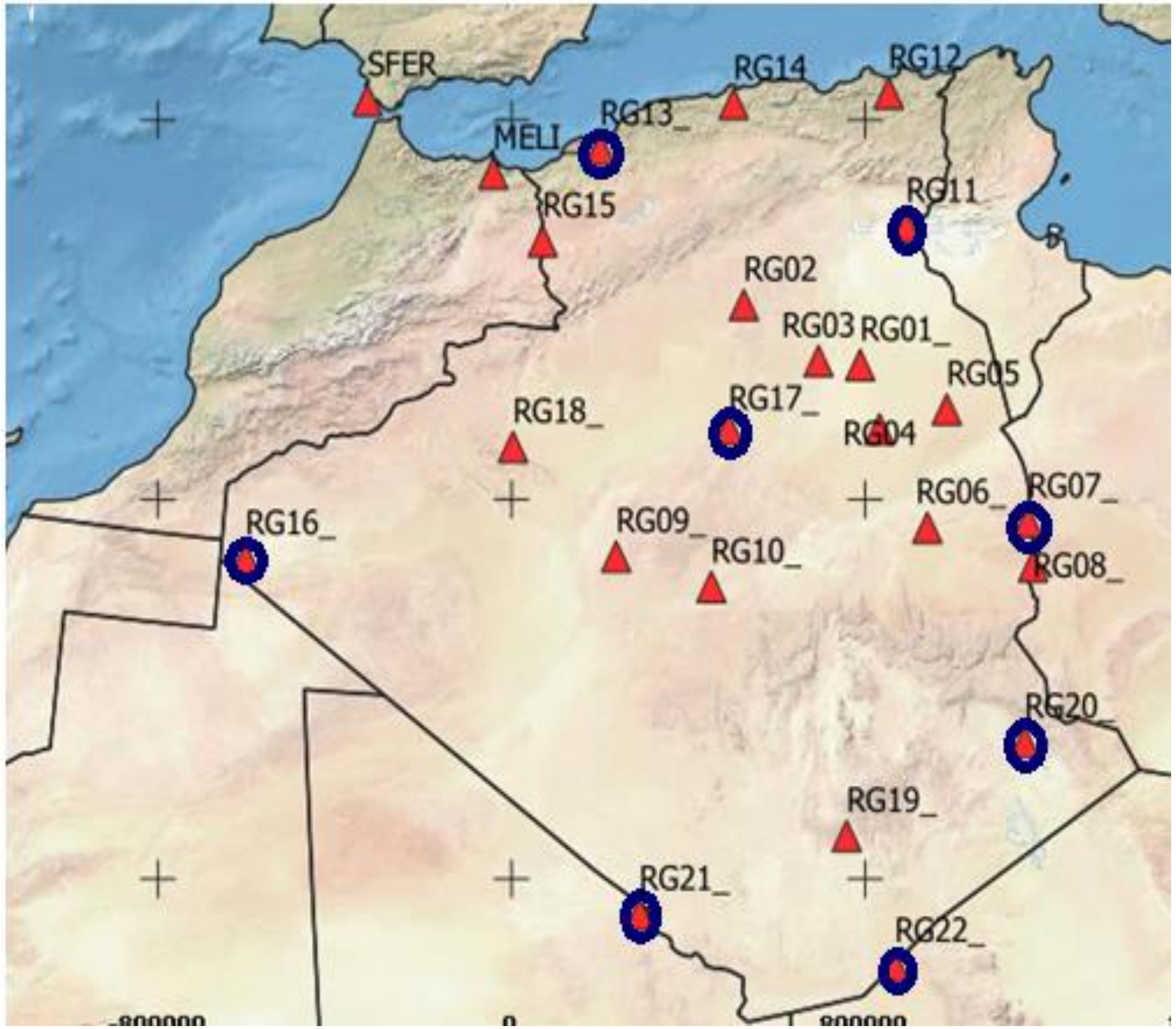
The setting up and the results of the **SONATRACH GEODETIC NETWORK (RGSH’2020)** were presented in the previous *ICG Workshop on the Applications of Global Navigation Satellite Systems* **25 - 29 October 2021, ULAANBAATAR 2021.**

Perspective: Use of Geodetic network (RGSH2020) to evaluate AL-SBAS

→ The protocole of test will serve as an external comparison and validation at the borders of Algeria (worst cases).

The first experimental test of AL-SBAS was conducted on site located at 35° of latitude and based on initial analysis of real data during one-week observation in October 2022.

SSTC receivers



Conclusion

- The current **performance** of Algerian augmentation system based on ALCOMSAT-1 in terms of accuracy, availability and integrity shows a **very promising** results by considering the number of currently available reference stations.

- The encouraging results open the possibility of a better application of the Algerian SBAS corrections. It is recommended to test the availability and the effectiveness of AL-SBAS corrections by using **real time positioning.**

- As a futur work, the final tests will be conducted, considering the **worst cases** of the coverage, at the borders of the country, and the RGSH, to evaluation the real precision of the system at the **boundary** of the actual coverage.

- The system as defined (as the problem of accuracy and integrity is solved), cannot yet be **certified** according to ICAO standard for civil aviation if **redundancy** is not ensured in all phases of project (AL-CORS network, which is also highly redundant; Data transmission (GSM + Internet or VSAT); but also transmission to users (telecommunications satellites).

- Encourage the **cooperation between the African** air navigation services providers to accelerate the SBAS services deployment and provision to meet requirements of the airspace users already interested → Extend the coverage of AL-SBAS system by **adding ALCORS stations in neighbouring** countries (Mali, Niger,....Nigeria) in order to improve the performance of the system.