

System Development - KASS

KASS : Korea Augmentation Satellite System

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GEO-KOMPSAT 2A Image



91.5°E
MEASAT-3d

Expected Signal in Space Area of KASS



국토교통부



해양수산부

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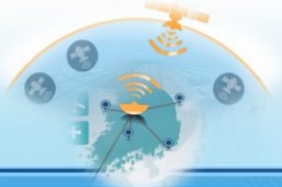
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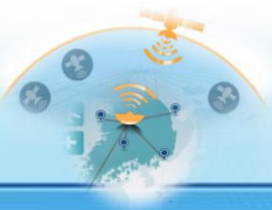
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FUTURE PLAN





I. OVERVIEW



KASS Program

Goal

Develop a Satellite-Based Augmentation System in Compliance with ICAO Annex 10 Performance Requirements

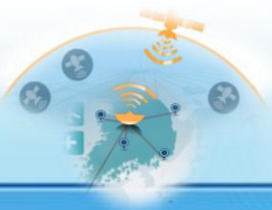
- 1** Provide APV-I SoL Service to Airports located in South Korea
- 2** Initiate Open Service in 2020 and APV-I SoL Service in 2022

[Period] 5 Phases in 8 Years (2014 - 2022)

- Phase A (Oct. 2014-Sept. 2015): System Definition
- Phase B (Oct. 2015-Apr. 2017): System Design and Preliminary Design
- Phase C (May 2017-Sept. 2019): Critical Design
- Phase D (Oct. 2019-Jun. 2020): Integration and Verification
- Phase E (Jul. 2020-Oct. 2022): Initial Operation and Approval Process

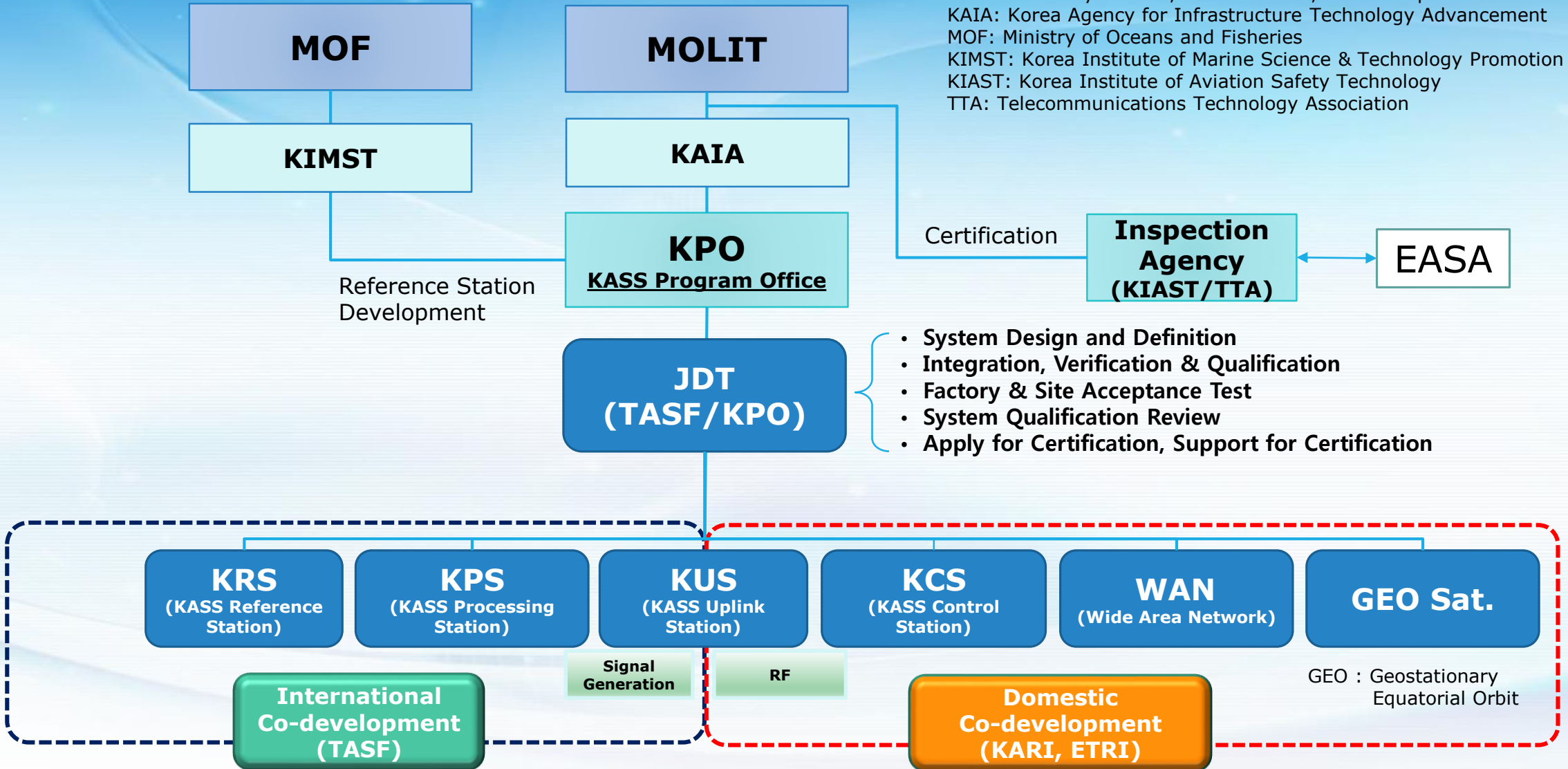
[Program Participants]

- Supervising Agency(MOLIT, KAIA), KASS Program Office, KARI, ETRI, TASF, KT, KTsat



KASS Development Organizational Structure

MOLIT: Ministry of Land, Infrastructure, and Transport
 KAIA: Korea Agency for Infrastructure Technology Advancement
 MOF: Ministry of Oceans and Fisheries
 KIMST: Korea Institute of Marine Science & Technology Promotion
 KIAS: Korea Institute of Aviation Safety Technology
 TTA: Telecommunications Technology Association

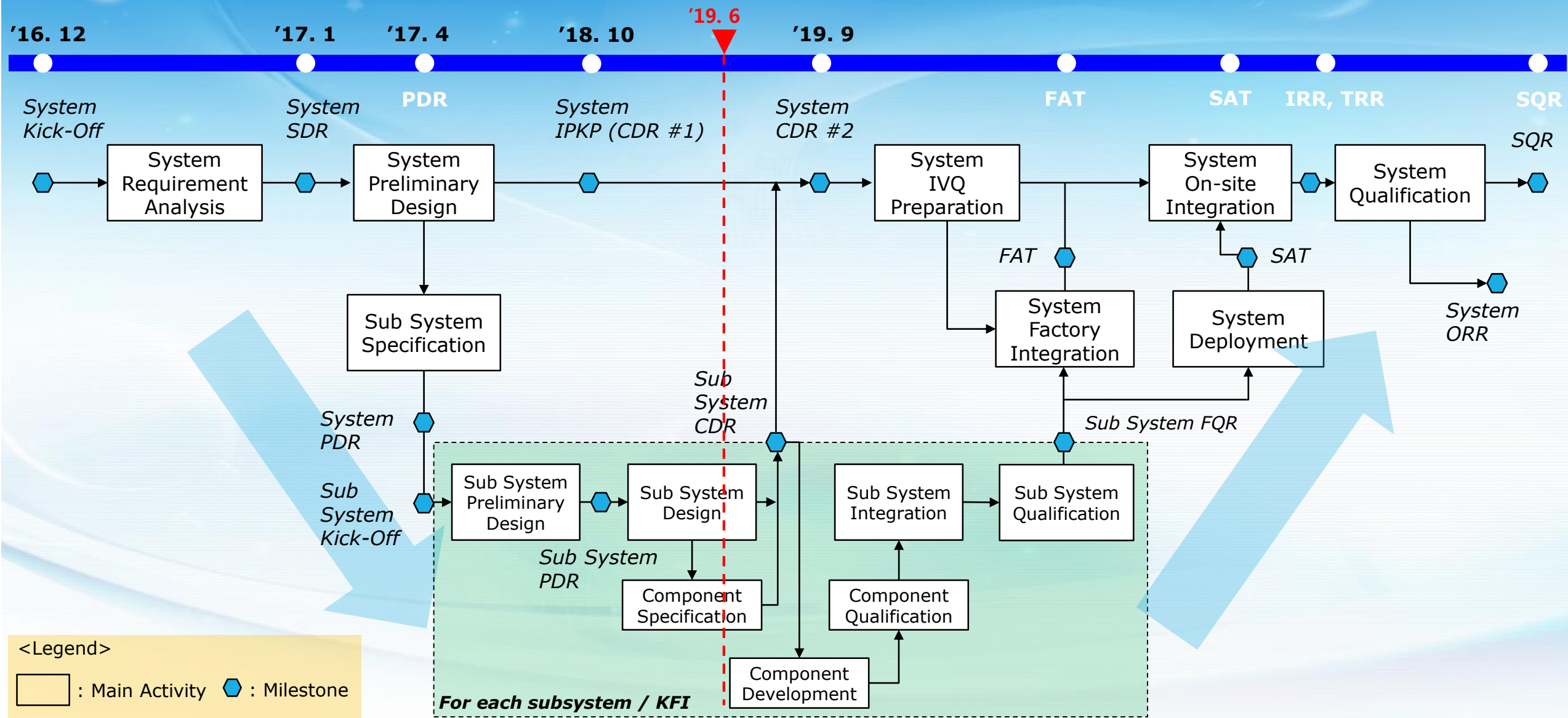




II. DEVELOPMENT STATUS



KASS Development Process

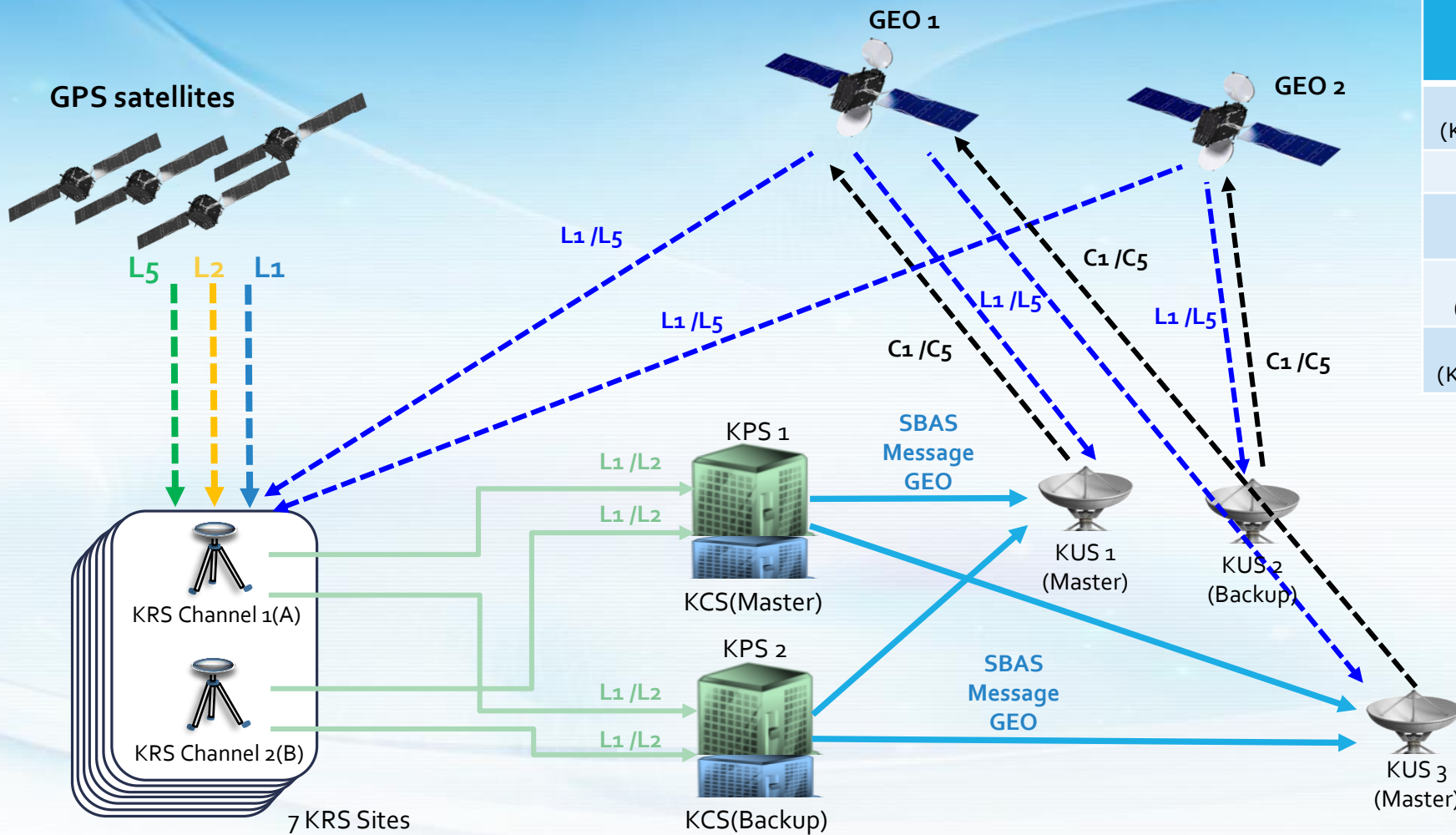


<Legend>
 [] : Main Activity [] : Milestone

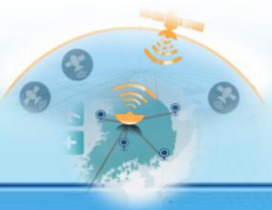
For each subsystem / KFI



KASS System Architecture



S/S (Sub System)	Qty. (Baseline)
KRS (KASS Reference Station)	7
GEOs	2
KUS (KASS Uplink Station)	3
KCS (KASS Control Station)	2
KPS (KASS Processing Station)	2



Sites for KASS system



KASS Operation Center #1 (Chungju)



KASS Operation Center #2 (Incheon)



KASS Uplink Station



KASS Reference Station



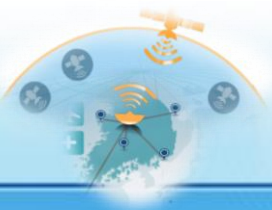
SBAS Message Broadcasting (2)



GEO Satellite

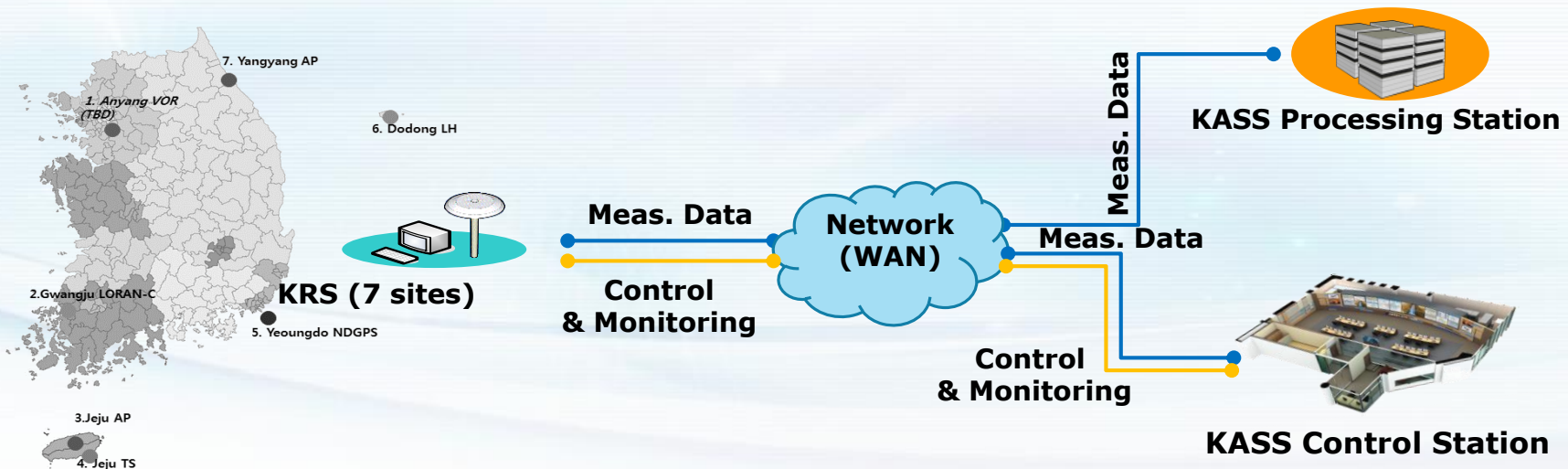
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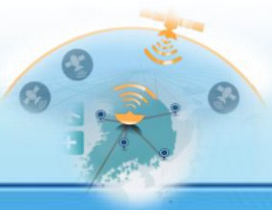
-  : KRSs
-  : KCSs & KPSs
-  : KUSs
-  : GEO satellites



KRS Overview

- ❖ The **KRS (KASS Reference Stations)** are the ranging and integrity monitoring stations of the KASS system used for data collection of the GPS and GEO measurement
- ❖ KASS acquires GPS and GEO measurement from 7 KRS and transmits the data to the KPS and KCS.
- ❖ **Each KRS consists of 1 Cabinet ***
 - KRS Cabinet : 2 KRS Channel*, 1 Frequency Standard, 2 FEE, RPMU, Sensors
 - * KRS channel : mainly composed by a GNSS antenna, a receiver and a core computer





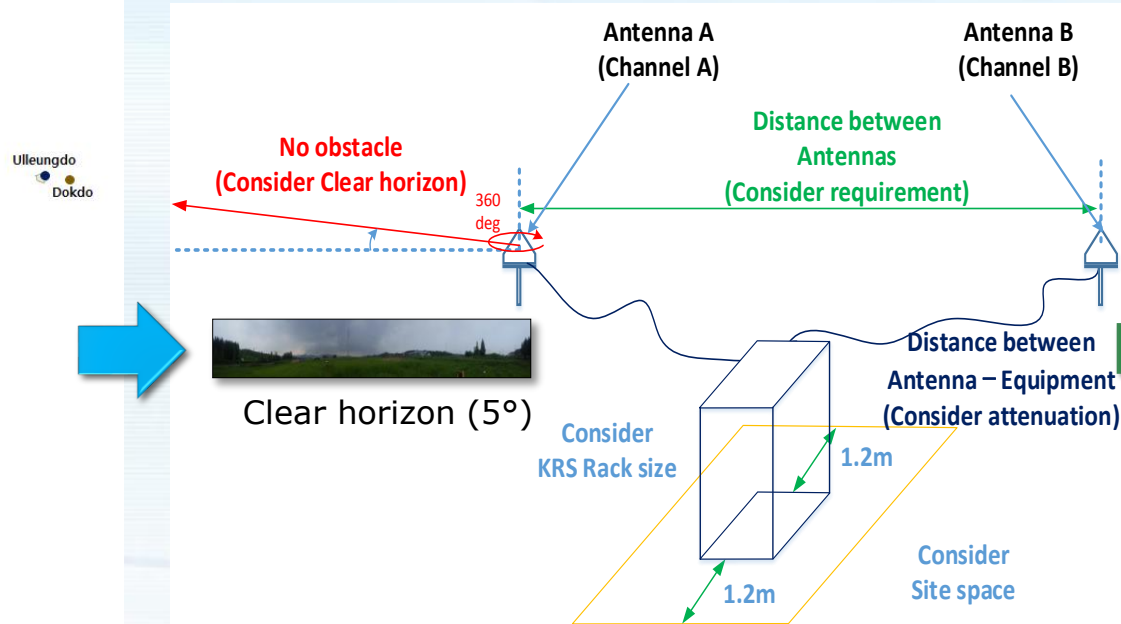
KRS Sites

- ❖ The survey was conducted for about 2 years in order to select the best KRS sites candidate. (KRS site candidates : 60 locations → 7 locations)
- ❖ 7 KRS sites were selected considering sufficient space for installation (the distance between the antennas), No obstacle (Clear horizon) and Good EMI(GPS band interference minimum).

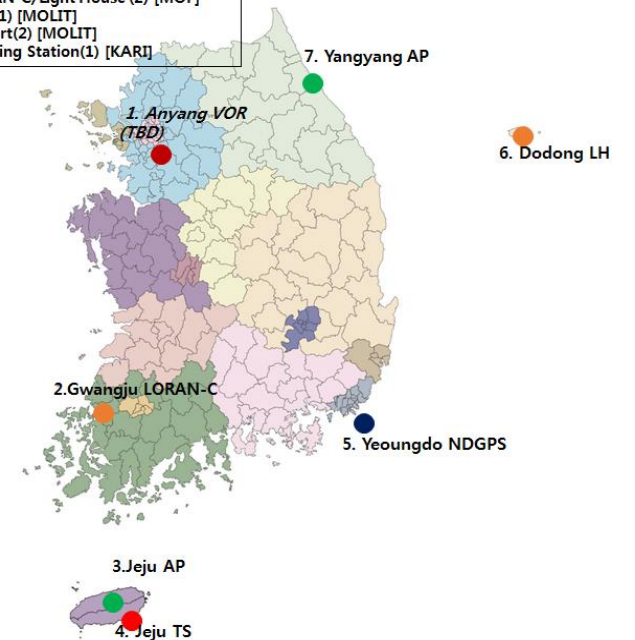
- NDGPS Reference Station(17) [MOF]
- NDGPS Monitoring Station(15) [MOF]
- VOR(10) [MOLIT]
- Airport(18) [MOLIT]



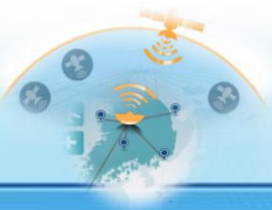
(Initial : 60 sites)



- NDGPS Reference Station (1) [MOF]
- LORAN-C/Light House (2) [MOF]
- VOR(1) [MOLIT]
- Airport(2) [MOLIT]
- Tracking Station(1) [KARI]



(Final : 7 sites)



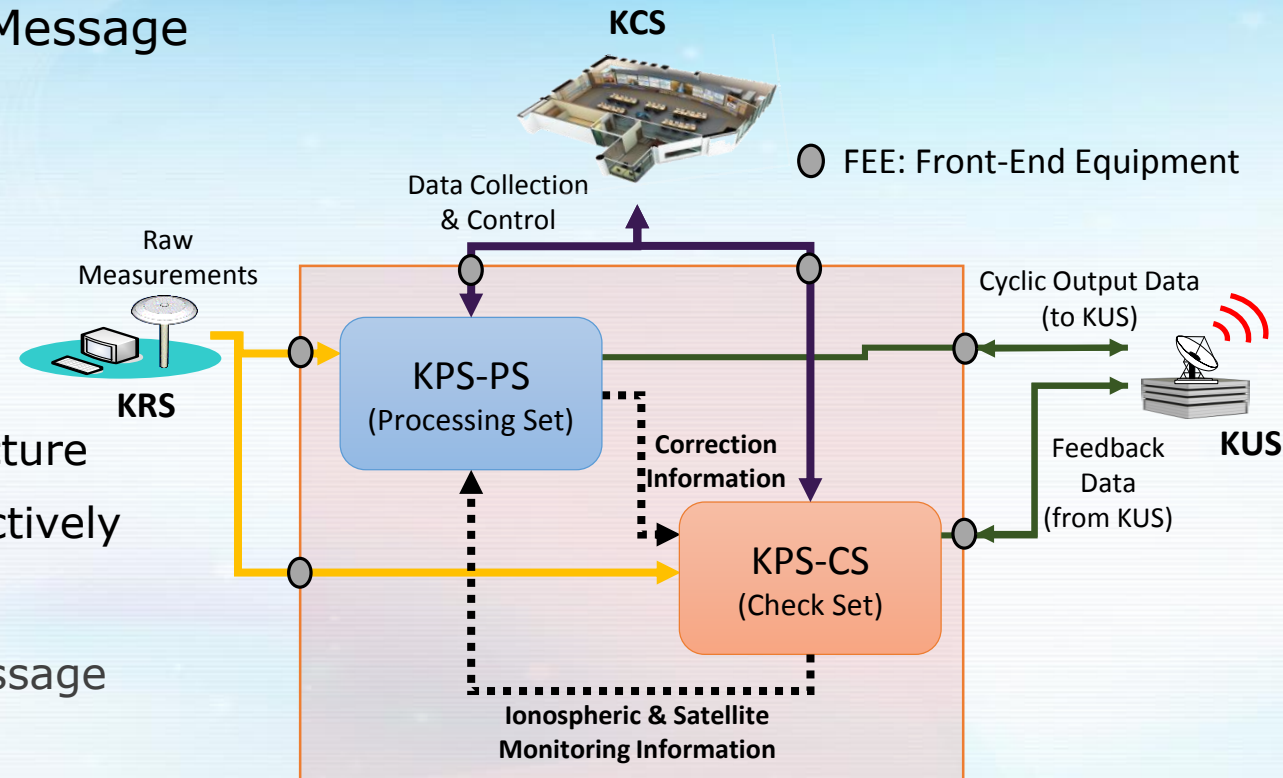
KPS Overview

❖ Main Roles of KPS

- **Generate SBAS Message** (Correction & Integrity Information)
- **Ensure the Integrity** of Provided SBAS Message

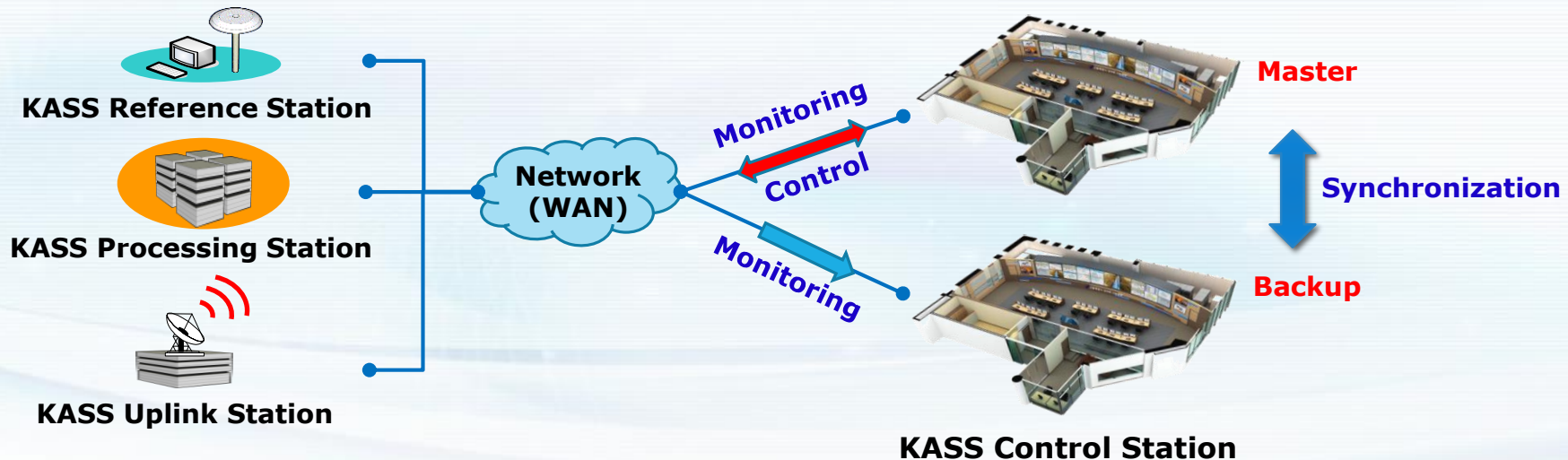
❖ Main Features of KPS

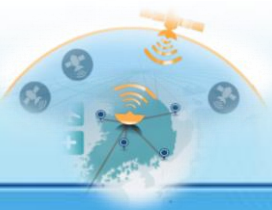
- Unmanned System
- Redundancy
 - There are two KPSs in KASS baseline architecture
 - Two KPSs are located at two MCC sites respectively
- Constitution
 - KPS-PS(Processing Set) : Generate SBAS Message
 - KPS-CS(Check Set) : Monitor SBAS Message
- Interface with All KASS Subsystems
- SW Development: DO-178B DAL-B



KCS Overview

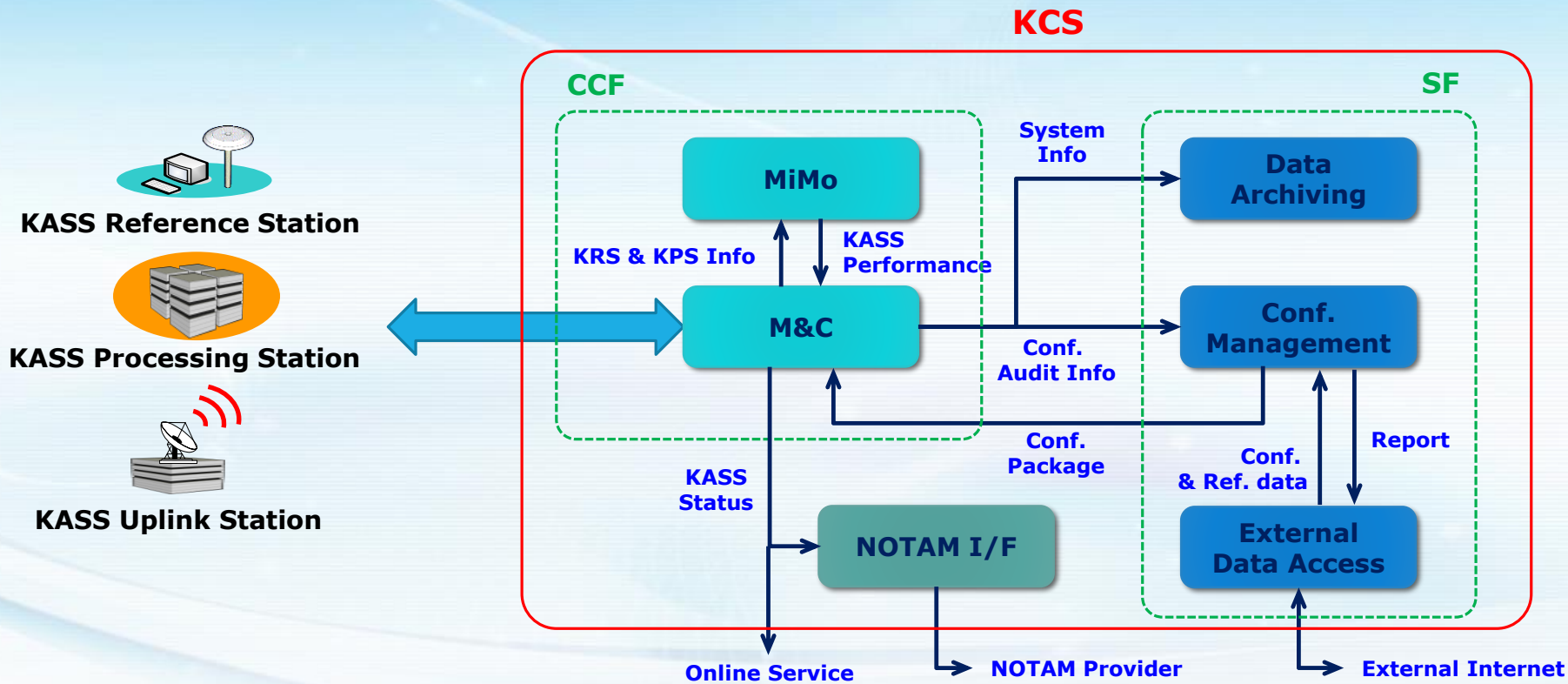
- ❖ **KCS (KASS Control Station) is in charge of the centralized supervision of the KASS System and Services**
 - Monitoring & Control (M&C) of KASS subsystem status
 - First level KASS Mission Monitoring (MiMo)
- ❖ **KCS is deployed in 2 distinct Mission Control Centers (MCCs)**
 - KCS has Master and Backup mode, and both KCSs are synchronized for the handover
 - Full control capability will be only possible through Master MCC



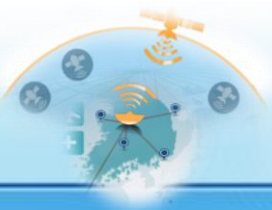


KCS Architecture

- ❖ KCS consists of 3 main components: Central Control Function (CCF), Support Function (SF), and NOTAM information Function



KCS Architecture



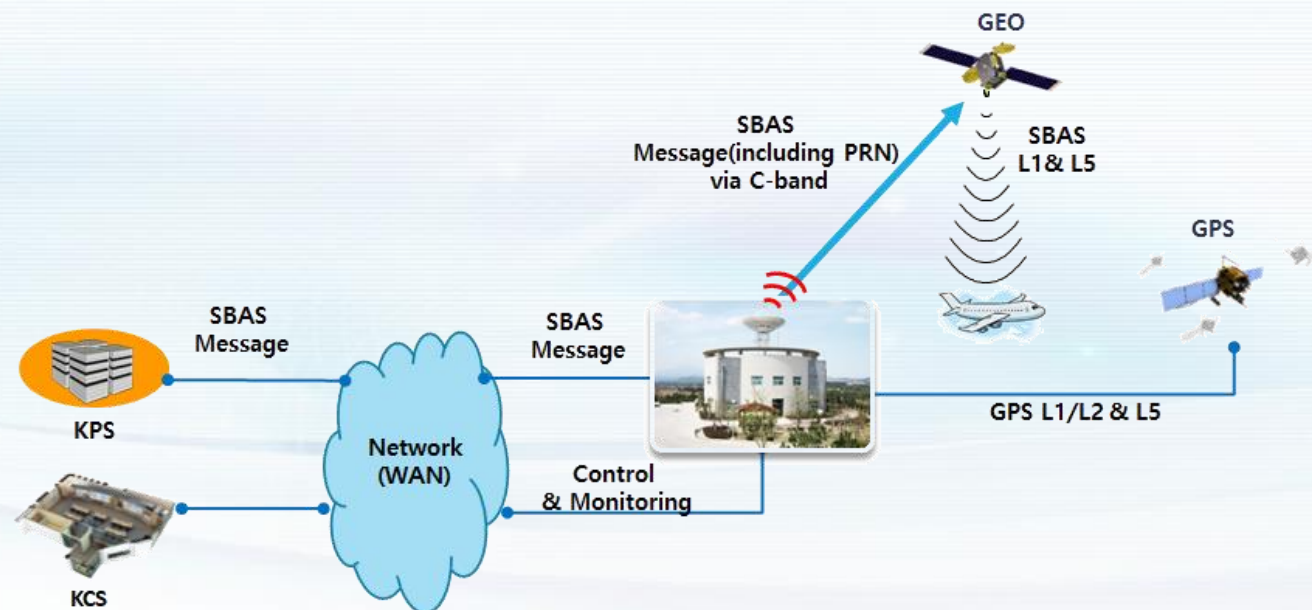
KUS Overview

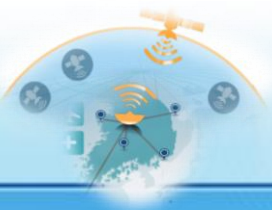
❖ KUS (KASS Uplink Station) is in charge of transmitting SBAS RF Signal to GEO Satellite

- Receive the Augmentation Message from KPS.
- Generate the PRN code, BPSK Modulation, Signal Amplify and then transmit the GEO satellite.

❖ KUS is deployed in 2 Site

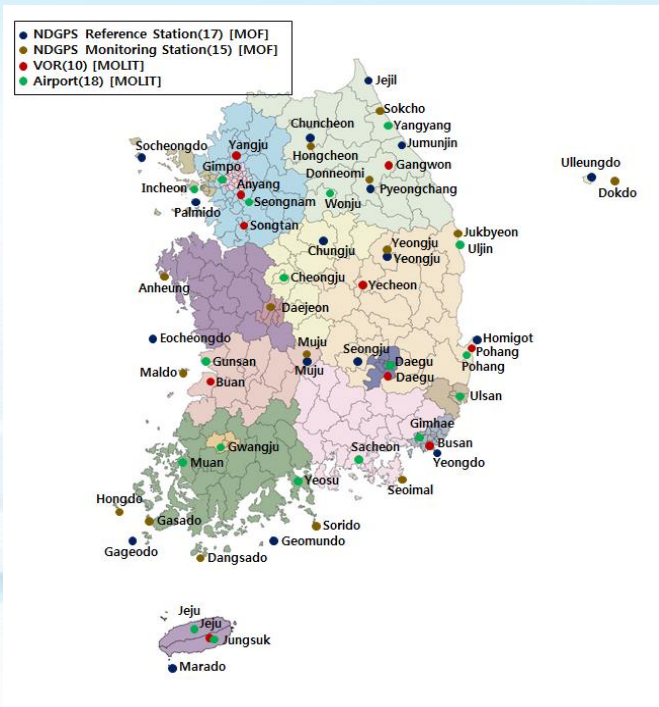
- KUS site consists of Primary and Backup Site.
- Primary site has a two(2) uplink station and Backup site has a one(1) uplink station.



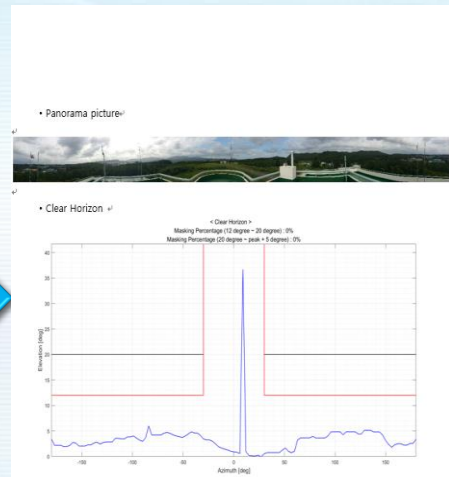


KUS Sites

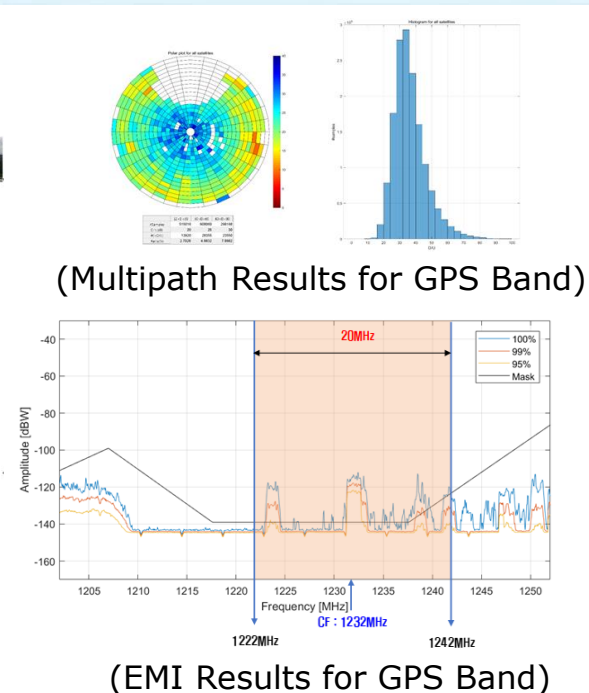
- ❖ To select the properly KUS sites, site survey was conducted during the 2 years.(KUS site candidates : 14 locations → 2 locations)
- ❖ KUS sites were selected by considering Clear horizon, Multipath and lower EMI for GPS L1, L2 and L5 band.



(Initial : 14 sites)



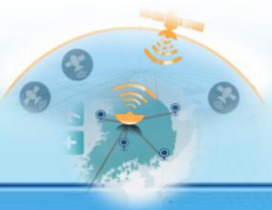
(Clear horizon > 12°)



(EMI Results for GPS Band)



(Final : 2 sites(Candidate))



WAN Overview

❖ Wide Area Network

- KASS ground segment is deployed on sub-system sites in Korea
- WAN is a system that provides telecommunication service between sub-systems
- WAN is aimed at ensuring the performance and quality of telecommunication

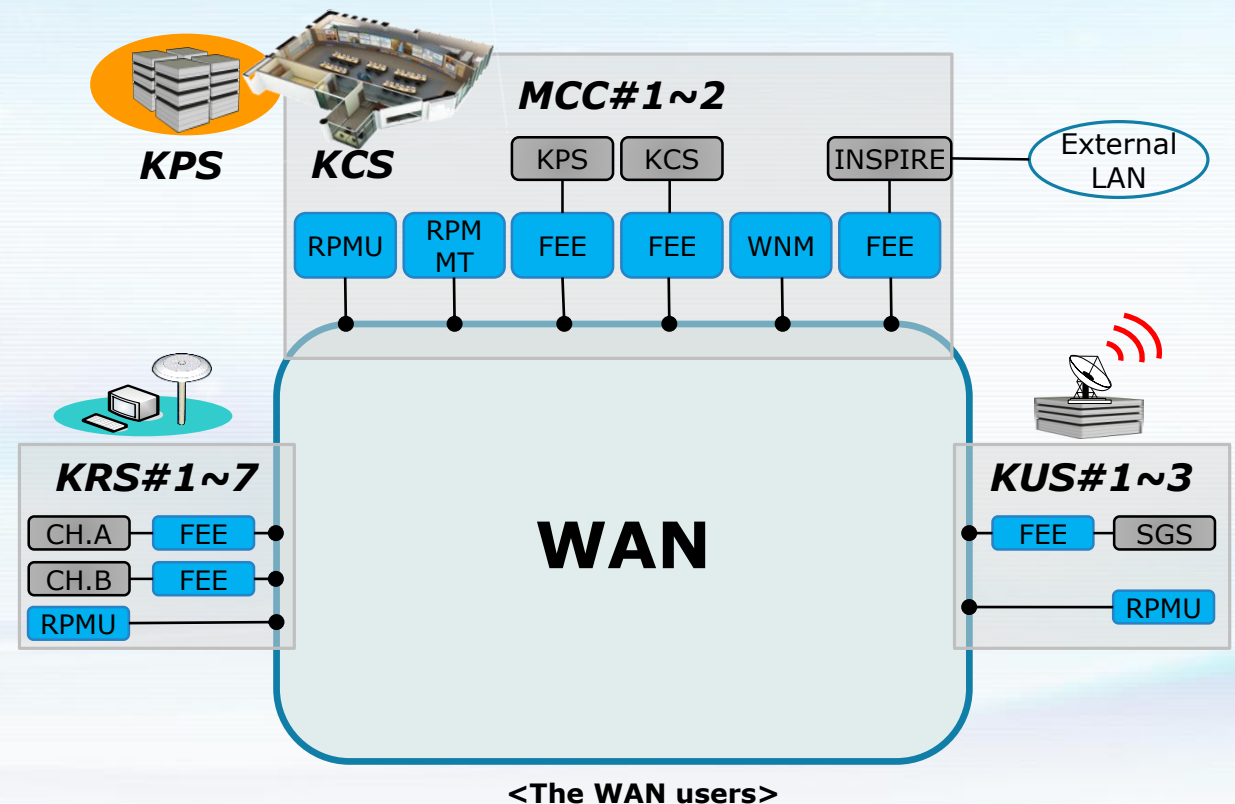
❖ Site Types

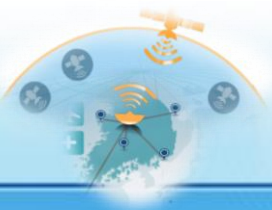
- 2 MCCs (KPS, KCS)
- 3 KUSs
- 7 KRSs

❖ Types of equipment per site types

	MCC	KRS	KUS
RPMU	○	○	○
FEE	○	○	○
RPM Maintenance Tool	○		
WNM	○		

- RPMU : Remote Power Management Unit
- FEE : Front End Equipment
- WNM : WAN Monitoring





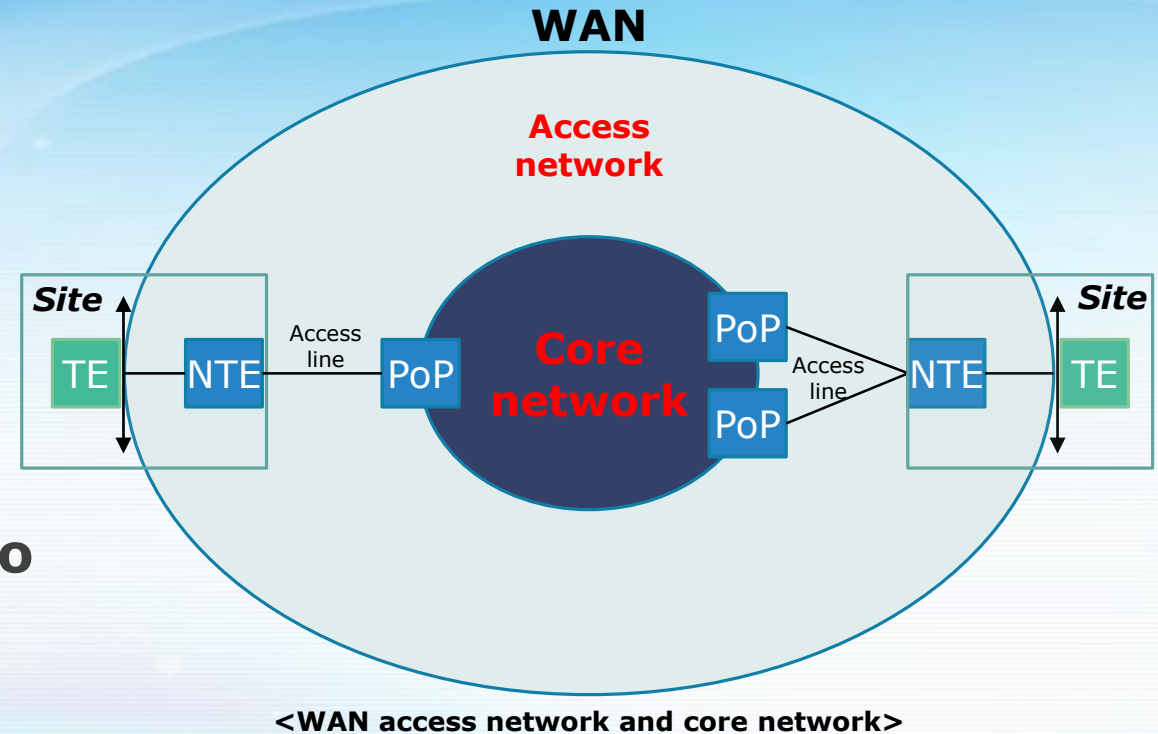
WAN Architecture

❖ WAN is divided into

- Access network (NTE, Access line)
- Core network

❖ The Access network connects the on-site TE to the Core network

❖ The Core network provides connectivity with the PoP assigned to reach the destination site



- NTE : Network Terminal Equipment, the WAN part installed in a KASS site
- Access line : one or two terrestrial access lines used for the connection to one or two different PoP's
- TE : Terminal Equipment, the set of subsystems using the WAN service
- PoP : Points of Presence



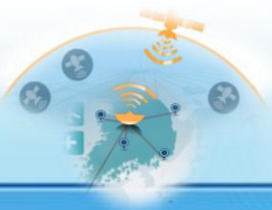
GEO and SBAS payload Acquisition Plan

			For Test and Open Service					For SoL Service				
			'18	'19	'20	'21	'22	'23	'24	'25	'26	
Original Schedule for leasing GEO			1 st GEO '18.12		◆	Open Service ('20.7)	◆	SoL ('22.10)				
			2 nd GEO '19.8									
Acquisition (lease) Plan	1 st GEO	New Satellite				'21 3Q	◆	Ktsat-Airbus				
	2 nd GEO	New Satellite						◆	TBD			

※ The plan may be changed after making contract of the 2nd GEO satellite



III. PERFORMANCE

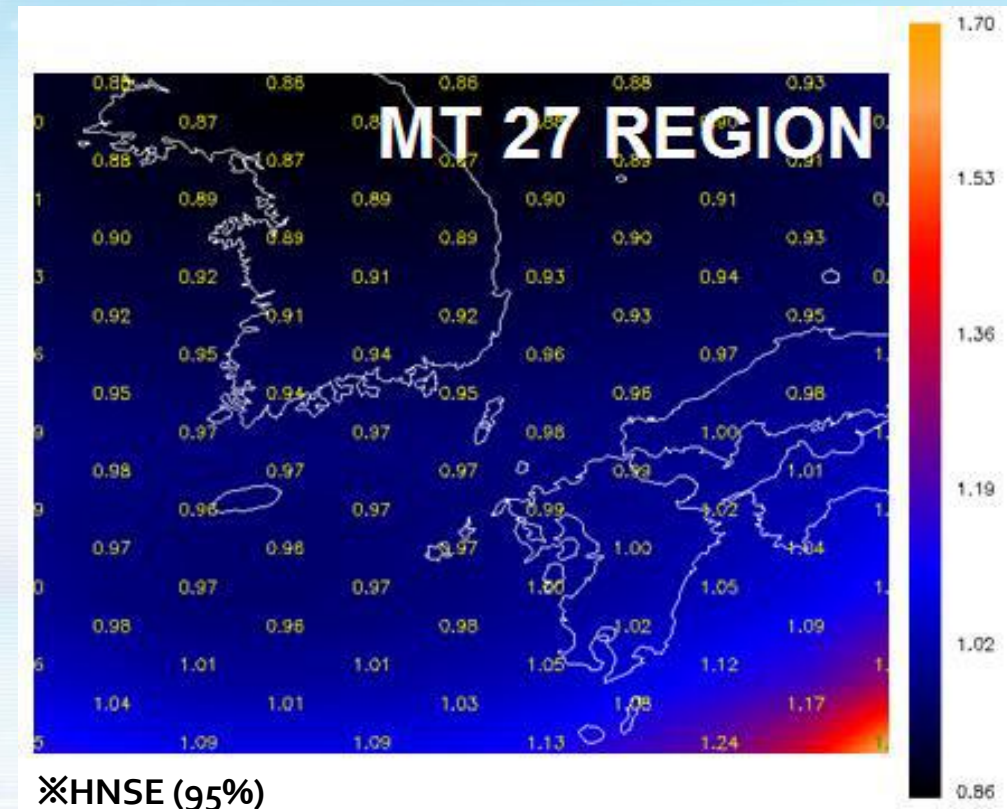


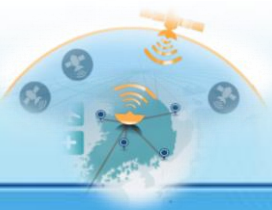
Open Service Performance

❖ Assessed availability performance is more than 99%

Performance	Best on LM*	Mean on LM*	Worst on LM*
Assessed availability performance	99.763 %	99.743 %	99.703 %
Assessed HNSE (95%)	0.87 m	0.92 m	0.97 m
Assessed VNSE (95%)	1.64 m	1.61 m	1.57 m

※ LM : South Korea Peninsula + Jeju Island

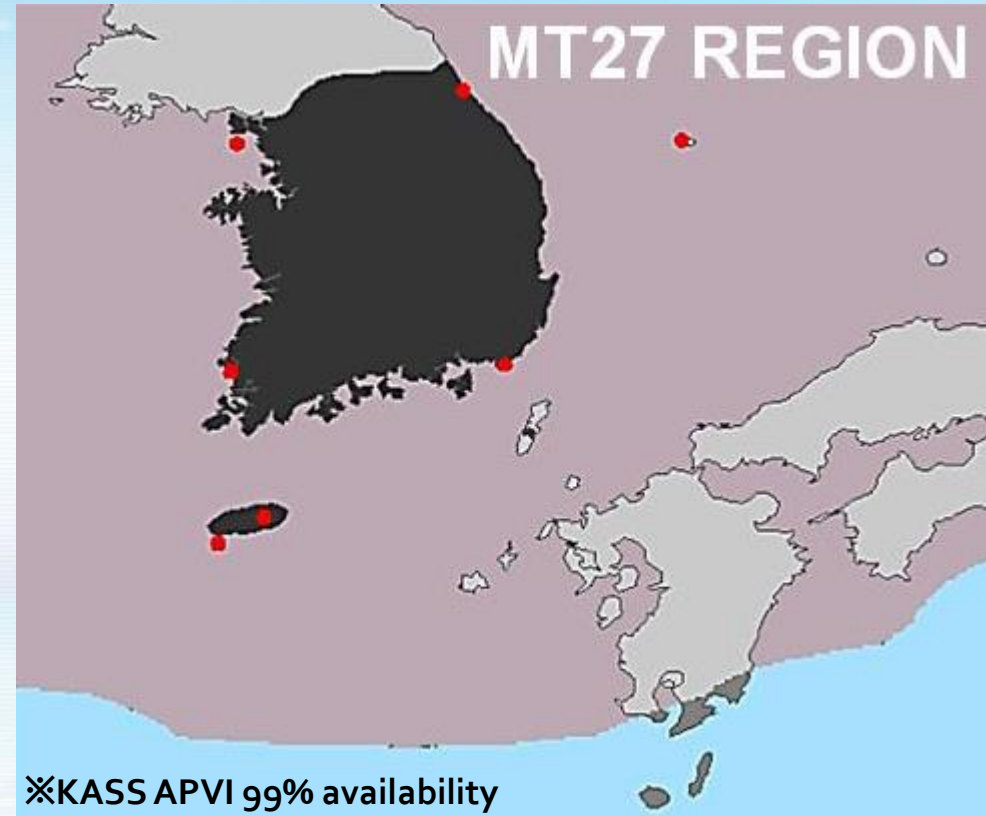




APV-I Service Performance (1/2)

- ❖ **Assessed availability performance is more than 99%**
 - South-Korea peninsula + Jeju Island are covered by the 99% compliance area.

Assessed availability performance (%)	Best on LM*	Mean on LM*	Worst on LM*
Fault Free	100	99.98	99.95
Including GPS failures	99.91	99.89	99.87
TOTAL including GPS + GEO + G/S** failures	99.763	99.743	99.703



※ LM : South Korea Peninsula + Jeju Island
 G/S : Ground Segment

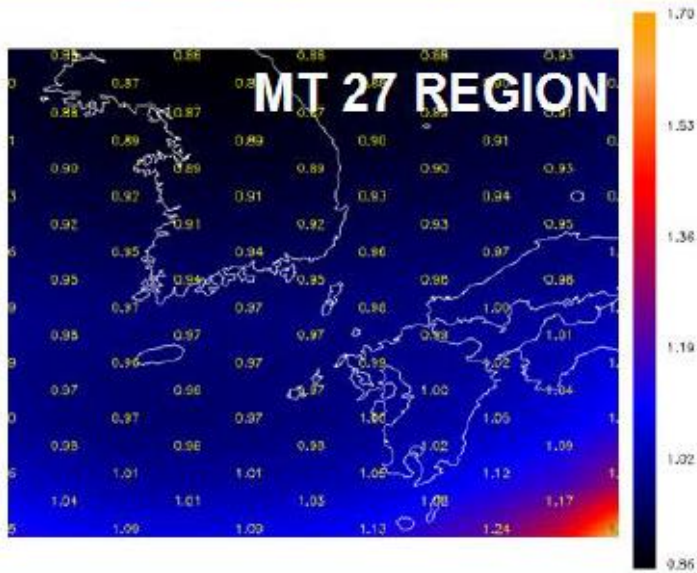
※KASS APVI 99% availability

APV-I Service Performance (2/2)

❖ Assessed accuracy

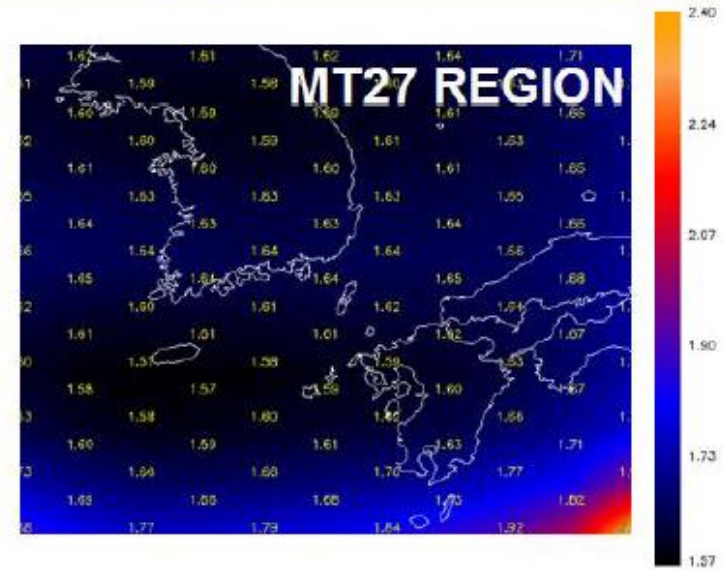
HNSE (95%) target < 20m

Performance on LM* (m)	Best	Mean	Worst
Assessed HNSE (95%)	0.87	0.92	0.97



VNSE (95%) target < 16m

Performance on LM* (m)	Best	Mean	Worst
Assessed VNSE (95%)	1.64	1.61	1.57

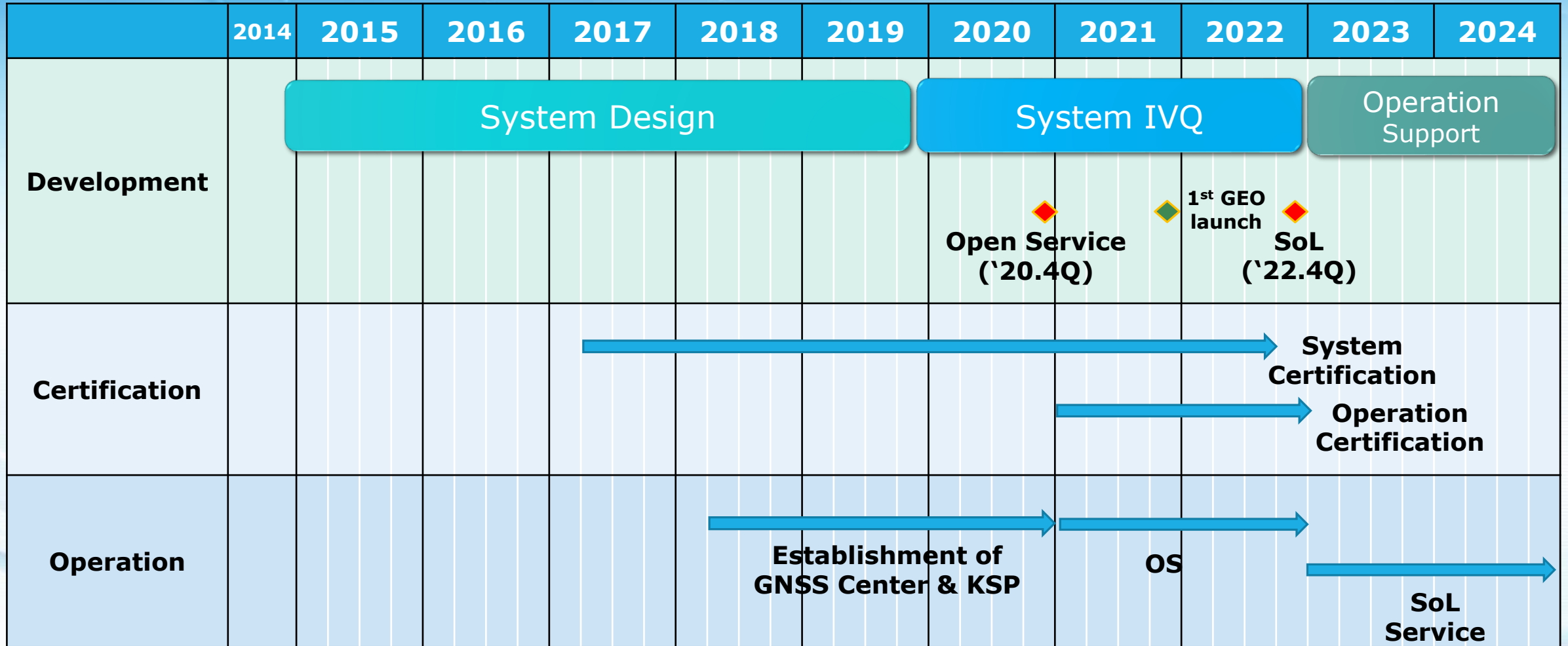




IV. FUTURE PLAN



Future Plan



Thank You!

