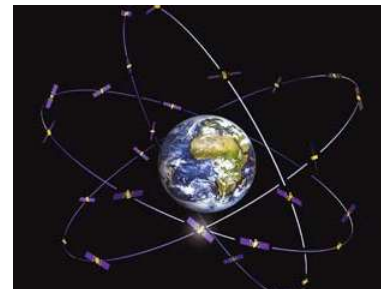


A general introduction to
**Aviation satellite services
including R&D activities**

Ruben Flohr
SATCOM FOR AVIATION, Webinar, 25 JANUARY 2022



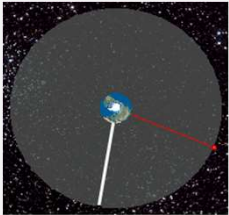
Potential drivers for moving from terrestrial to space-based

- No terrestrial option available
Oceanic, remote areas
- Better performance than terrestrial based options
Reliable, scalable, capacity, resilience, latency, cybersecurity
- Higher cost efficiency
Shared resources, shared usage, prioritisation
Regional rather than national or local
- Higher spectrum efficiency
Bigger surfaces, less impact from curvature earth

CNS satellite systems

Note that distance has impact on:

- Geostationary & Coverage
- Rotation time & Doppler effect
- Transmission time & Latency
- Potential disruptions

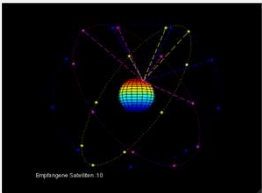


GEO – Geostationary Orbit

- NAV: Satellite Based Augmentation System (SBAS) – EGNOS, WAAS, GAGAN

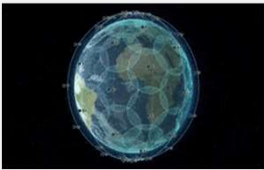


- COM: Inmarsat



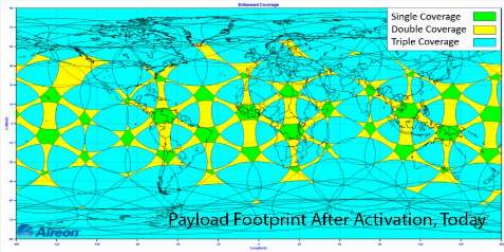
MEO – Medium Earth Orbit

- NAV: GNSS: GALILEO, GPS, GLONASS, BEIDOU



LEO – Low Earth Orbit

- COM: Iridium
- SUR: Aireon Payload in Iridium Satellites



Communications A/G



Communication: Operational needs

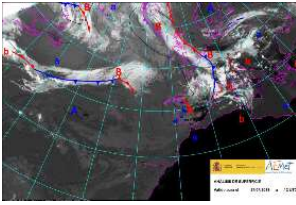


i4D/EPP

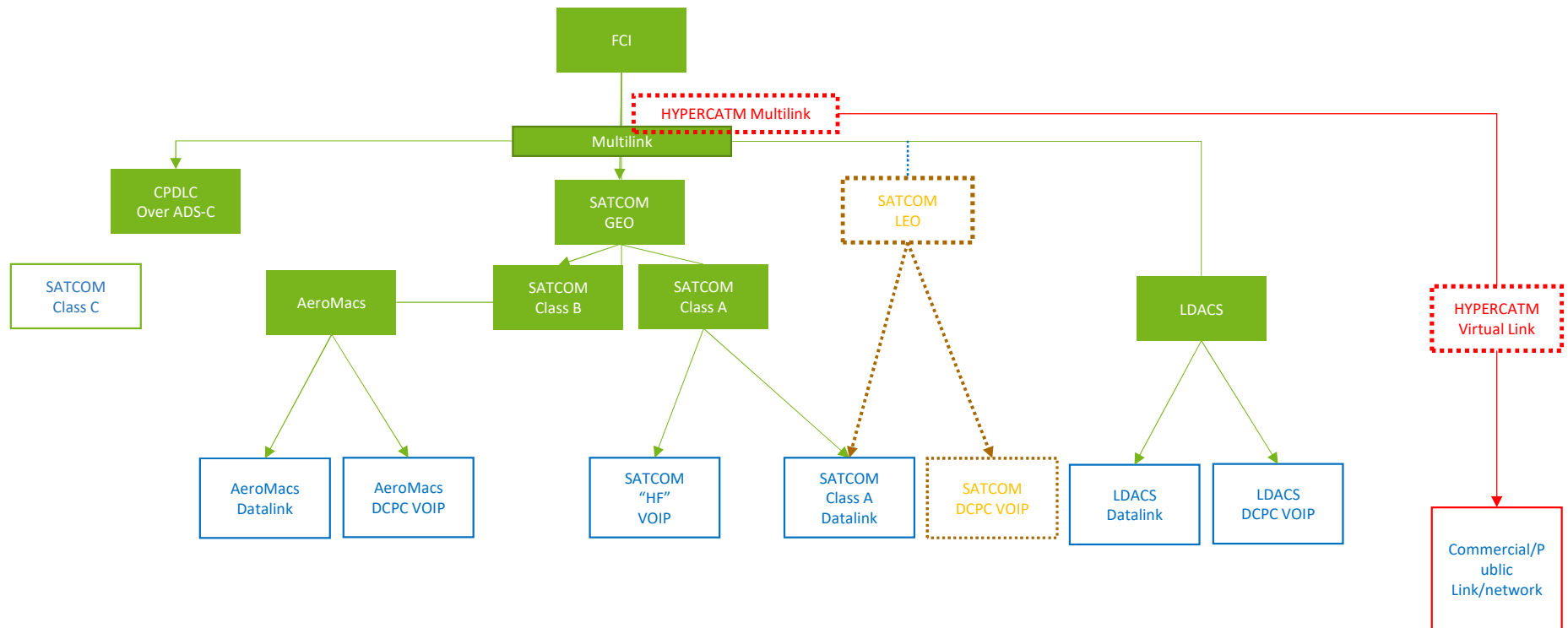
FULL 4D

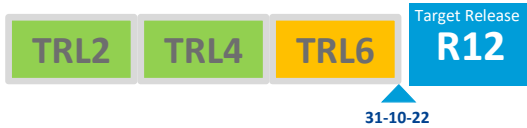


- ATC
 - R/T (“VHF radio”) – Analogue or digital
 - CPDLC datalink \
 - ADS-C EPP / TBO
- AOC
 - AOC – pilot voice connection (“SATVOICE”)
 - Meteo, Aeronautical- and Network data for EFB
 - Passenger services
 - Non-critical cabin data
 - Flight Engineering data
- New entrants
 - U-space (drones)
 - High Altitude Operations



Communication: Research & Development

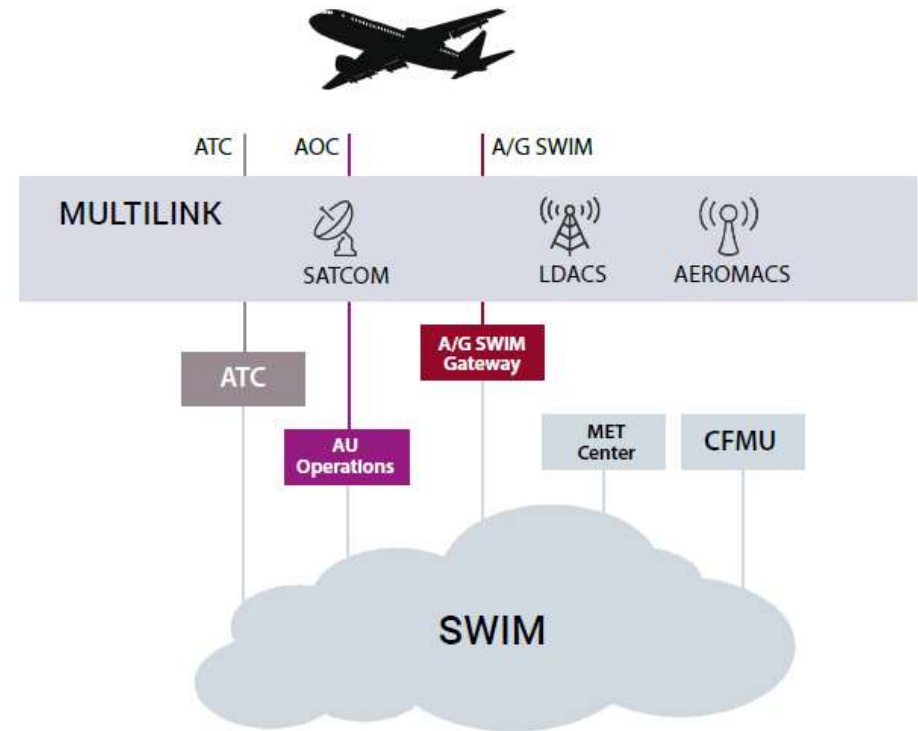




PJ.14-W2-77 – FCI Services (MultiLink)

Need to support an increased number of aircraft, new types of manned and unmanned craft, as well as military air traffic.

- Higher capacity and better performance
- More resilient
- Includes support to future air traffic services
- Migration towards internet protocol
- Enable SWIM applications and interfaces between all parties, including the military.
- Message prioritization & Security



TRL2

TRL4

TRL6

Target Release
R13

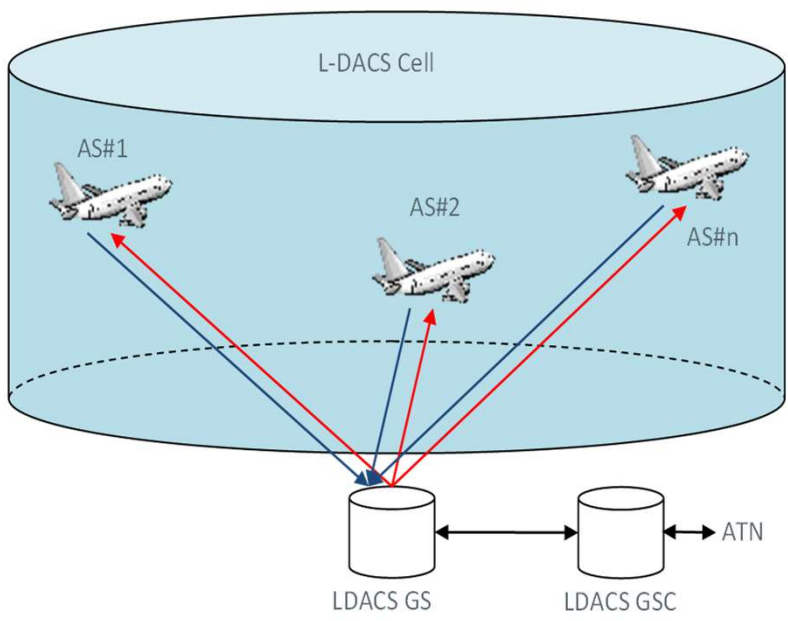
30-04-23



PJ.14-W2-60 – FCI Terrestrial Data Link (LDACS)

Developing and standardising the candidate future terrestrial datalink system L-band-digital aeronautical communication system (LDACS).

- Seamless transition from existing datalink technologies to LDACS
- Provision of a ranging functionality in order to support Navigation services (A-PNT)
- Aligned with international standardisation activities conducted at global level by agencies such as ICAO, EUROCAE, RTCA and the Airlines Electronic Engineering Committee (AEEC)

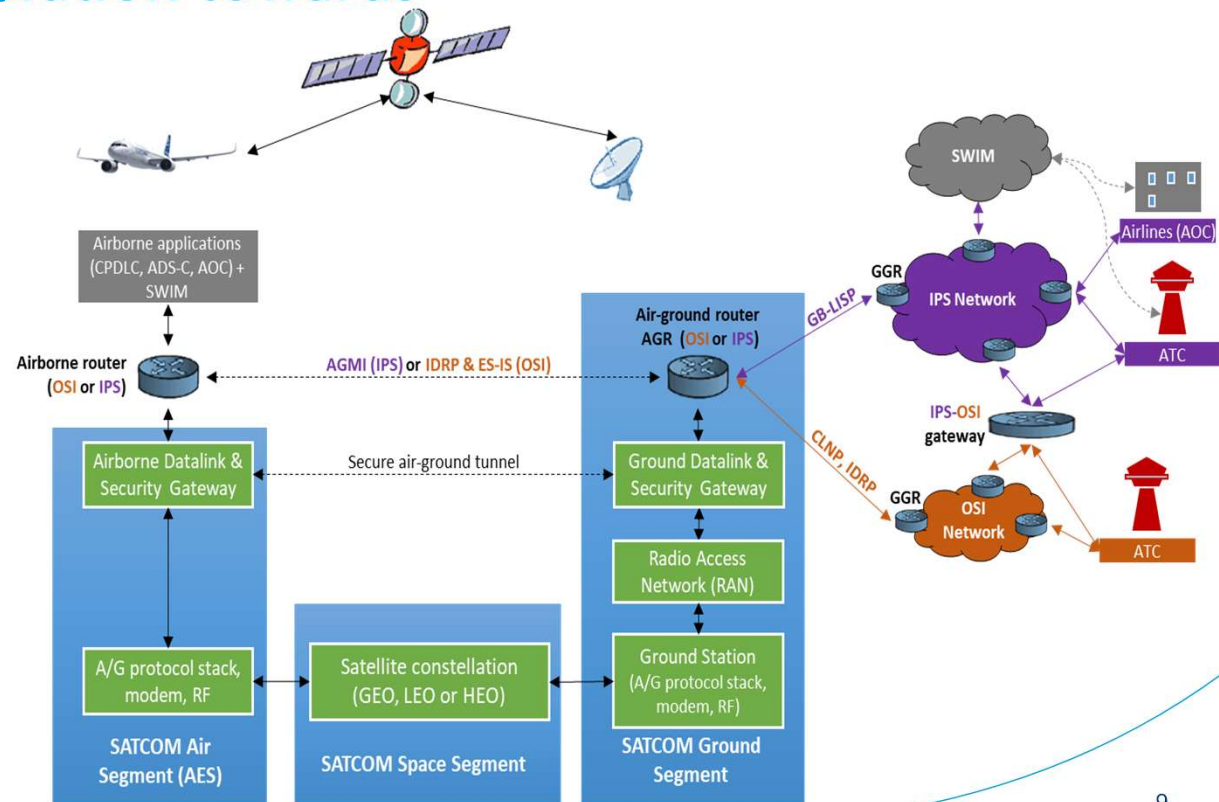




PJ.14-W2-107 - SATCOM evolution towards IPS-based FCI

Technical specification, development and validation of the future satellite data link technologies,

- Also referred as “Long Term” or “Class A” SATCOM
- For both the continental and remote/oceanic regions
- Needed for supporting the future concepts beyond 2025.



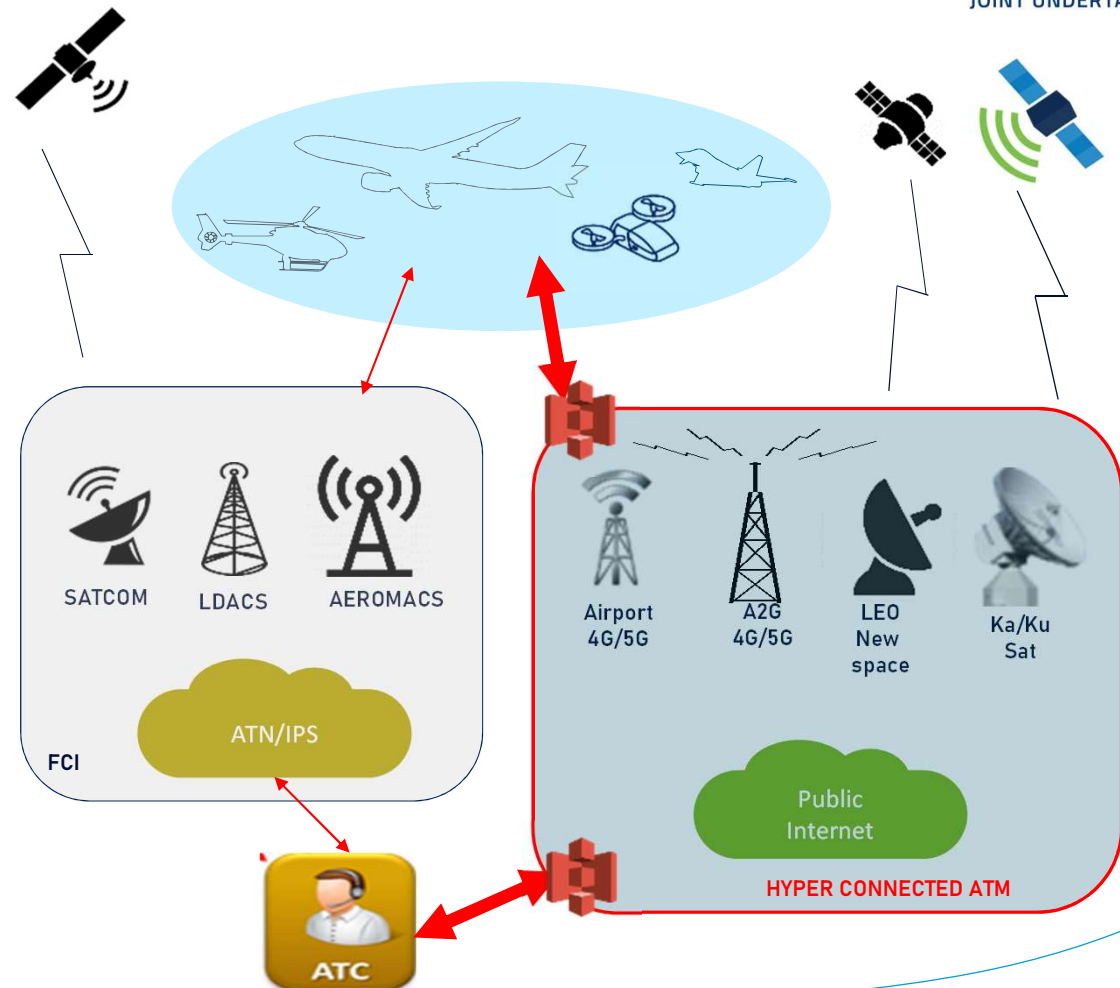


31-10-22

PJ.14-W2-61 Hyper Connected ATM

Integration of open network services and commercial public radio links or technologies, into the safety-critical domain.

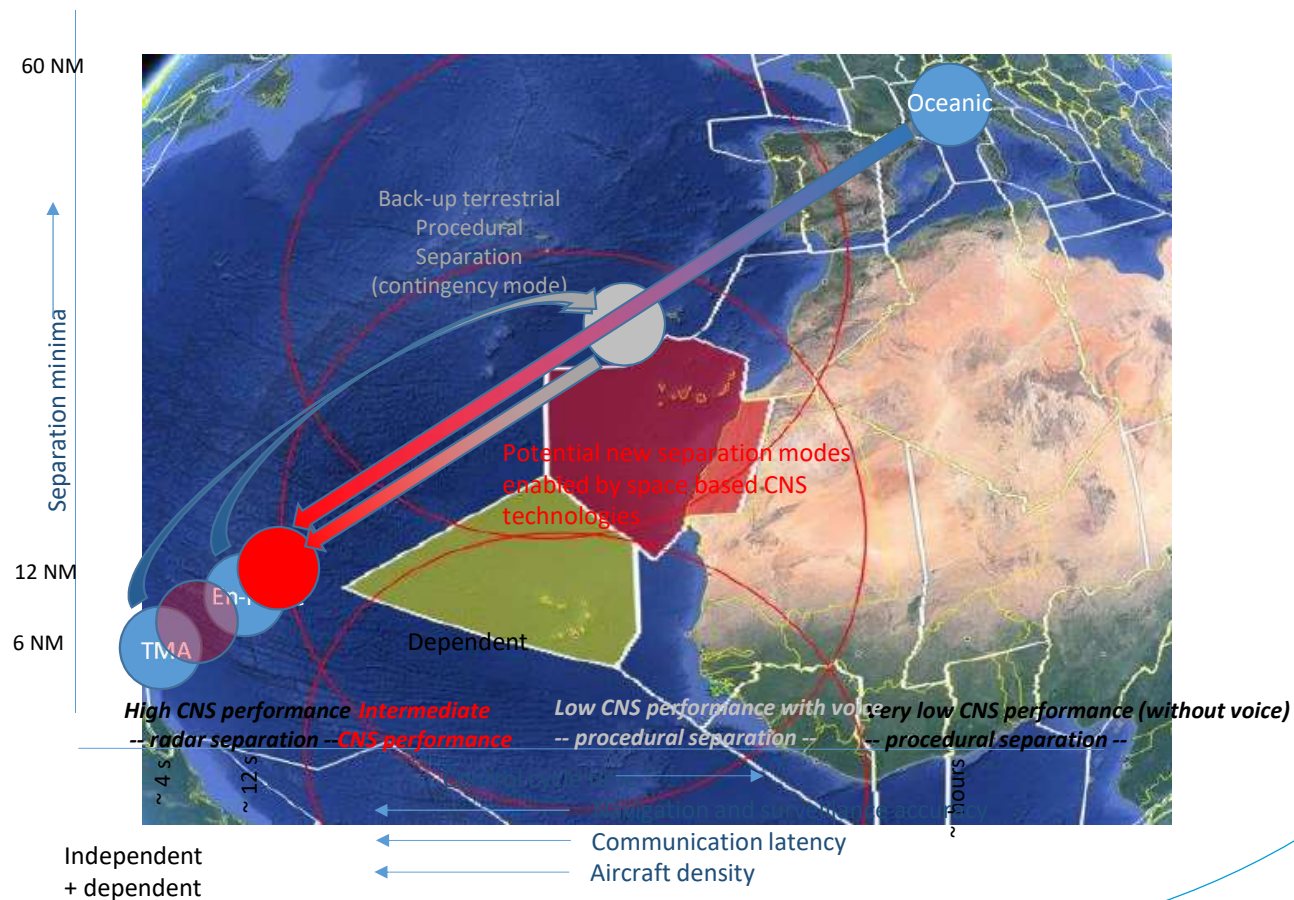
May include Ka/Ku bands



VLD-02 VOICE

Demonstrate that, with the use of LEO satellite-based VHF communication systems

- Providing voice and Datalink ATS
- Combining them with satellite-based ADS-B surveillance
- Traffic in remote airspace could be handled as in a continental one, and current separation minima could be reduced without compromising safety
- Independently of their equipage



Navigation



Navigation: Operational needs

Area navigation

Approach and landing navigation

- CAT I landings
- CAT II / III

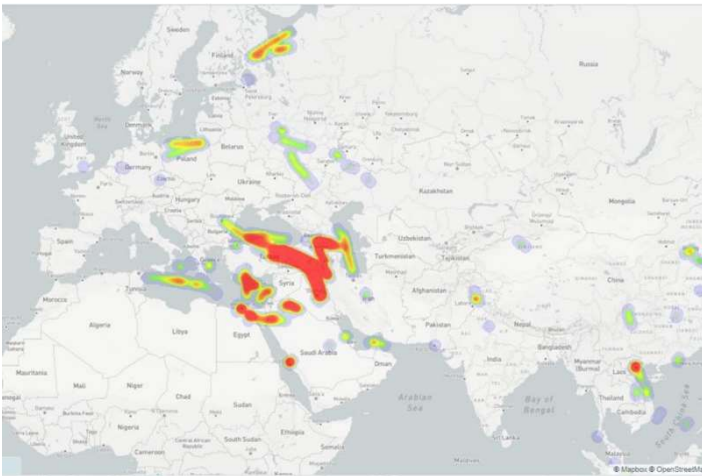
Accurate (airborne) time reference

Vulnerabilities and corrections

Correction signal through space (Regional level: EGNOS/WAAS)

Correction signal through ground broadcast (Local level: GBAS)

Frequency jamming



Solar activity (ionisation)



SBAS and GBAS evolutions

Technology	Characteristics	Performance
SBAS (EGNOS/WAAS)	Single constellation (GPS), single frequency	CAT. I
SBAS MCMF	Multi constellation, multi frequency	CAT. II under research
GBAS GAST-C	Single constellation (GPS), single frequency	CAT. I
GBAS GAST-D	Single constellation (GPS), single frequency	CAT. II/III TRL2 TRL4 TRL6 Target Release R12
GBAS GAST-F	Multi constellation, multi frequency Ground based error processing	CAT. II/III GPS independent More resilient against ionosphere disruptions More resilient against jamming TRL2 TRL4 TRL6 Target Release R12

02-02-22

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Navigation: Other topics for (future) research

- A-PNT
- U-space (drones)
- High Altitude Operations
- From Barometric to Geometric altimetry

Surveillance



Surveillance

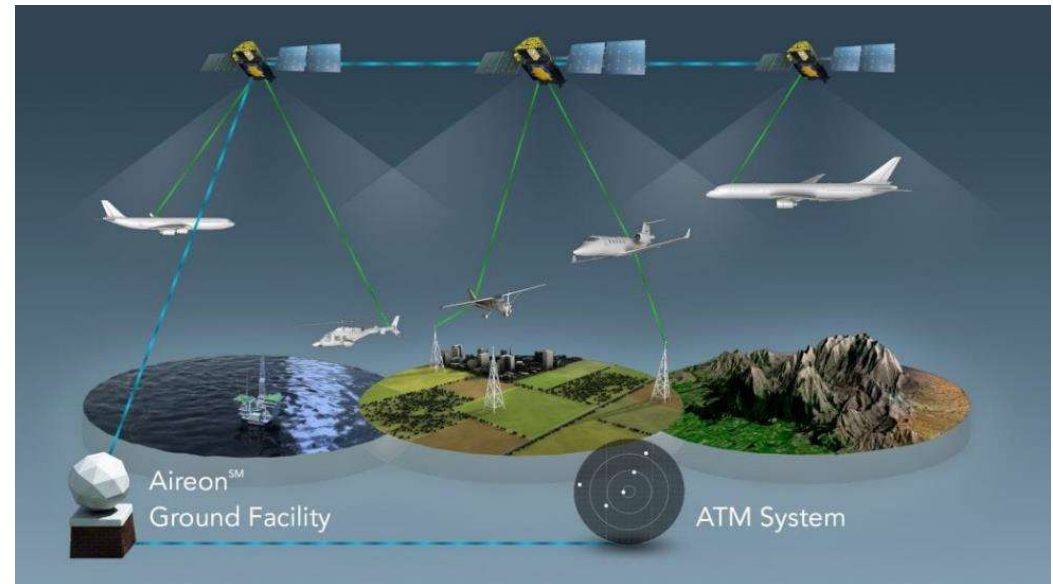
The ability to accurately and reliably determine the location of aircraft.

Has a direct influence on the separation distances required between aircraft (i.e. separation standards), and therefore on how efficiently a given airspace may be utilised.

- Primary radar
- Mode-S
- ADS-B (Automatic Dependent Surveillance – Broadcast)
- Wide Area Multilateration (WAM)

Industrial research:

- Improved monitoring by combining signals from space and ground
- End-to-end performance monitoring



Since 2019 NAV CANADA and NATS began using space-based ADS-B data (Certified by EASA) to separate aircraft in the North Atlantic Ocean

THANK YOU FOR
YOUR ATTENTION