

# **GBAS/SBAS Implementation Perspective - Japan**

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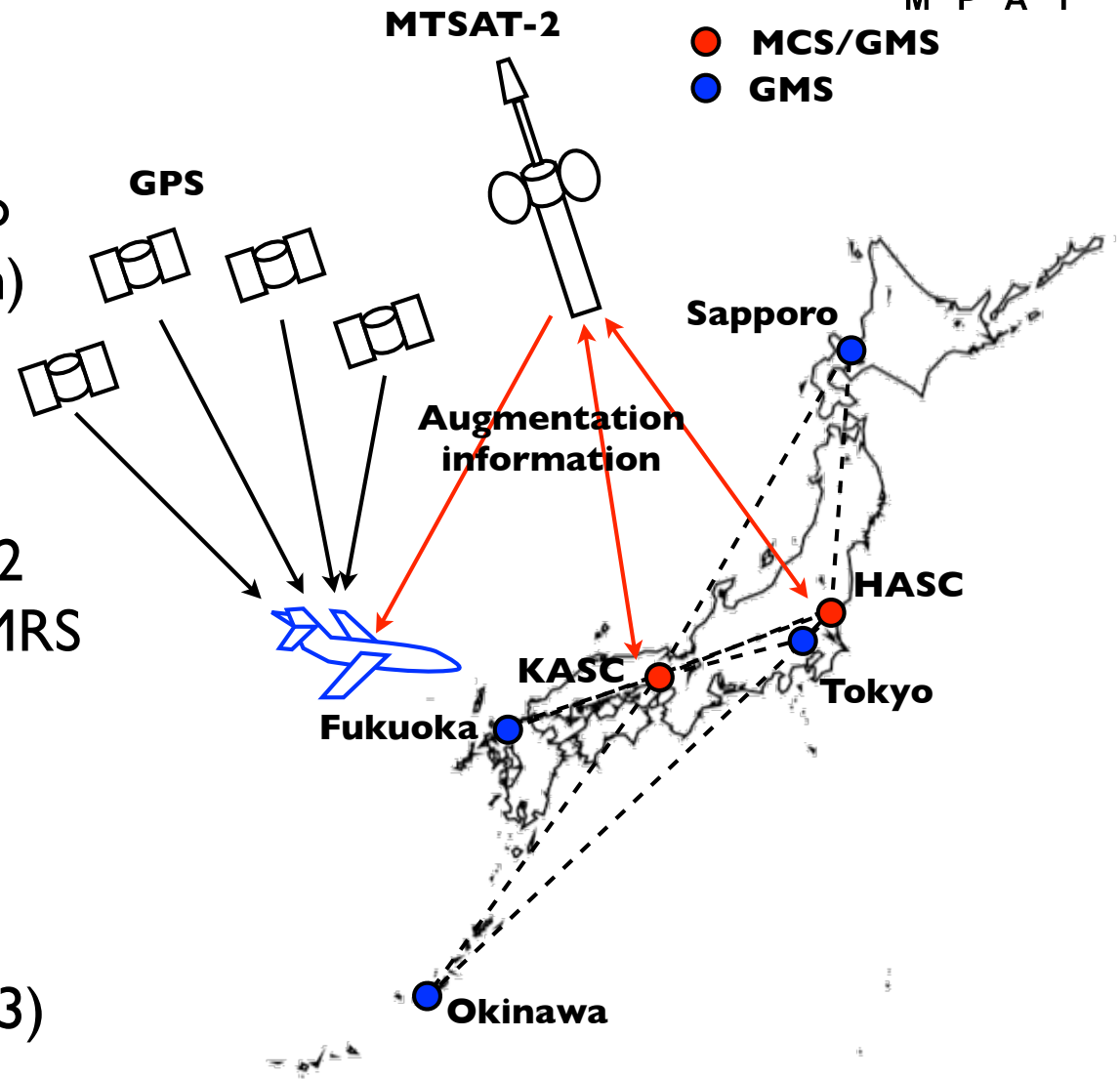
## \* MSAS

- Current status
- System update with QZSS (Michibiki) (V2)
- LPV implementation (V3)
- DFMC SBAS validation (V4)

## \* GBAS implementation

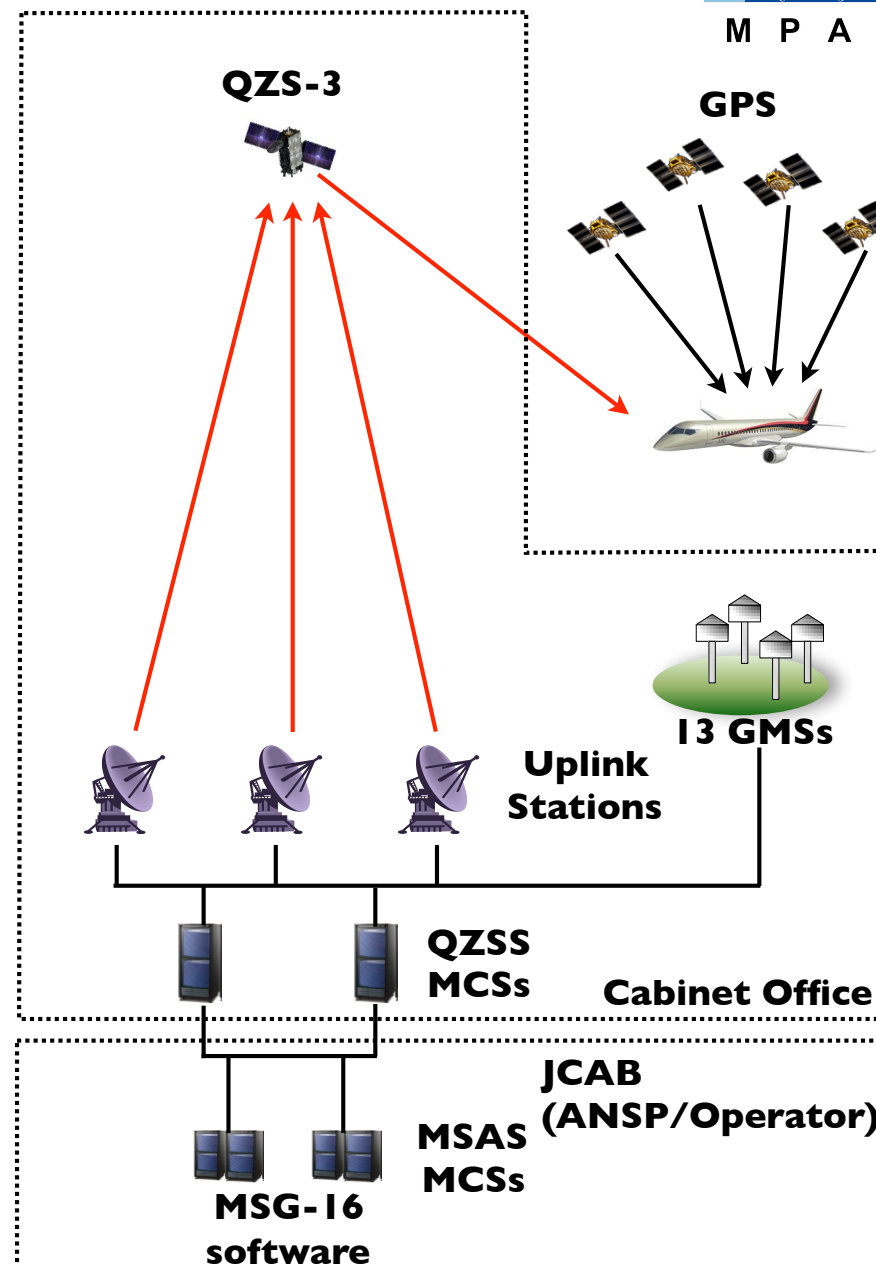
- Current status
- GBAS in Tokyo Haneda
- Ionospheric threat mitigation
- Further implementation including GAST-D

- \* Augments GPS LI signals
- \* System configuration
  - 1 GEO (MTSAT-2) with two signals (dual-PRN operation)
  - MTSAT-1R was decommissioned in December 2015.
  - 2 MCSs, 6 GMSs (including 2 GMSs with MCSs) and no MRS
  - 2 MRSs were decommissioned in February 2015.
- \* Service level
  - RNAV (en-route to RNP-0.3) in Fukuoka FIR
  - Horizontal guidance only due to ionospheric activities



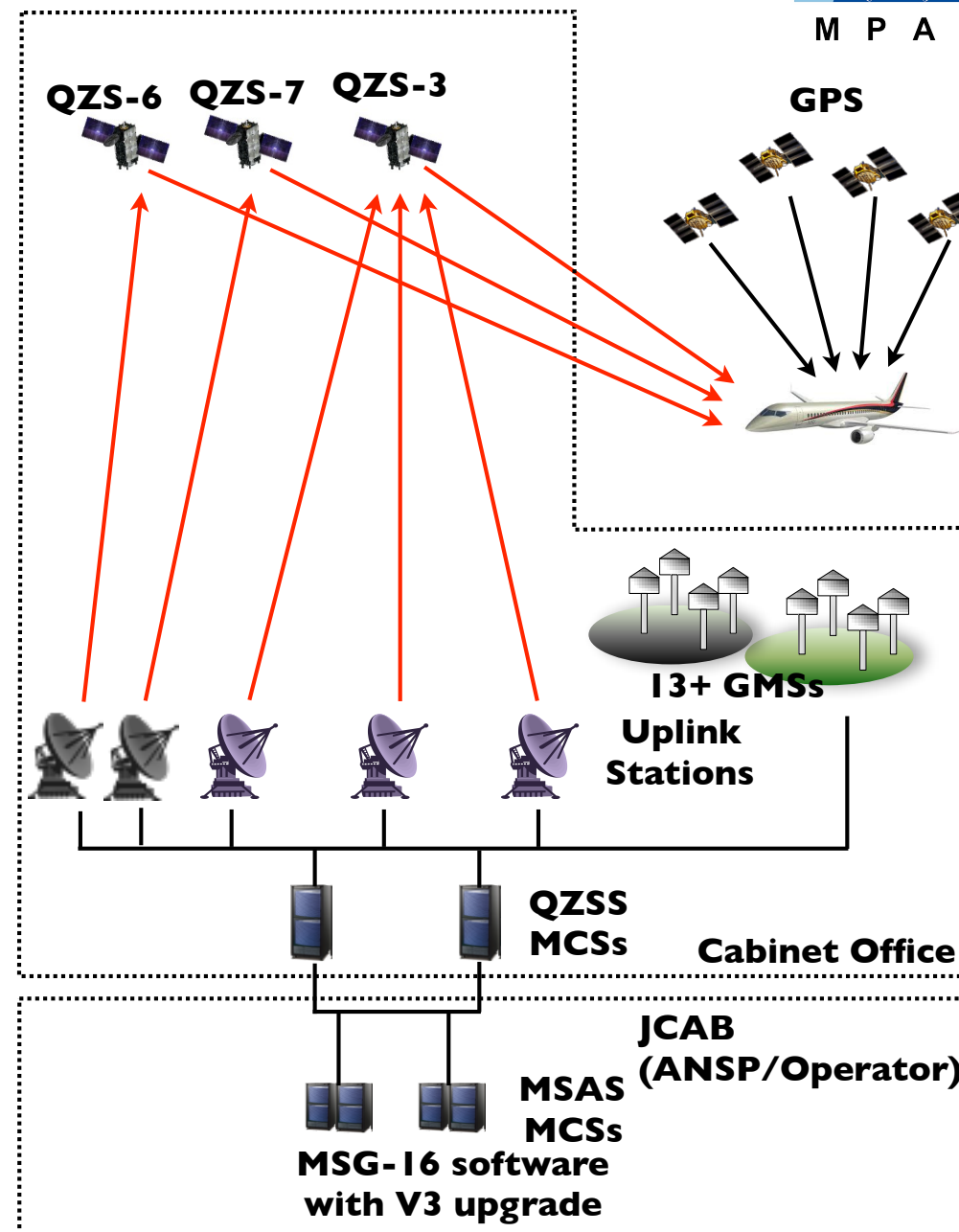
- \* MSAS V2 (2020-)
  - System update with QZSS (Michibiki)
- \* MSAS V3 (2023(TBD)-)
  - Additional GEOs and GMSs
  - LPV implementation
- \* MSAS V4
  - DFMC SBAS validation (2017-)

- \* MSAS V2 will use QZSS (Quasi-Zenith Satellite System, or “Michibiki” Satellite System) a GEO from 2020 after decommission of MTSAT-2.
  - MSAS will stand for “Michibiki-Satellite-based Augmentation System”.
- \* Facility
  - 1 GEO (QZS-3) with two signals (dual-PRN operation)
  - 3 uplink stations (1 Main, 2 Backups)
  - 13 GMSs
  - 2 MCSs (1 Main, 1 Backup) with MSG-I6 software (manufactured by NEC)
- \* Service
  - Augments GPS L1 signals
  - RNAV (En-route to RNP 0.3)



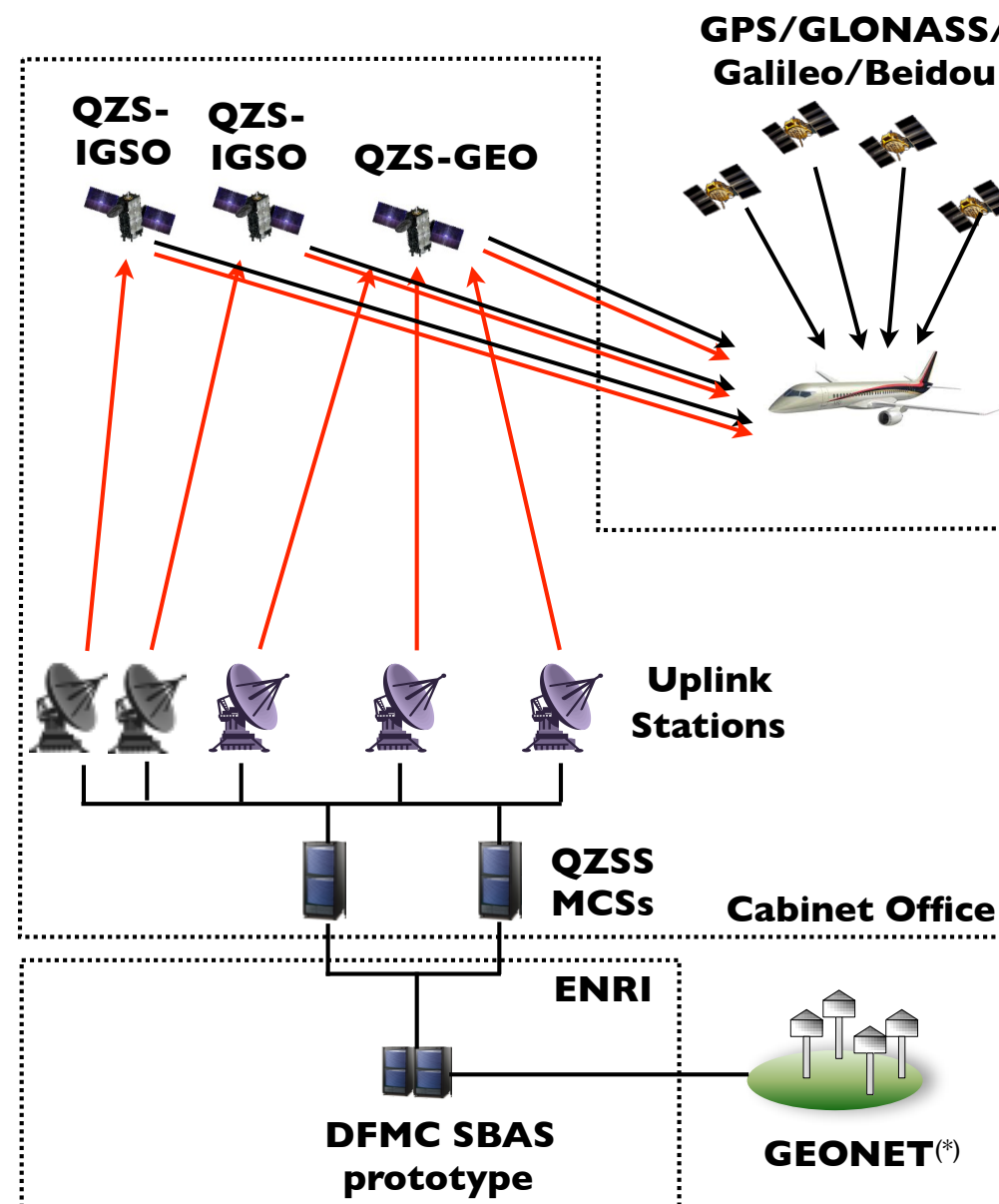
# MSAS V3 (2023 (TBD)-)

- \* 3 QZSS-GEOs
- \* 3 MCSs with upgraded software
- \* 3+additional uplink stations
- \* 13+additional GMSs
- ◆ RNAV (en-route to RNP 0.3) and LPV-200 operations with GPS L1 signals

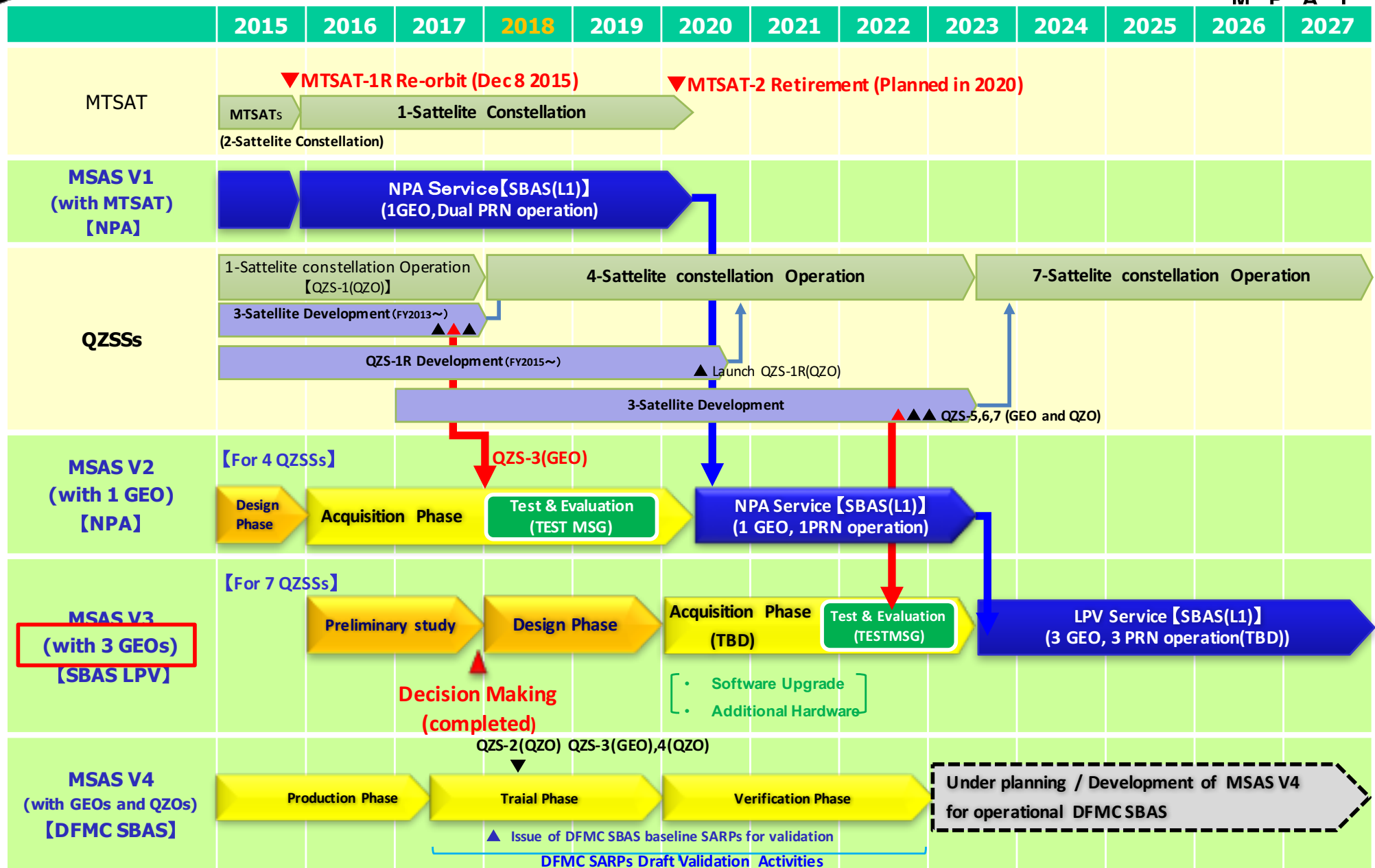


## Validation Configuration

- \* DFMC (Dual-Frequency and Multi-Constellation) SBAS
- \* For CAT-I operations
- \* GEOs and IGSOs
- \* Validation activity by ENRI has started in 2017
  - Prototype augments GPS, GLONASS, Galileo, Beidou and QZSS
- \* Implementation of DFMC SBAS is under consideration.

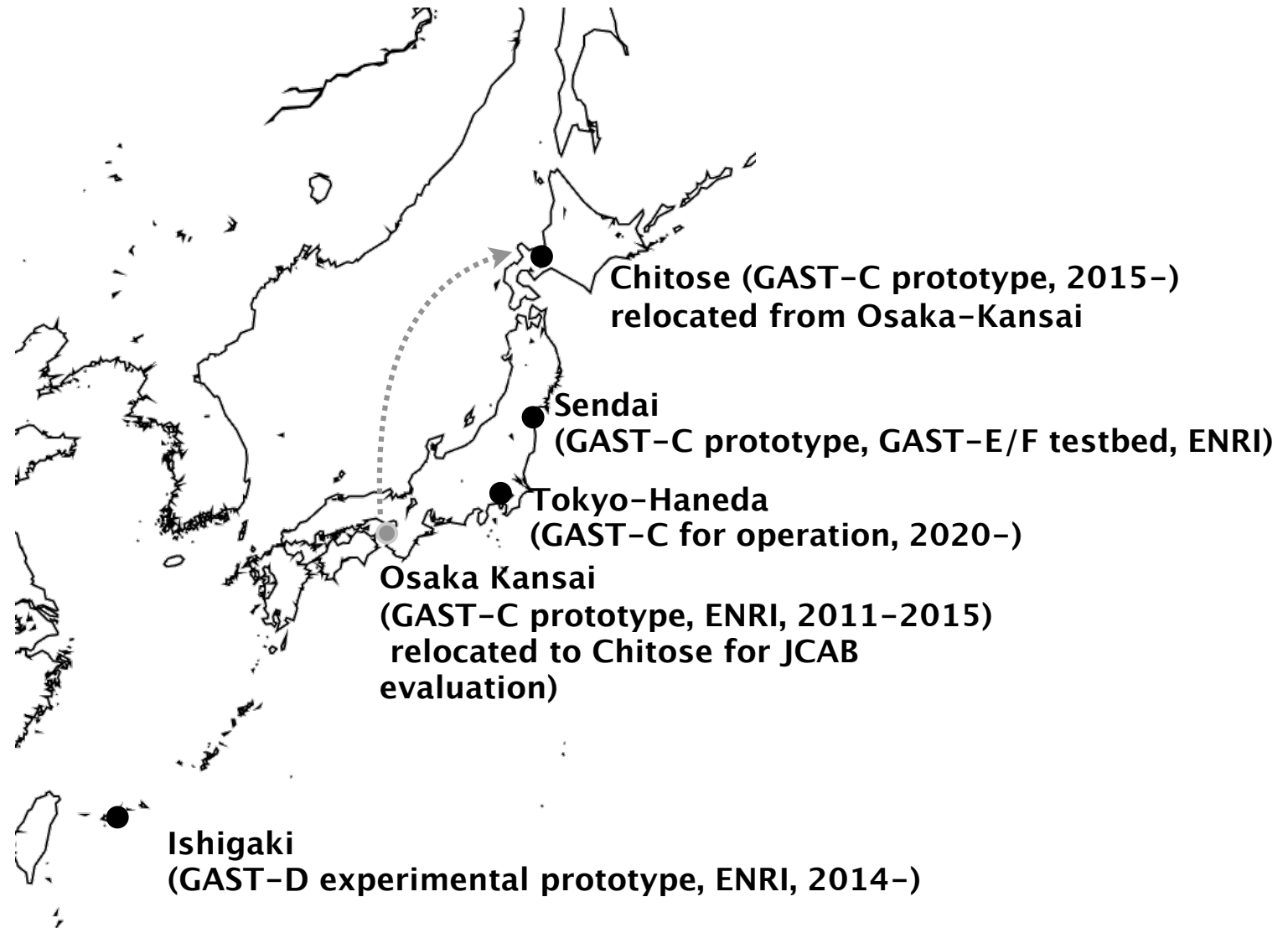


\*GEONET is a Japanese nationwide GNSS receiver network operated by Geospatial Information Authority of Japan.

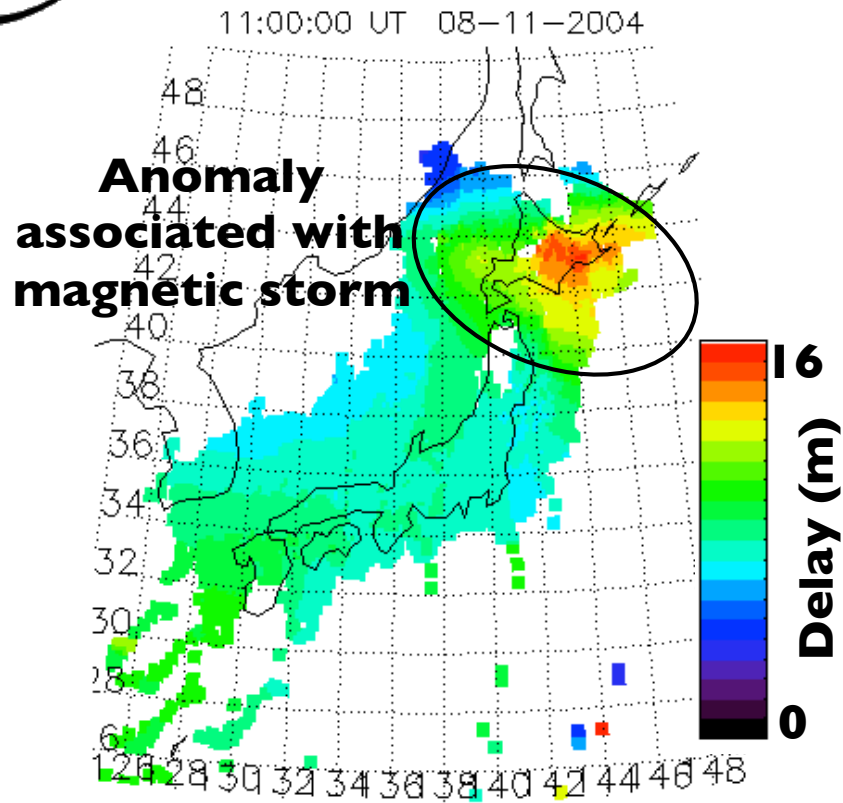




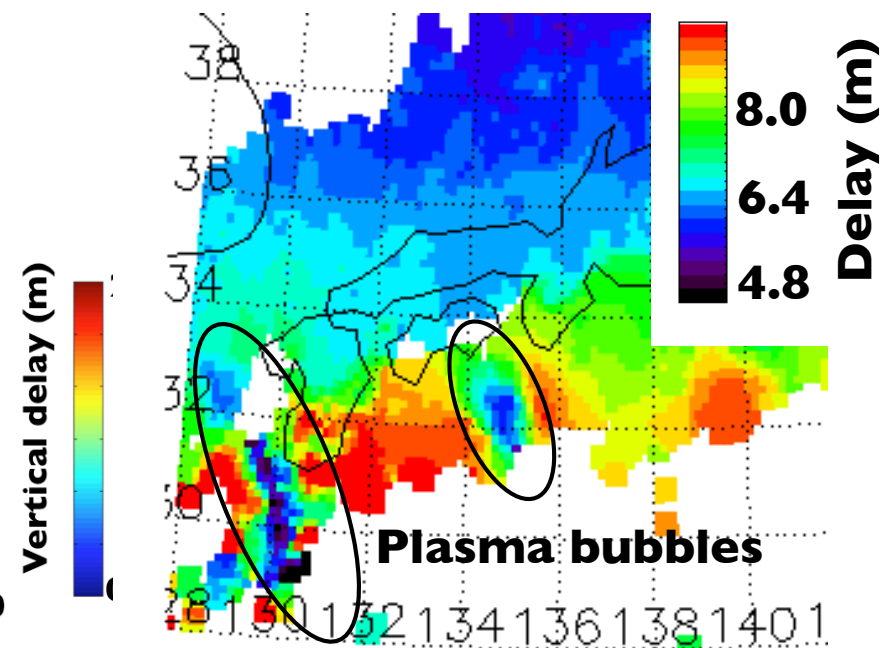
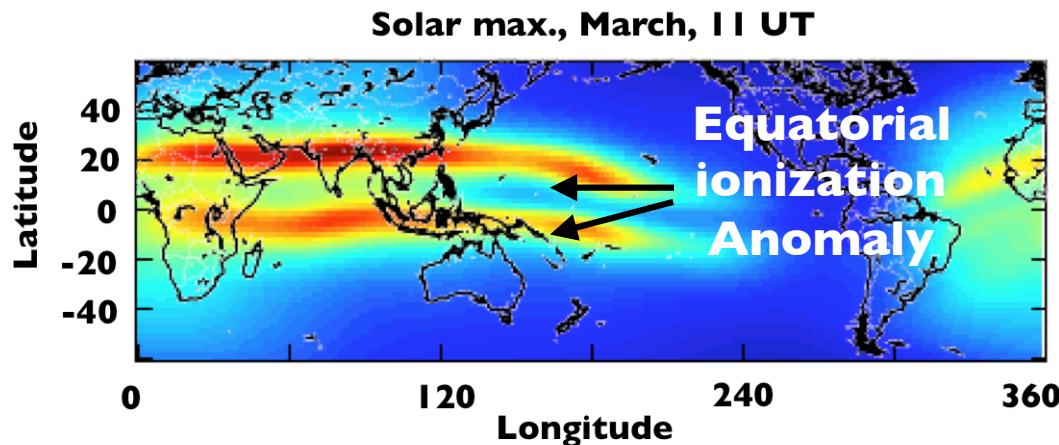
# GBAS current status in Japan



- \* Operational Target
  - CAT-I service for all operational runway ends
- \* Key points
  - Implementation at a large complex airport
  - Ionospheric threat mitigation with high availability
- \* System
  - GBAS-I6, manufactured by NEC
- \* System configuration
  - 4 Reference Stations
  - 2 additional stations for ionosphere threat mitigation (Ionosphere Field Monitor: IFM)
  - 2 VDB Tx antennas to serve all operational runway ends

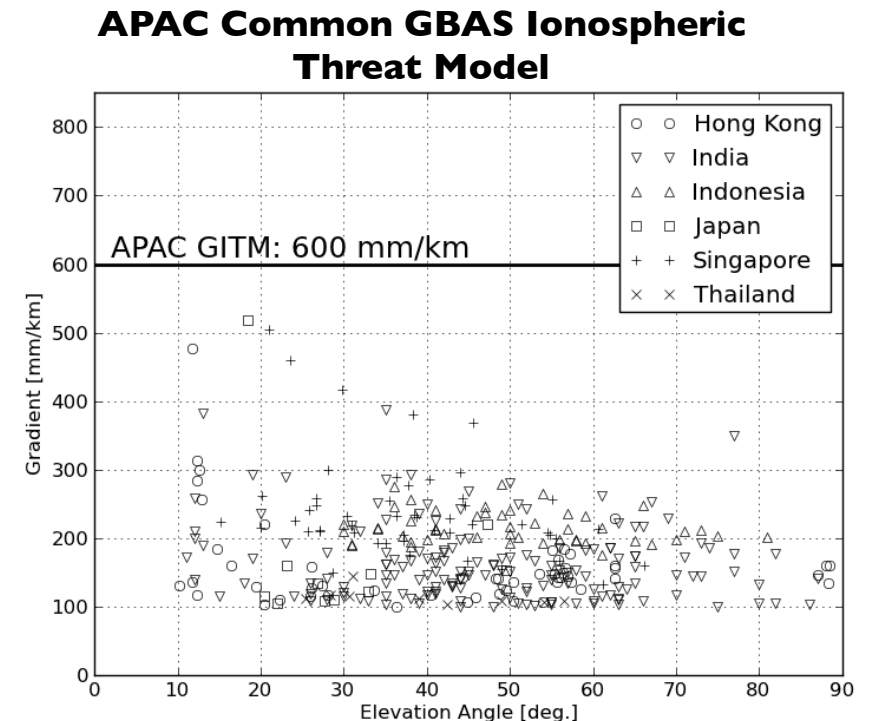
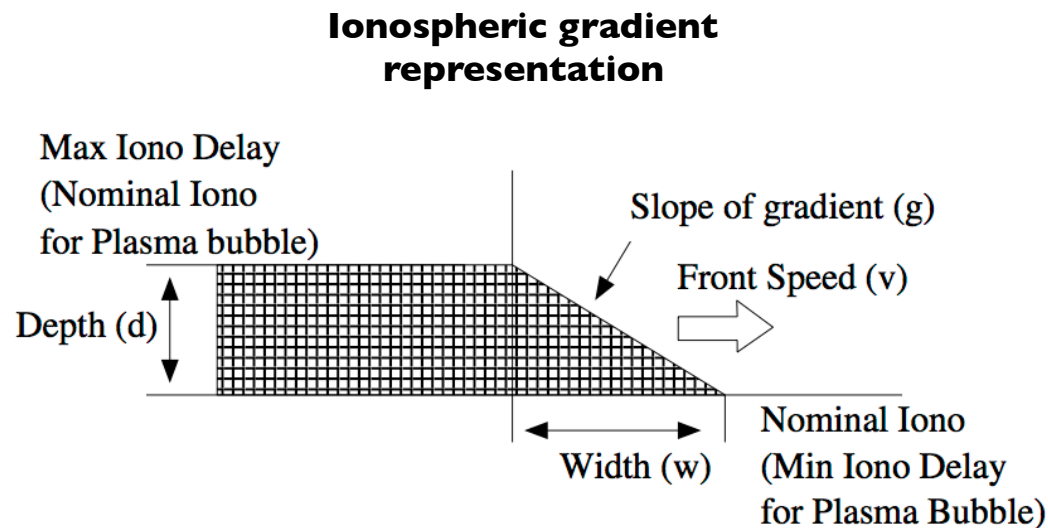


- \* Japan is located at mid- to low magnetic latitude region ( $\sim 15\text{--}41^\circ$  in magnetic latitude).
- Subject to both mid-latitude type and low latitude type ionospheric anomalies

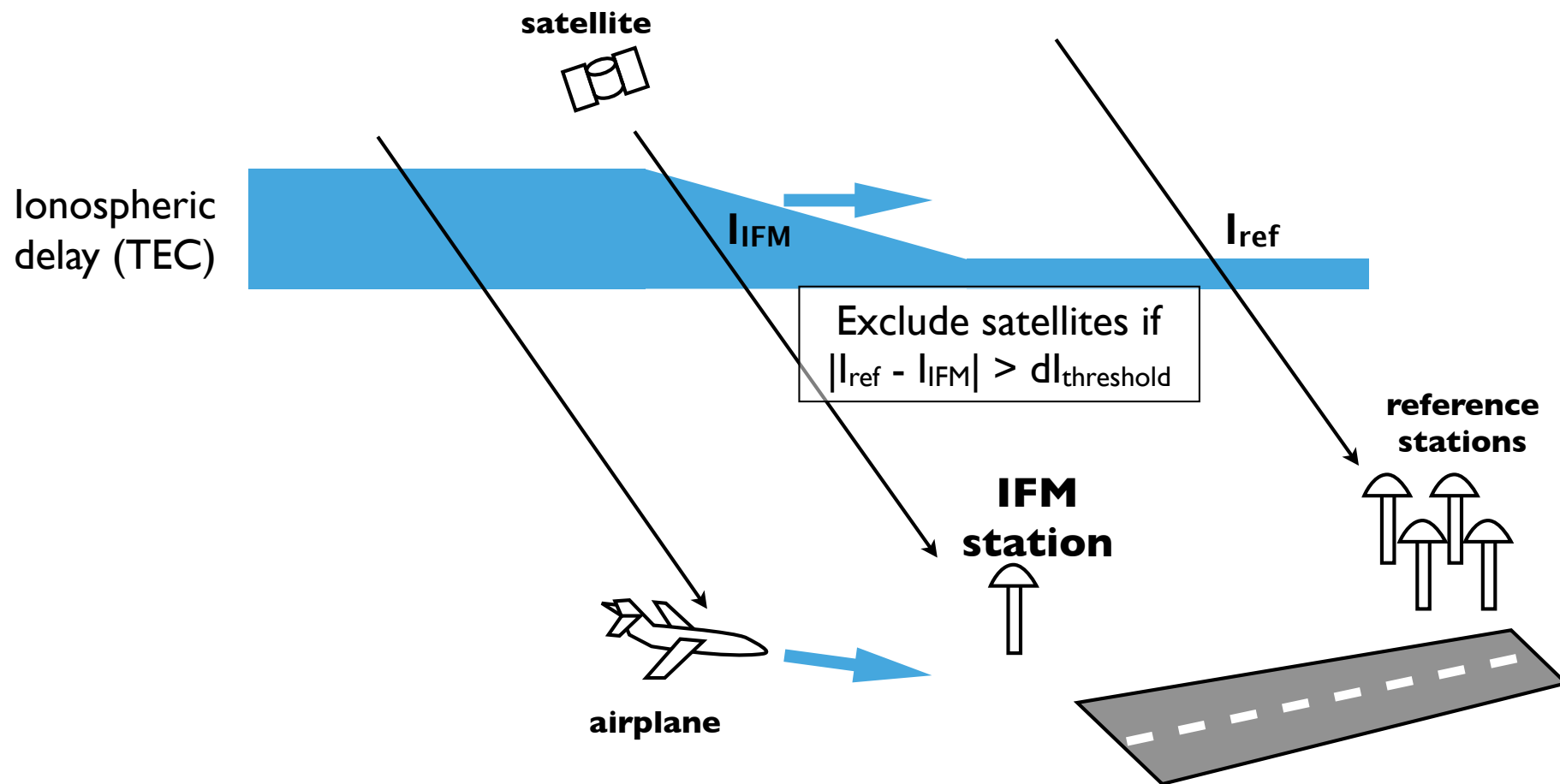


# Ionospheric Threat Mitigation - Ionospheric Threat Model

- \* Based on APAC common GBAS ionospheric threat model
- \* Tokyo-Haneda is in a transition region from low to mid-latitude region
  - Adaptation of the ionospheric threat model for Tokyo-Haneda by historical data analysis by ENRI



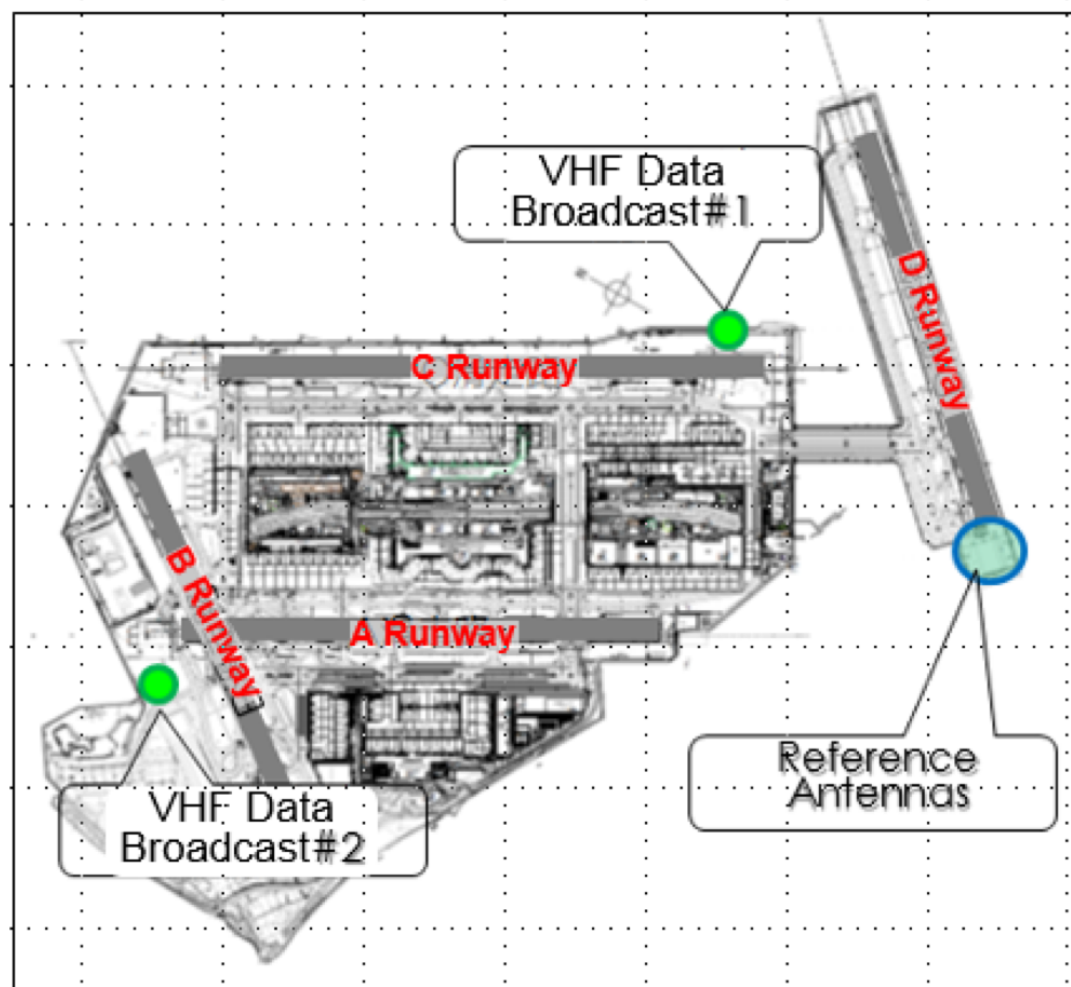
# Ionospheric Threat Mitigation - Ionosphere Field Monitor (IFM)



- \* Additional receivers to limit the maximum potential error associated with ionospheric gradients

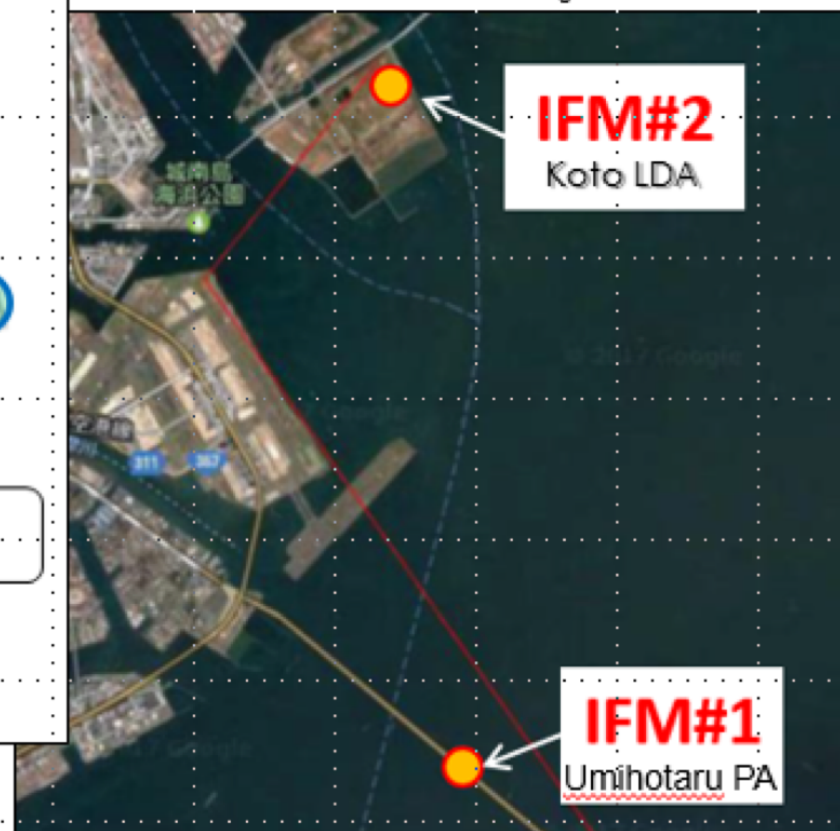


## Tokyo International (Haneda) Airport









## Construction plan

IFM: Ionosphere Field Monitor  
LDA: Localizer Type Directional Aids  
PA: Parking Area



# GBAS at Tokyo-Haneda Implementation Schedule

Year <sup>(1)</sup>	2016	2017	2018	2019	2020
System Implementation					
System Design					
Production					
Installation					
Operational Evaluation <sup>(2,3)</sup>					
CAT-I Operation					

(1) Year in Japanese Fiscal Year (April to March)

(2) Expected date of AIP publication: TBD

(3) Under negotiation with airlines



## \* GAST-C

- Implementation of GAST-C systems to other airports are under investigation.
- Narita International Airport Company decided to implement GAST-C at Tokyo-Narita Airport.

## \* GAST-D

- Implementation of GAST-D is being studied.
- Decision will be made in 2020.