



AGENCE SPATIALE ALGERIENNE



UNITED NATIONS
Office for Outer Space Affairs

PRESENTATION OF THE ALGERIAN SATELLITE BASED AUGMENTATION SYSTEM

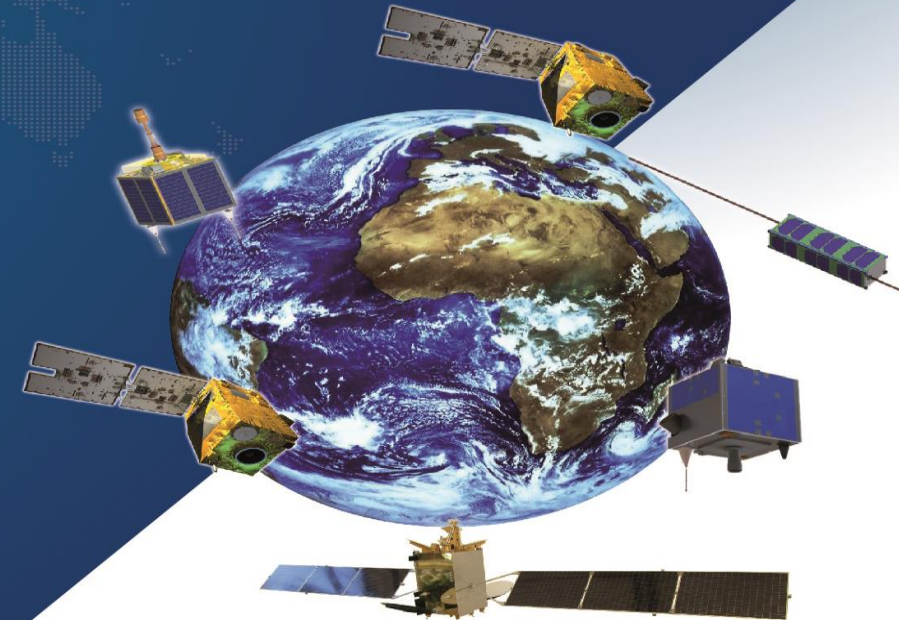
**United Nations/Philippines Workshop on the Applications of Global
Navigation Satellite Systems**

Hosted by

The National Mapping and Resource Information Authority

Manila, the Philippines

22 - 26 April 2024



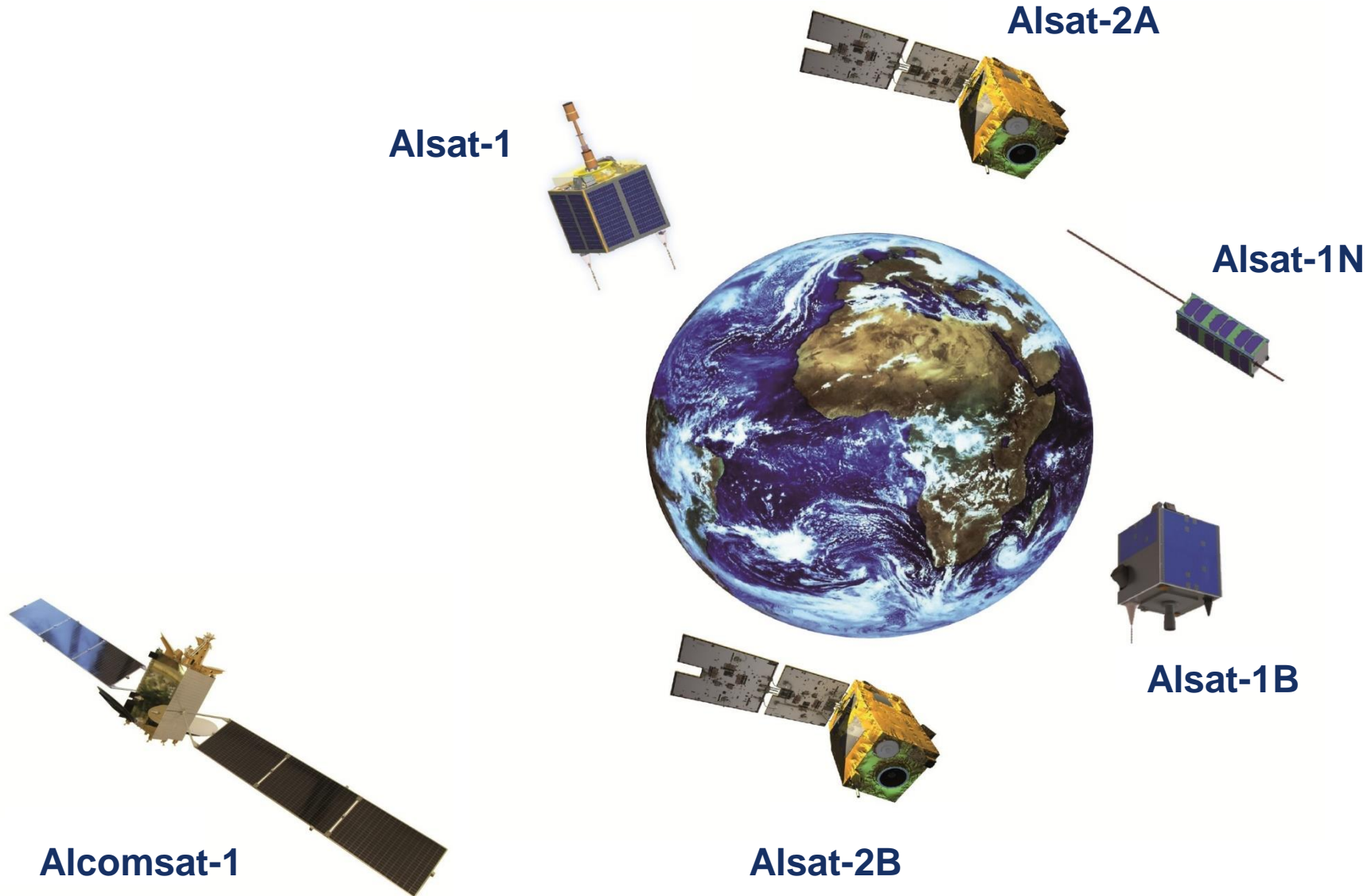


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- ❑ Conclusions & Perspectives
- ❑ Purpose of participation in UNOOSA workshops



Algerian space systems





The first Algerian communication satellite: Alcomsat-1

- ❑ Alcomsat-1 project is part of the Algerian national space program.
- ❑ Alcomsat-1 satellite is operated by the Algerian Space Agency (ASAL), which was launched in December 2017.
- ❑ The satellite is managed by two control and operation centers in Algeria



Service life: 15 years



- ❑ Alcomsat-1 is located at 24.8° W in geostationary orbit.
- ❑ Alcomsat-1 contains 33 transponders → two in L band reserved for AL-SBAS.



The first Algerian communication satellite: Alcomsat-1

- **Multi-Media Broadcasting Service (MMBS):**

- **Ku Band (BSS): 09 transponders**

- ✓ Nine (09) * 36MHz

- **Fixed service :**

- **Ku Band (FSS): 10 transponders**

- ✓ Four (04) * 54MHz and six (6) * 36MHz

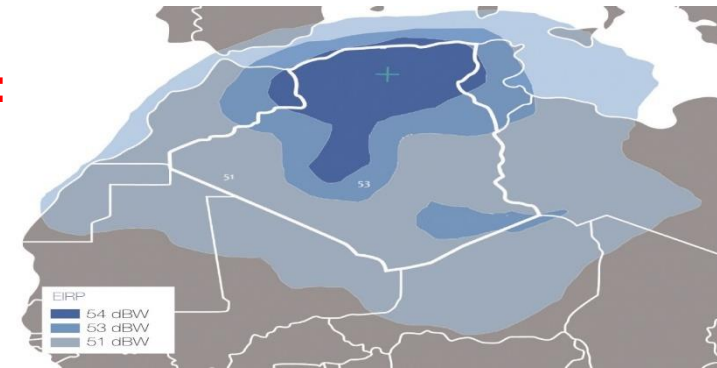
- **Fixed broadband service:**

- **Ka Band (FSS): 10 transponders**

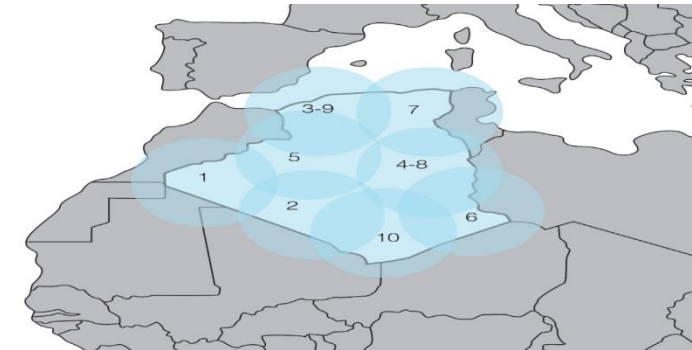
- ✓ Ten (10) * 320MHz

- **L Band (SBAS): 02 transponders**

- ✓ One (1) * 4MHz (L1) et One (1) * 20MHz (L5)



Ku Band Coverage



Ka Band Coverage



L Band Coverage



Solutions and advanced Applications of Alcomsar-1

Backhauling

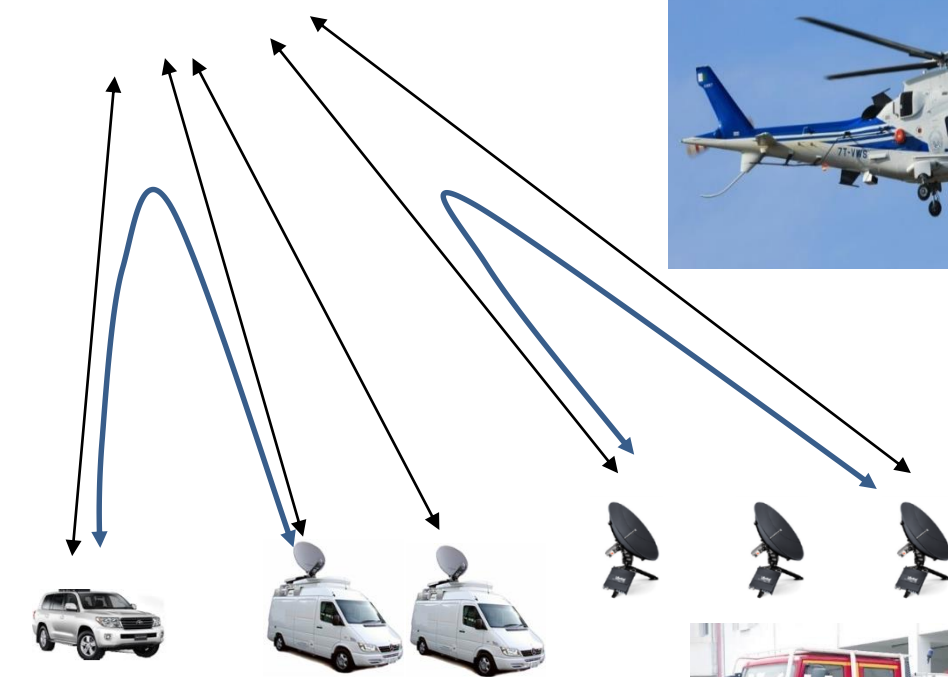
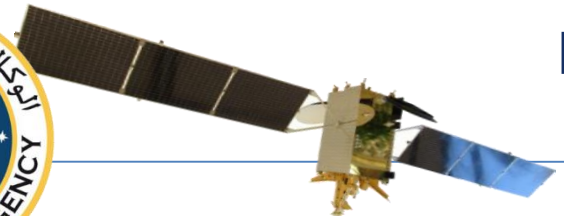
Coverage of isolated regions and areas

ERP
54 dBW
53 dBW
51 dBW

➤ **Videoconference; VoIP ; Data transmission; Messaging; Internet access; Remote monitoring;**

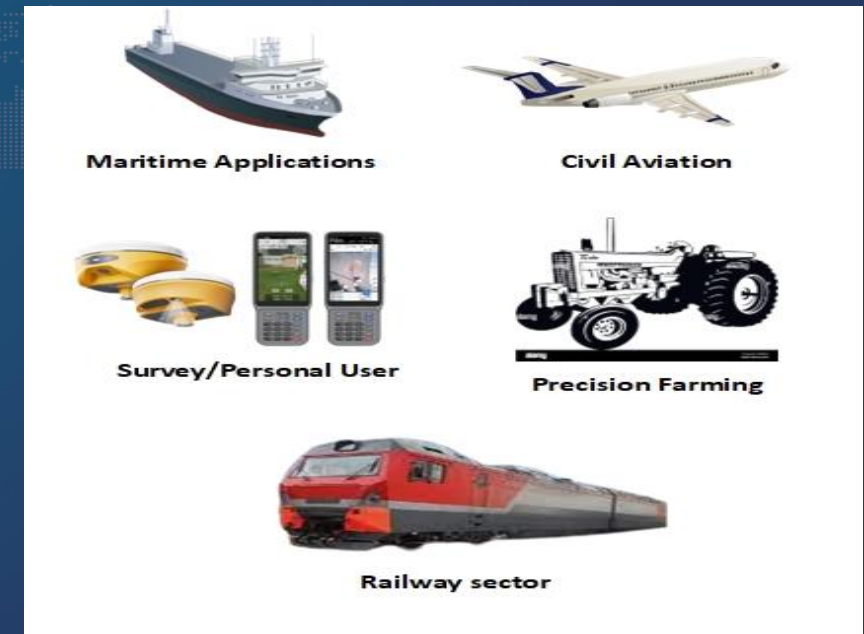
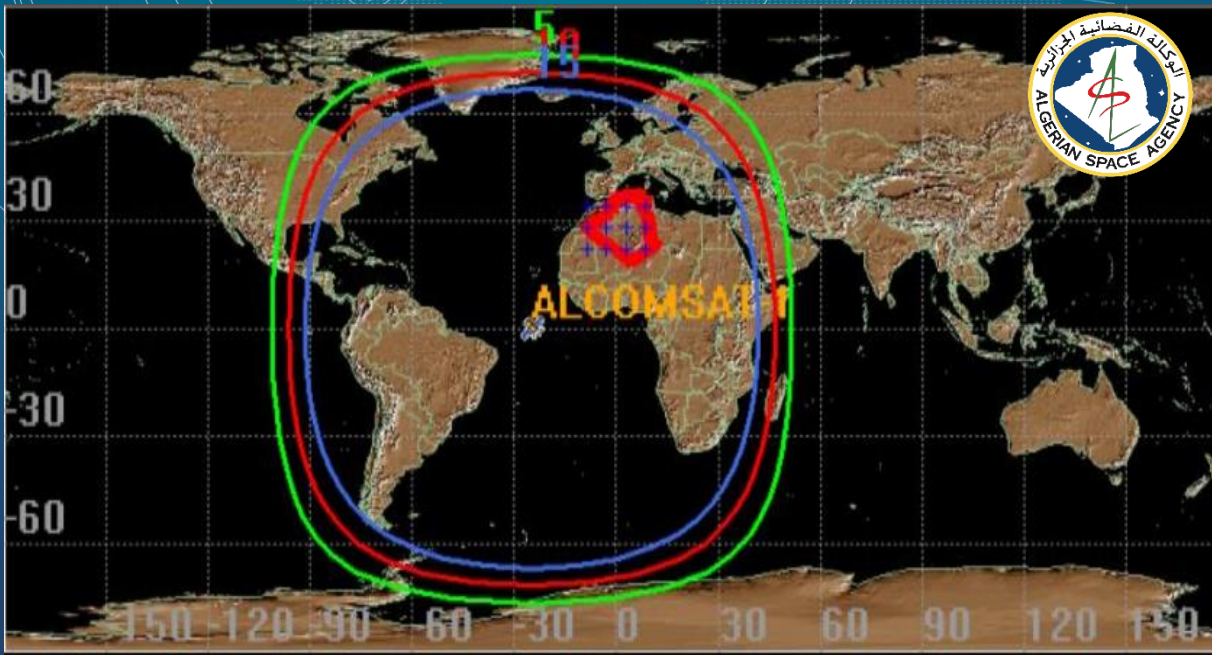


Emergency communications



- The Algerian Space Agency successfully deployed an SBAS payload equipped with L1 and L5 transponders channels on board of Alcomsat-1.

- The primary objective of the AL-SBAS system is to provide SBAS services not only to aviation users but also to various other sectors such as maritime navigation, surveying, transportation, and railways.

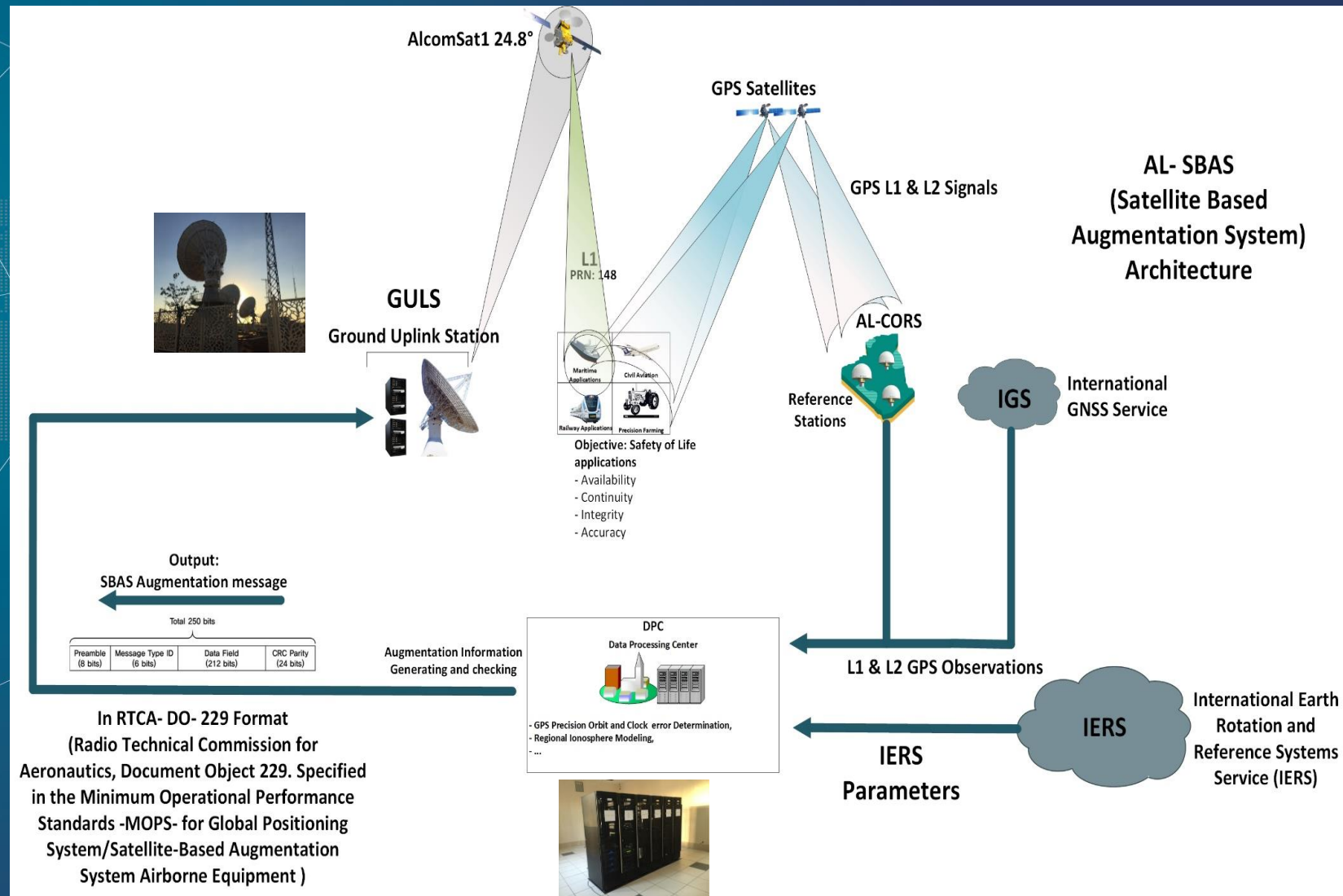




AL-SBAS System architecture

AL-SBAS

- Reference Stations (AL-CORS) are deployed and strategically dispersed across Algeria Country
- 01 Data Processing Centre (DPC), for orbit and clock error determination, regional ionosphere modelling ...etc
- 01 Ground UpLink Station (GULS),
- Alcomsat-1 navigation transponders L1/L5,
- User terminals.





AL-SBAS Messages

AL-SBAS transmit a navigation message containing 250 bits of information  MOPS

Type	Contents
0	Don't use for safety applications
1	PRN mask assignments, set up to 51 of 210 possible
2-5	Fast corrections
6	Integrity information
7	Degradation Parameters
9	Geo Navigation message (X,Y,Z, time, etc.)
10	Degradation parameters
12	SBAS Network time / UTC offset parameters
17	Geo satellite almanacs
18	Ionospheric grid points masks
24	Mixed fast corrections/long term satellite error corrections
25	Long term satellite error corrections
26	Ionospheric delay corrections
27	SBAS Service message
28	Clock Ephemeris Covariance Matrix message
62	Internal test message
63	Null message



AL-SBAS Code PRN

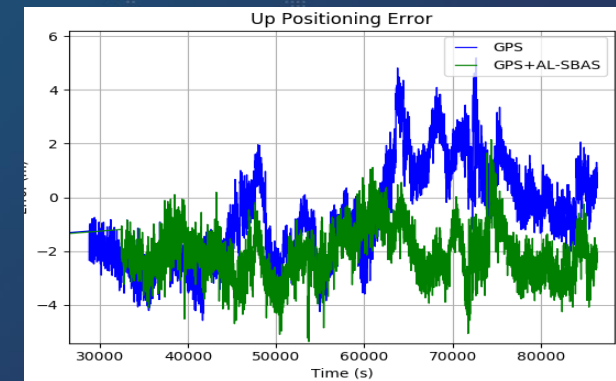
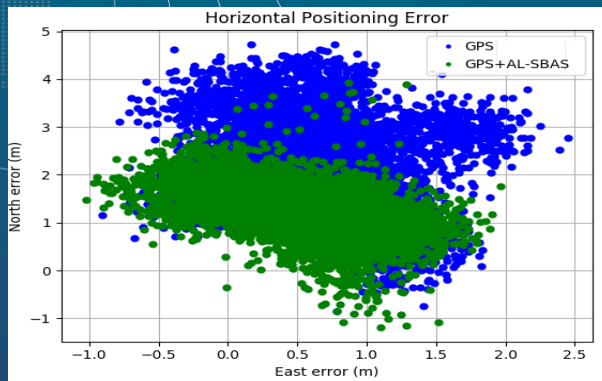
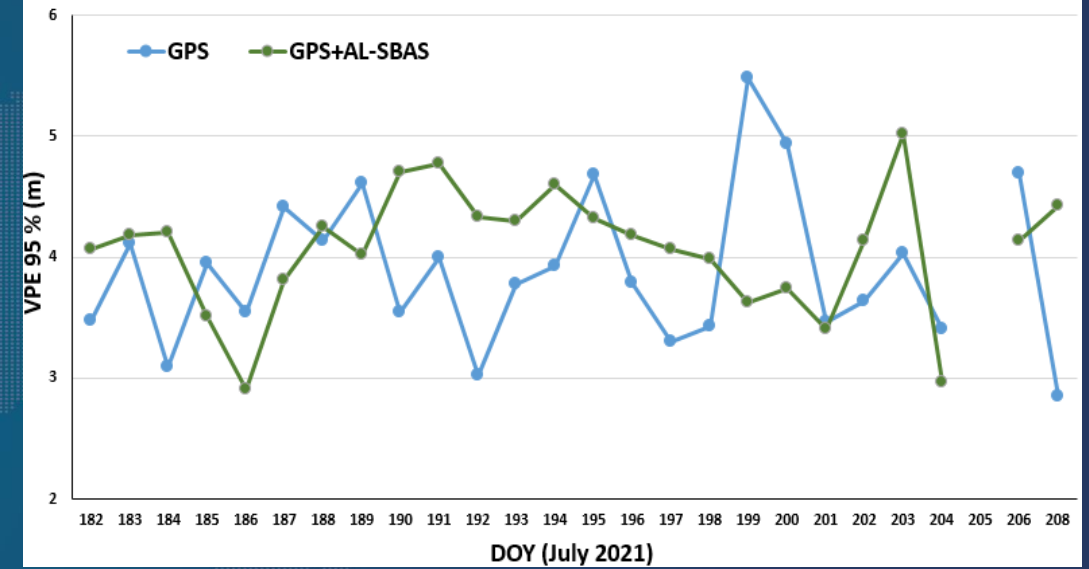
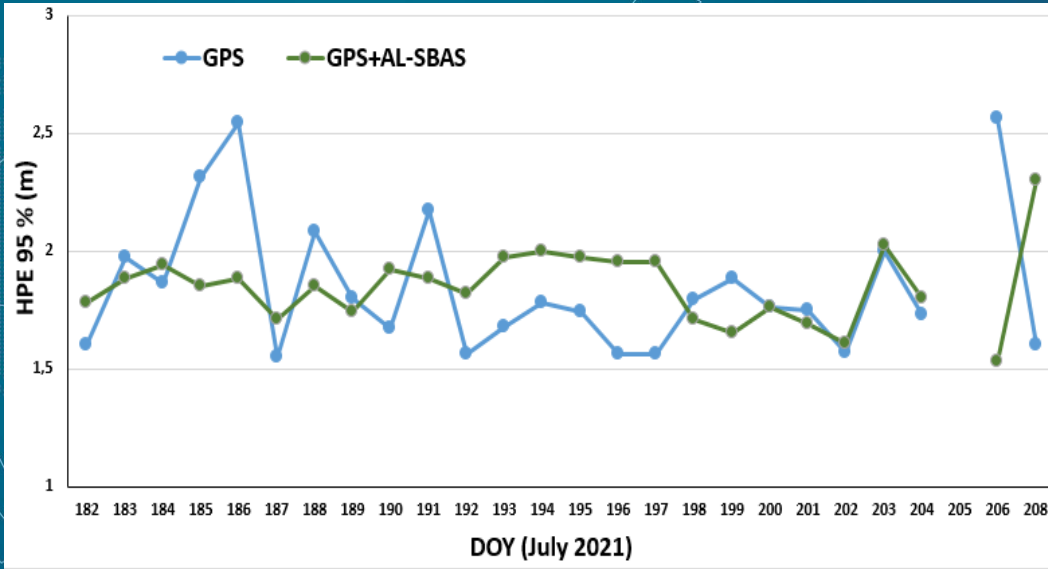
The U.S. Space Force assigned the code PRN 148 for AL-SBAS: this code is used to broadcast the AL-SBAS signal in space (SIS).

PRN code (SBAS Range)	Effective date	Expiry date	Motive	Type of assignment
148	Jan 4, 2018	Jan 4 , 2019	Test and Validation	Temporary assignment
148	Jan, 2019	Jan, 2020	Test and Validation	Temporary assignment
148 (Nov. 2020)	Jan, 2020	Jan, 2021	Test and Validation	Temporary assignment
148	Jan, 2021	Jan, 2022	Test and Validation	Temporary assignment
148	Jan, 2022	Dec 31, 2023	Test and Validation	Temporary assignment
148	Jan, 2024	Dec 31, 2027	Test and Validation	Temporary assignment



AL-SBAS Performance : July 2021

95 percentile position errors for Oran site in north Algeria

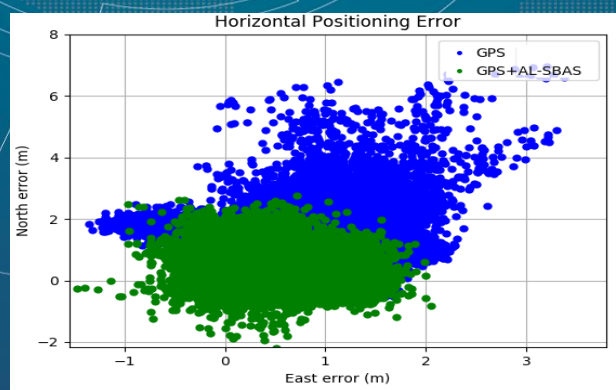
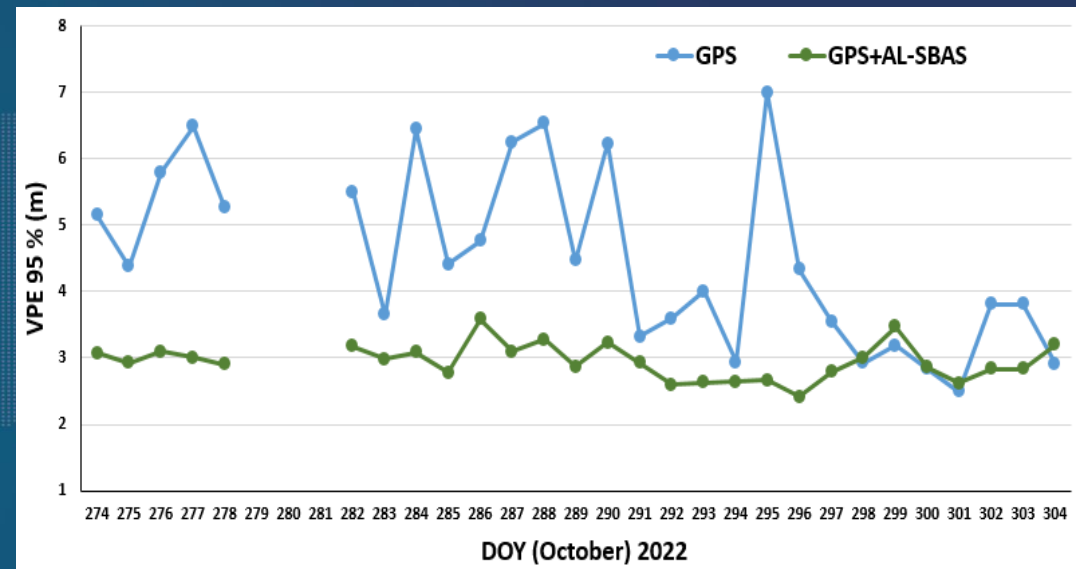
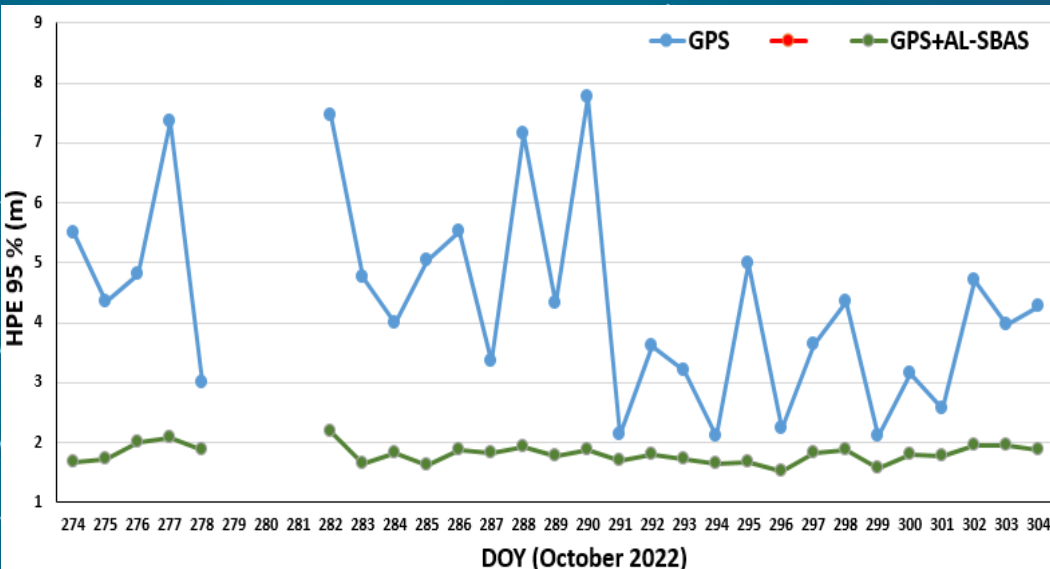


5 July (DOY 186)

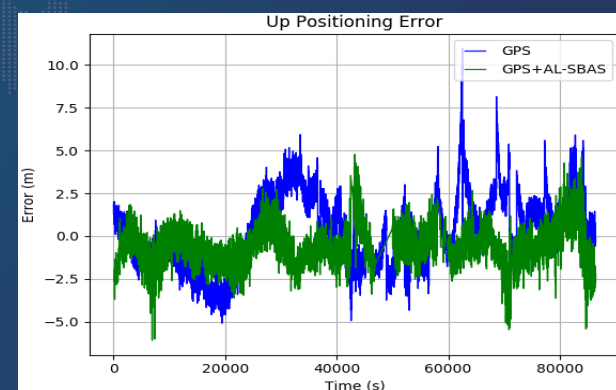


AL-SBAS Performance tests : October 2022

95 percentile position errors for Oran site in north Alegria



23 october (296)



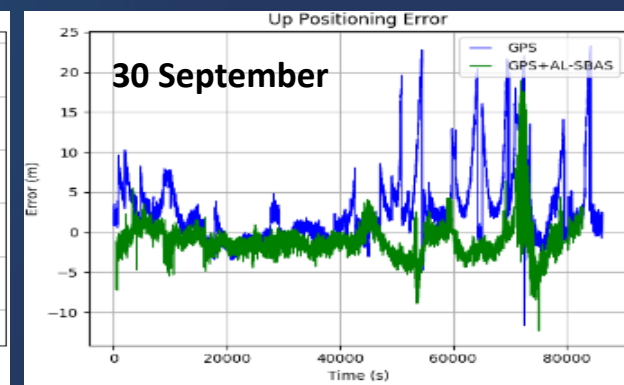
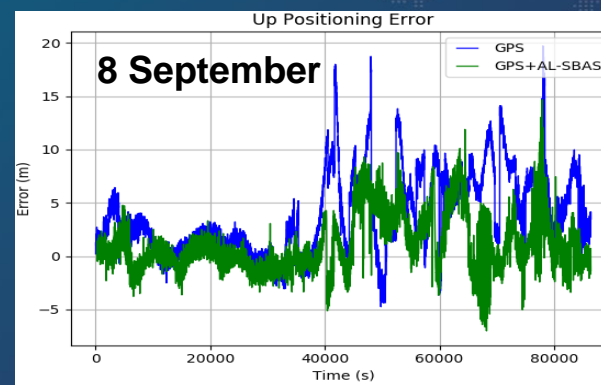
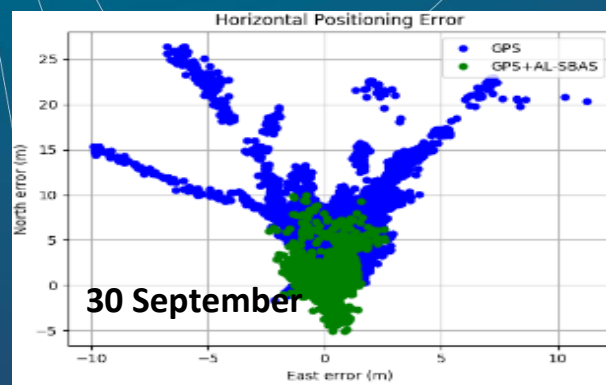
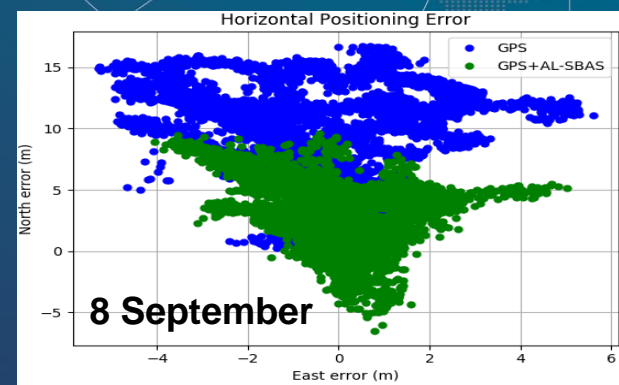
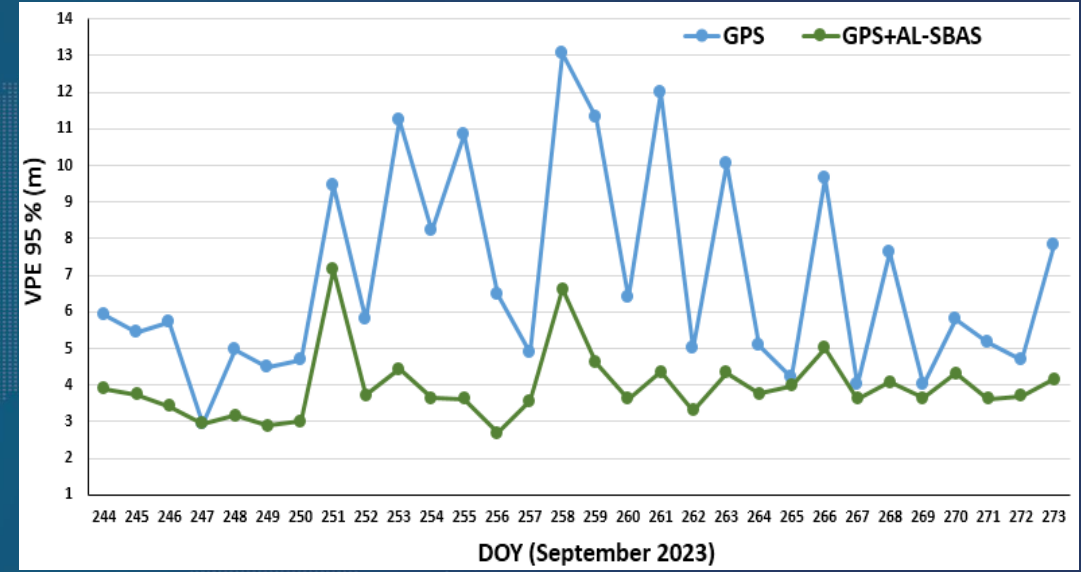
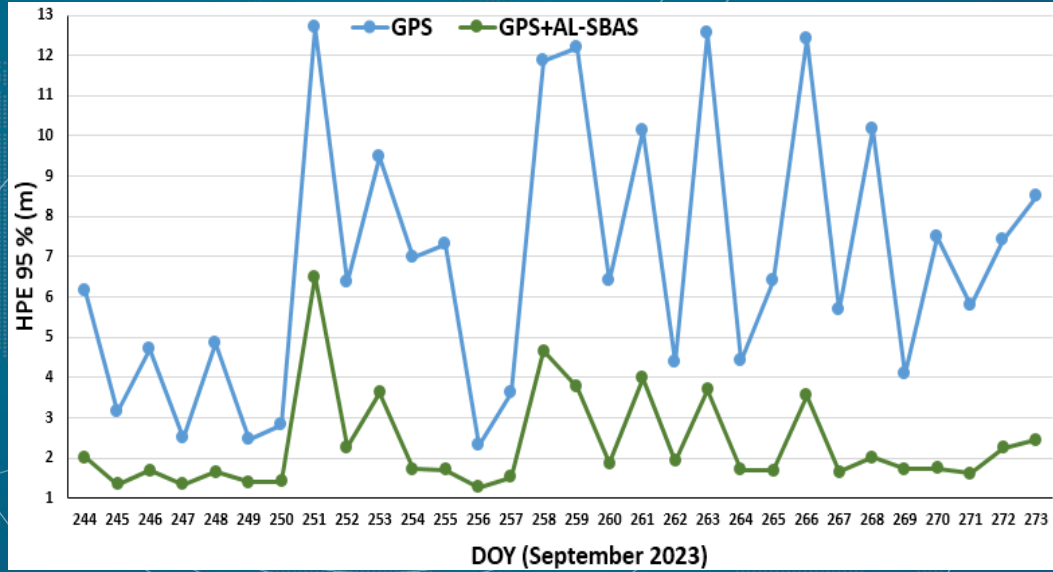
- S. Kahlouche, L. Tabti, A.B. Benbouzid, F. Outamazirt, Algerian satellite based augmentation system based on ALCOMSAT-1 : characteristics and preliminary performance tests. *International Meeting on the Applications of Global Navigation Satellite Systems*, 5 - 9 December 2022, Vienna, Austria.

- L. Tabti, A.B. Benbouzid⁽²⁾, F. Outamazirt, Y.A Betchim, Y. Bouhafi, Current status and Assessment performance of Algerian Augmentation System AL-SBAS based on Alcomsat-1, *ICG WG B: Enhancement of GNSS Performance, New Services and Capabilities*, July 19 th, 2023,



AL-SBAS Performance tests : September 2023

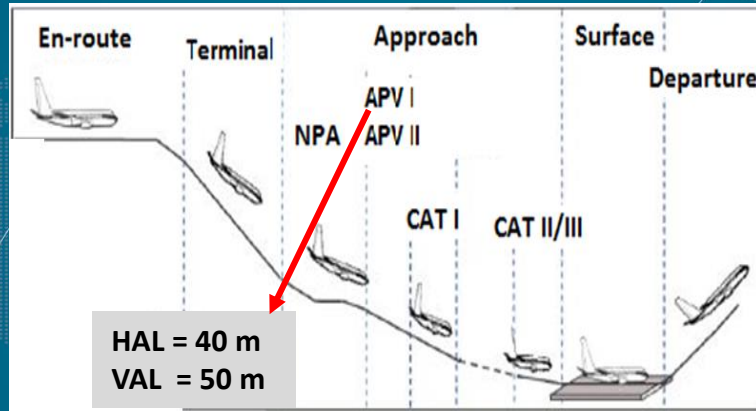
95 percentile position errors for Oran site in north Algeria



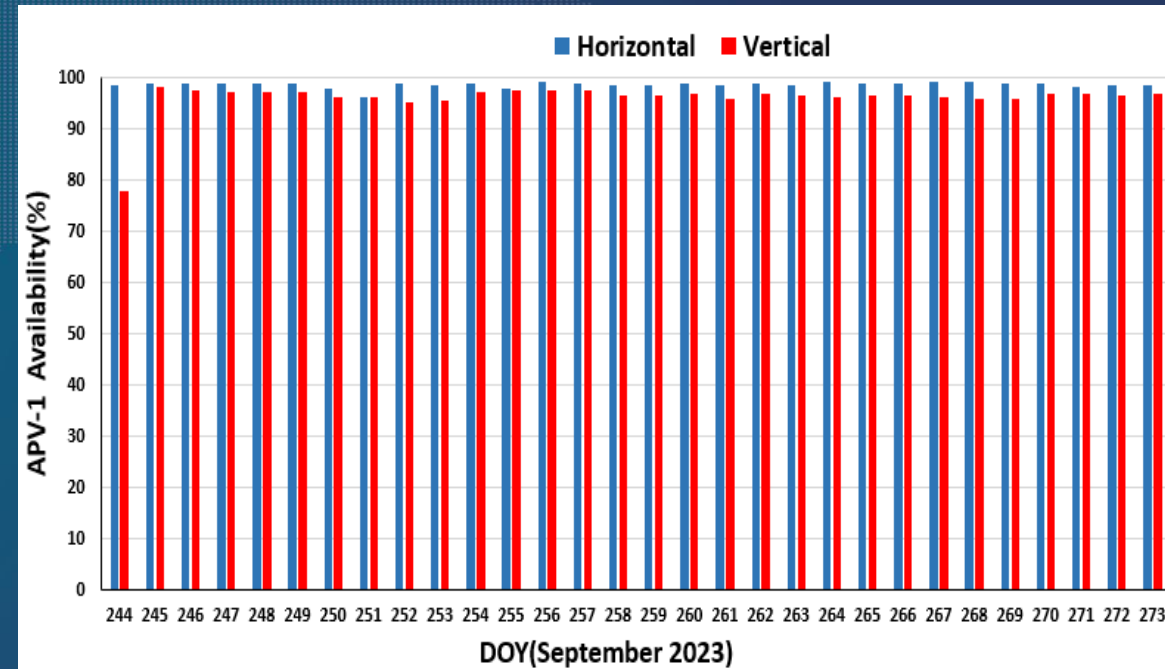
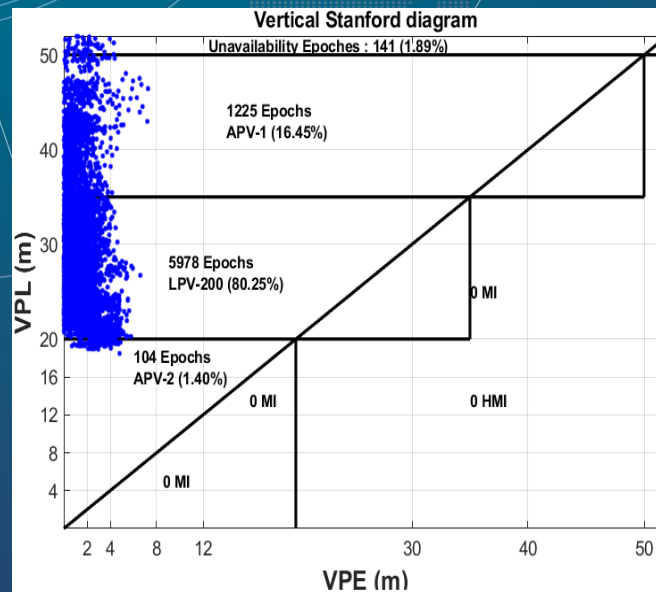
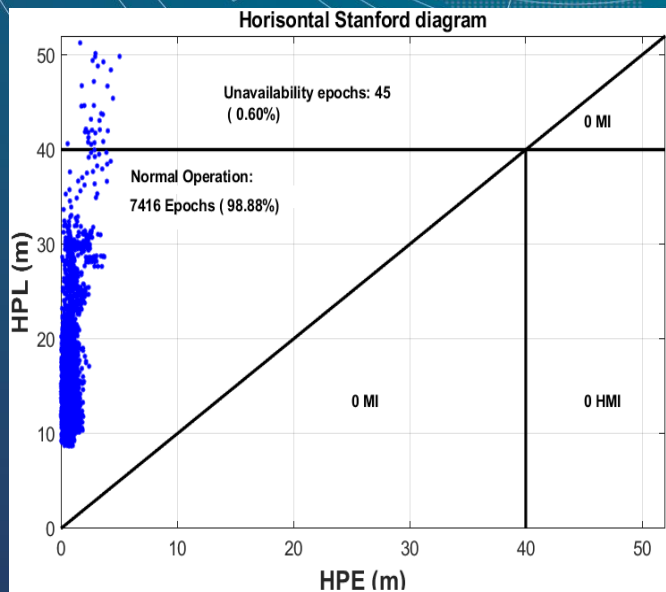


AL-SBAS APV-1 Availability : 2023

Availability : Protection level (PL) /Alarm limit (AL)

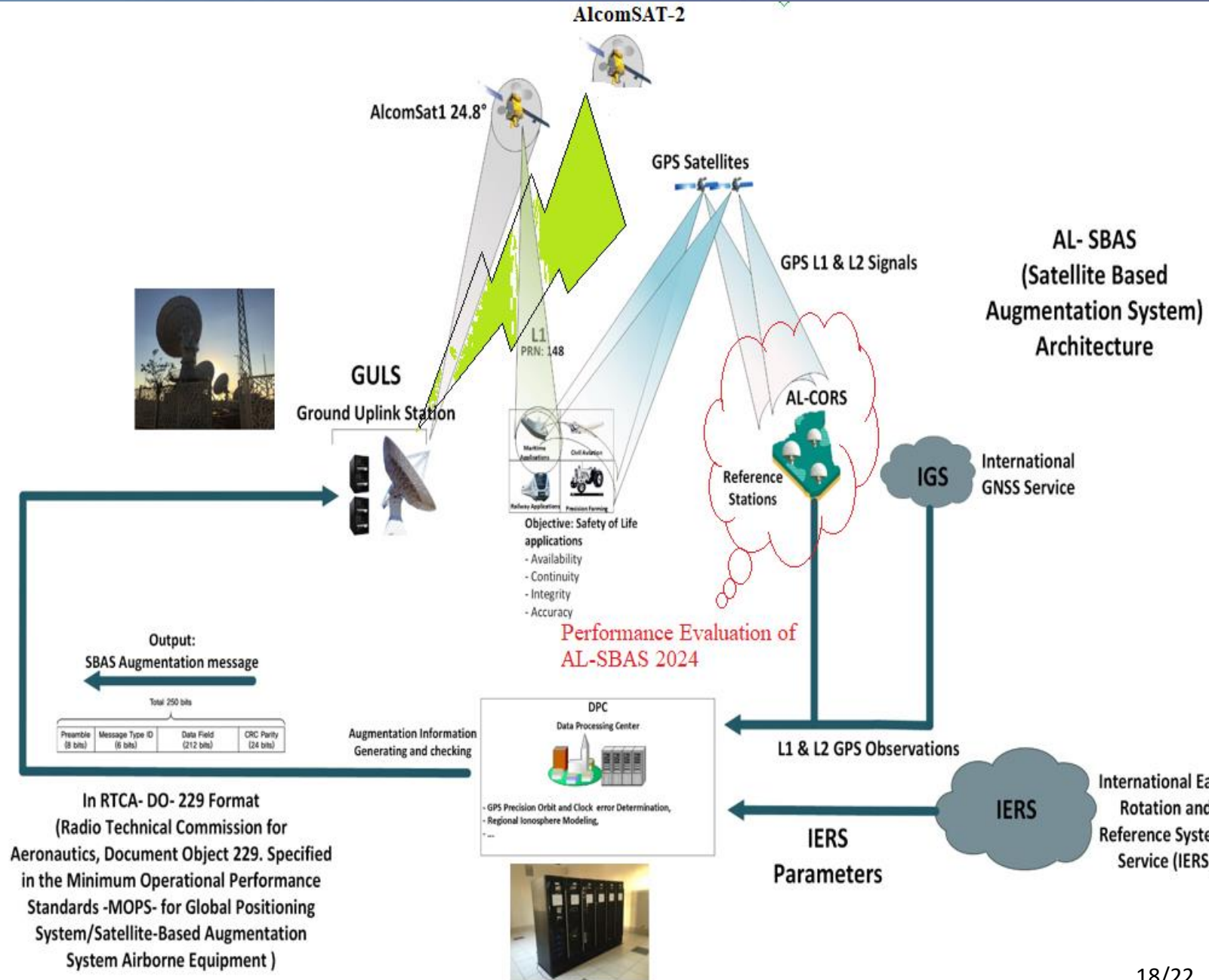


Integrity (2 September 2023: Stanford diagram



ASAL adopted an important measures to achieve the CDR requirements.

- Short-term : Upgrade and extend Algeria's continuously operating reference.
- Long-term : Upgrade ASAL's satellite network with a new communications satellite for more performance and accuracy.

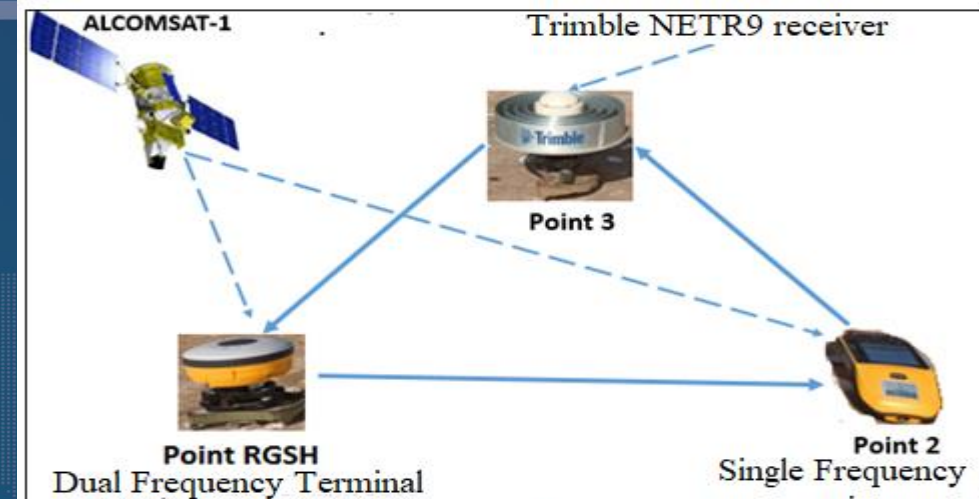


Upgrade and extend Algeria's continuously operating reference Plan.

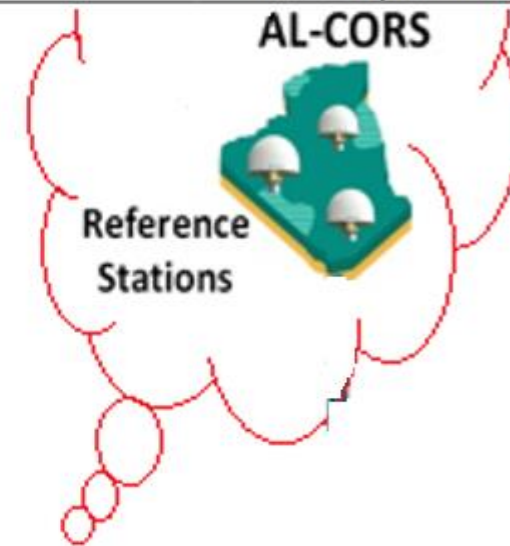
This upgrade suggestion, including upgrading GNSS antenna, GNSS receiver, atomic clock and network, infrastructure conditions.

- More stations will improve the ionosphere modeling and satellite clock estimation accuracy, and are strongly suggested to improve the whole system performance, especially positioning accuracy.
- These stations will be calibrated and tested according to a precise plan for maximum performance., these tests will be carried out using single-frequency (SF) and dual-frequency (DF) receivers, and applying AL-SBAS (national coverage) and EGNOS (coverage north of Algeria) corrections. To this end, observation periods must be several hours long, spread over three (03) days (diurnal and nocturnal observations), to take account of ionospheric effects.

Note: Description of the geodetic reference network (RGSH) :
 The Algerian geodetic reference frame (RGSH2020) is a static geodetic reference frame (fixed in time). It has a network of over 150 primary and secondary stations. The three-dimensional coordinates of these stations are obtained by analyzing GNSS data (GPS & GLONASS). This network has a sub-centimeter accuracy (6 to 8 mm) at all its stations.
 RGSH2020 is linked to the IGS14 global reference system, and is consistent with IGS14 at the mean observation epoch, i.e. February 24, 2020.



Add reference stations with high calibrated positioning accuracy (standardized according to RGSH2020 (IGS2014))



Performance Evaluation of AL-SBAS 2024



Conclusion

- ❑ Algeria sets up the Algerian Satellite Based Augmentation System (AL-SBAS), which is currently in the testing and validation phase.
- ❑ The initial Single Frequency (SF) services of AL-SBAS with PRN 148 was started in July, 2020, the system operates permanently since this date.
- ❑ The initial tests have yielded very interesting results in term of precision (July 2021, October 2022 and September 2023),
- ❑ Algeria is taking short, medium and long-term actions to ensure that the AL-SBAS complies with the ICAO Standards and Recommended Practices.
- ❑ To ensure system redundancy, Algeria encourages the cooperation with EGNOS and ANGA to accelerate the SBAS services deployment and provision to meet requirements of the aviation and extend the coverage of AL-SBAS system and then ensures an uncut in the African areas.



AL-SBAS Perspective

- The Algerian space agency attaches great interest, through its 2020-2040 space program, in order to ensure the continuity and sustainability of the AL-SBAS system and its effective implementation through the realization of the second Alcomsat-2 satellite and its related installations.
- Additionally, under this national space program, ASAL aims to strengthen its capacity building in the field of space technologies, especially highly qualified human resources in the field of GNSS and added value services.



Purpose of participation in UNOOSA workshops

- Algeria firmly believe that our participation in this workshops will enable us to contribute to the UNOOSA's mission and vision, while gaining valuable insights and collaborating with other GNSS providers, users, and related organizations.
- As a member of the ICG, we look forward to actively participating in its initiatives, workshops, and working groups, and contributing to the ongoing dialogue and exchange of information among member states. We believe that our engagement will foster mutual learning and cooperation, supporting sustainable development, and benefiting both Algeria and the global community.
- In alignment with the UNOOSA's mission statement, we share the vision of facilitating compatibility, interoperability, and transparency among all satellite navigation systems, promoting the use of their open service applications, and **ensuring the best satellite-based positioning, navigation, and timing for peaceful uses worldwide.**



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**Thanks for
your attention**



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