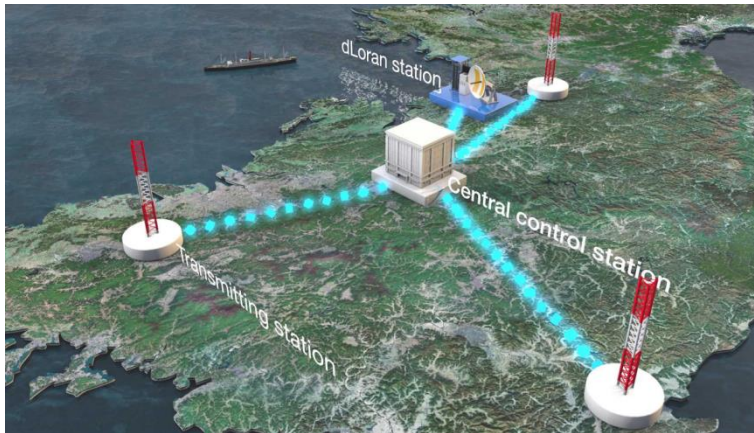


IALA ENG 10th Meeting

The Status of Korean eLoran Development & Implementation



September 30, 2019



Ministry of Oceans
and Fisheries

KRISO



Korea Research Institute of Ships & Ocean Engineering

Marine Safety & Environmental Research Division

Principal Researcher / Tae Hyun Fang



WHAT
GOAL

What is the goal and objective of eLoran Service?
Performance Requirements of eLoran Testbed

HOW
STATUS

How has eLoran project developed?
eLoran Project Status

WHEN
TIMELINE

What is the timeline for eLoran IOC / FOC?
Timeline for eLoran Implementation

IF
APP.

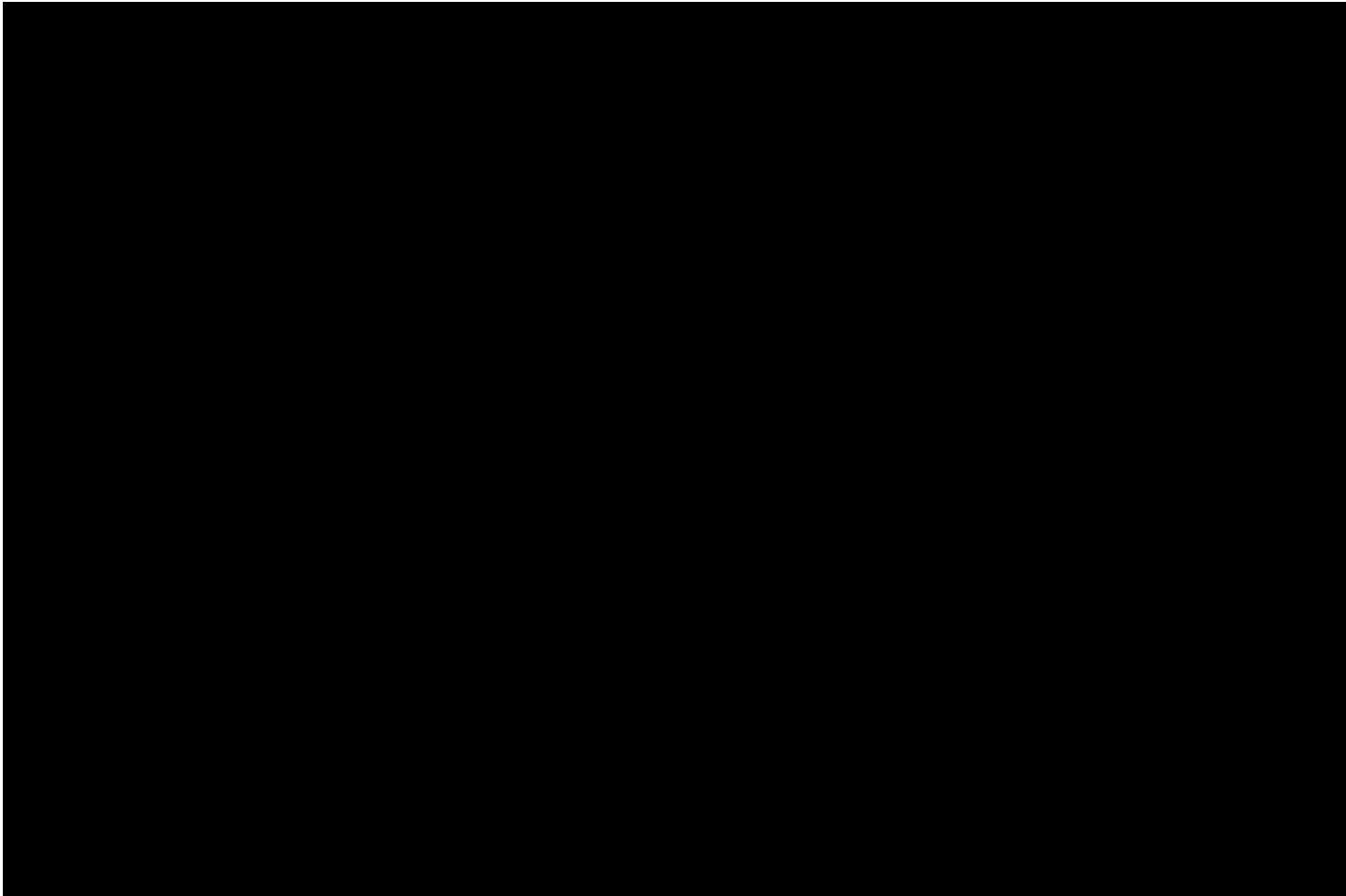
What is the future applications?
Applications of eLoran Service

1

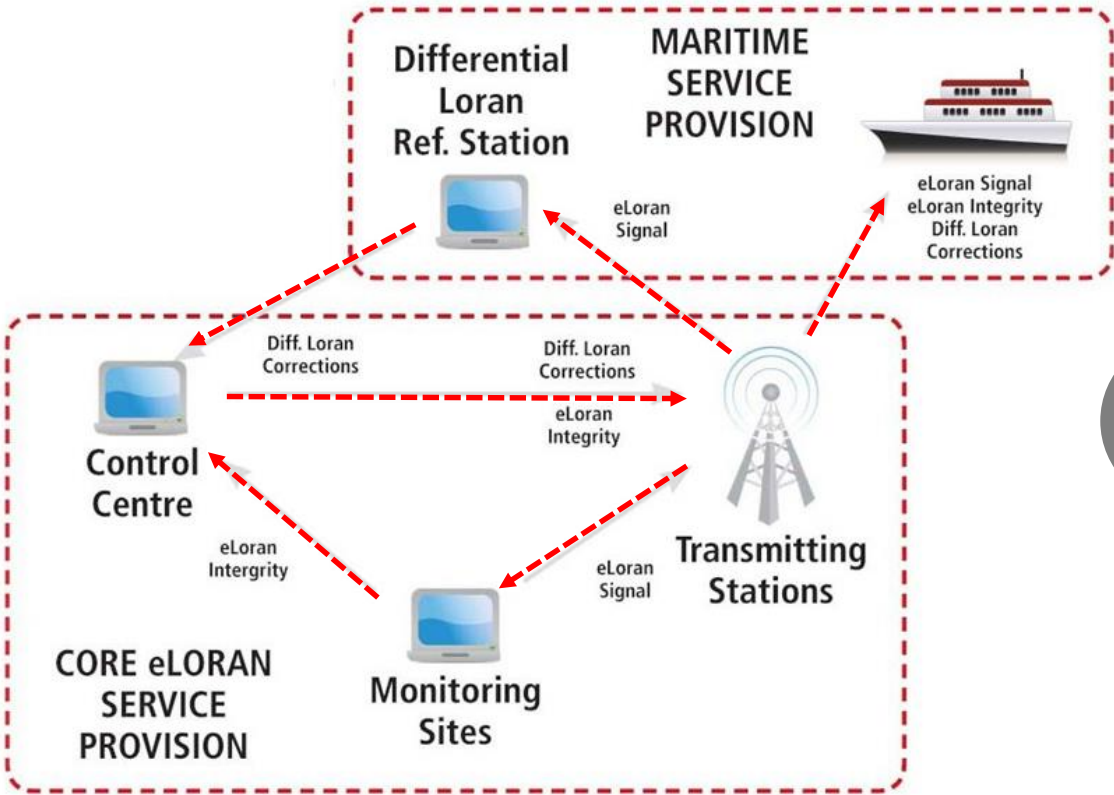
WHAT - eLoran

Introduction to eLoran Project

Introduction to eLoran Project



eLoran = Position, Navigation, Timing, and Data (PNT&D)



The first trial in Korea

Independent Navigation system

Meaning



GNSS Backup

PNT&D App.

*Ref.) ILA eLoran Definition Document
(<http://www.itsinternational.com/categories/location-based-systems/features/terrestrial-solution-to-stellar-shortcomings/>)

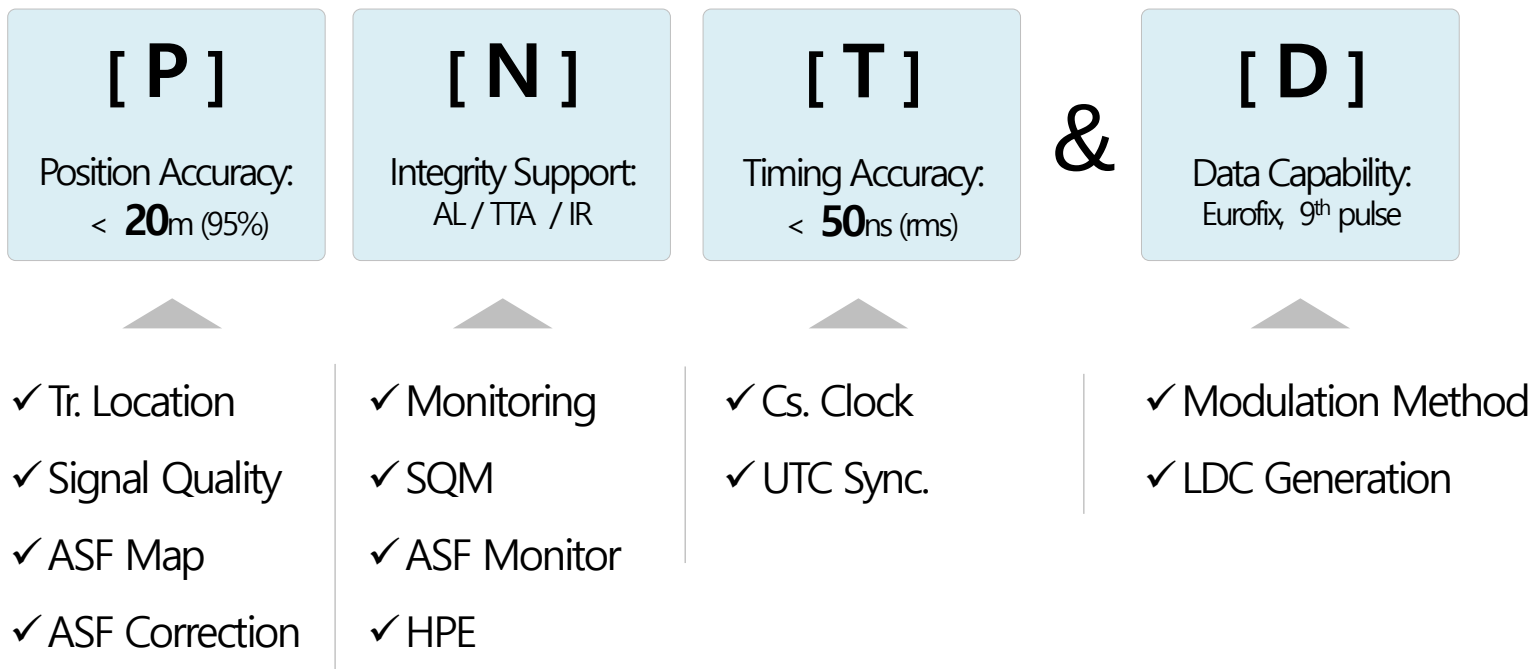
Project Goal & the Requirements

Building of Independent **eLoran System**



dLoran Coverage
< 30km

Requirement for **PNT&D** Service: **100%**
Based on eLoran Testbed Implementation



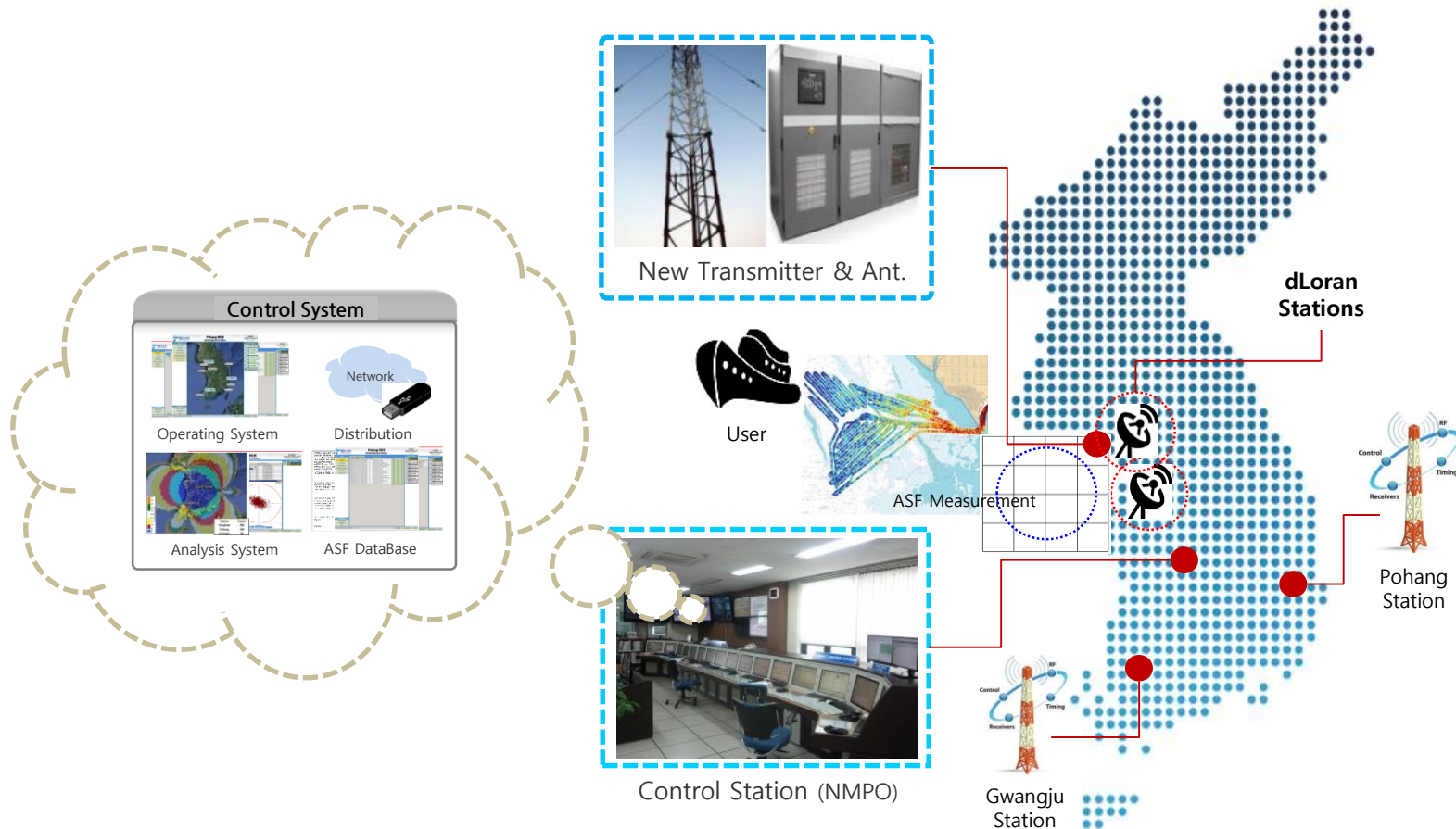
2

HOW - eLoran

Status of eLoran Project

Building of eLoran Testbed

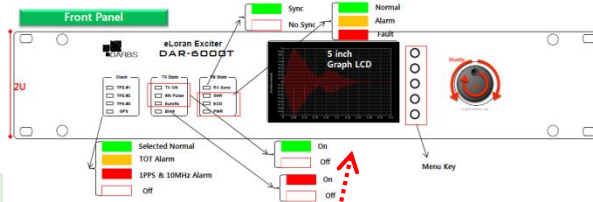
eLoran Testbed = New Tr. & Ant. + 2 Loran-C signals + 2 dLoran stations
(with ASF measurement & control station)



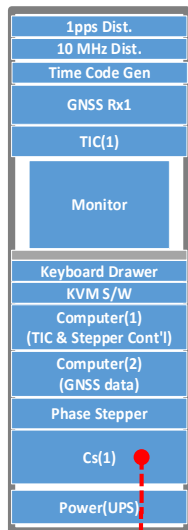
<Entire Configuration of eLoran Testbed System>

1. 50kW eLoran Transmitter

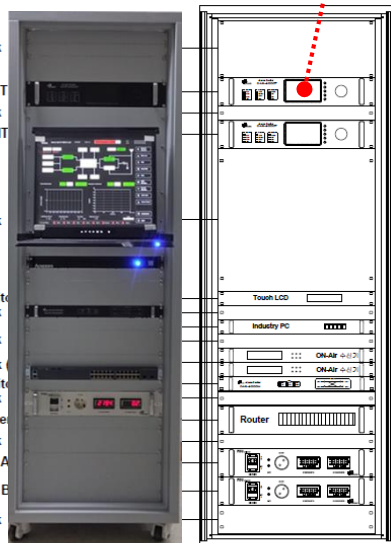
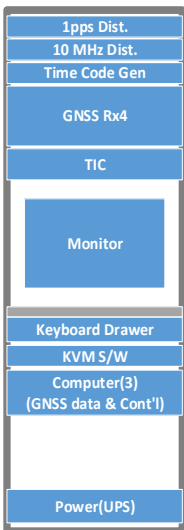
- ❖ Prototype of 50kW (ERP) eLoran transmitter
- ❖ eLoran Exciter and control system
- ❖ eLoran time synchronization system



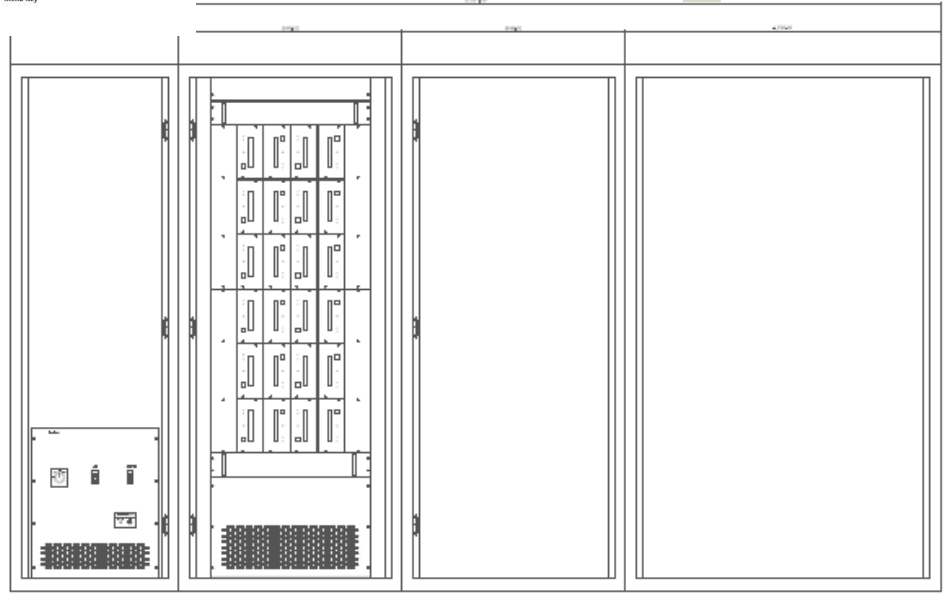
기준시 생성 시스템 1
(eLoran 송신국)



UTC-GPS
(KRISS)



120mm



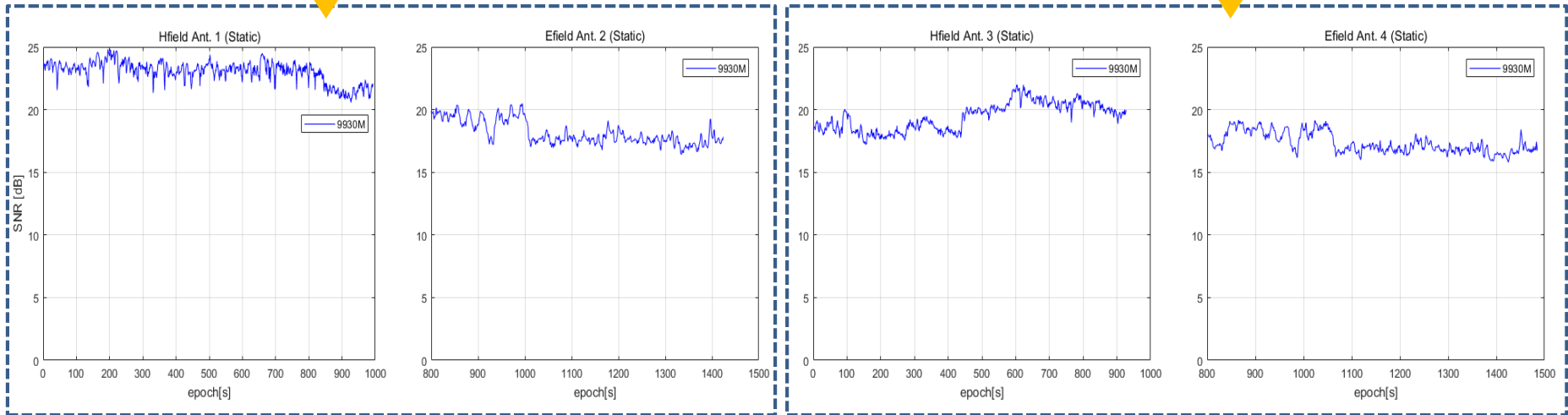
*Cs. Clock
redundancy



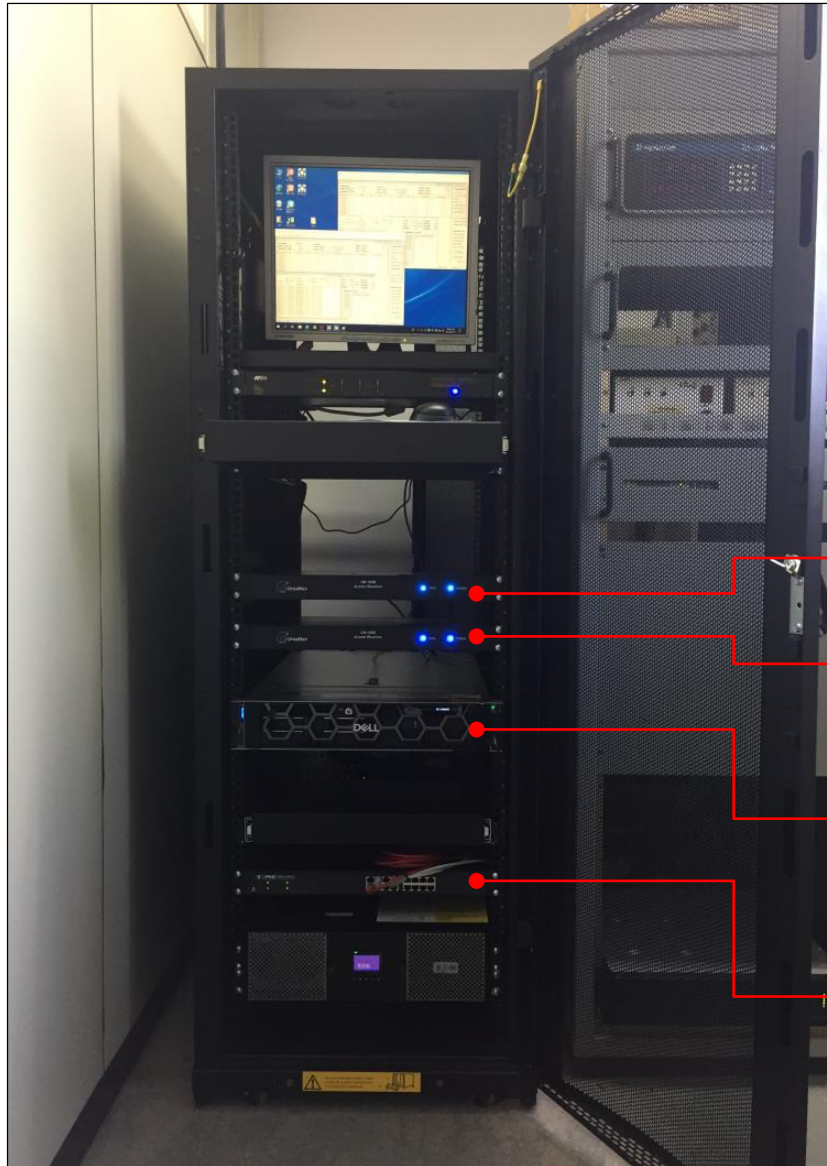
System configuration of eLoran transmitting station

2. Differential Loran (dLoran) Station

❖ Antenna Installation at dLoran station (Pyeongtaek)



❖ Build up the **Test dLoran** system



- ✓ dLoran RS/IM single system using eLoran receivers
- ✓ Performance analysis and dLoran RSIM capability test

RS Receiver (UN-152B)

IM Receiver (UN-152B)

dLoran RSIM S/W

Network Switch Hub

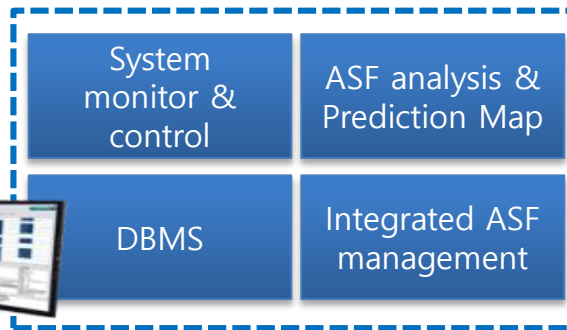
3. Integrated Operation & Control System (IOCS)

❖ eLM: eLoran RSIM message (60)

- control and monitor the eLoran systems
- 2 dLoran stations, 1 eLoran station and 2 Loran-C stations

0000	TITLE
0001	ELM MESSAGE QUERY/REPORTING INTERVAL
0002	ELM UNRECORDED MESSAGE ALARM
0003	ELM RESET COMMAND
0004	SYSTEM PARAMETERS
0005	ELM Diagnostic Report/Alarm
0006	ELM LORAN RECEIVER AND QC PARAMETERS
0007	ELM DIFFERENTIAL PARAMETERS
0008	ELM LORAN SIGNAL TRACKING STATUS
0009	ELM LORAN SIGNAL HEALTH CONTROL
0010	ELM LORAN SIGNAL HEALTH CONTROL
0011	ELM DATA LINK PARAMETERS
0012	ELM ALARM THRESHOLD
0013	ELM ALARMS
0014	ELM PRE-INTegrity CORRECTION DATA
0015	ELM POST-INTegrity CORRECTION DATA
0016	ELM ALARM
0017	ELM LDC MESSAGE SCHEDULE
0018	ELM CORRECTIVE ACTION PARAMETERS
0019	NO CORRECTIVE ACTION
0020	ELM CORRECTIVE ACTION
0021	ELM DATA LINK PARAMETERS
0022	ELM DATA LINK STATUS

Operation Console

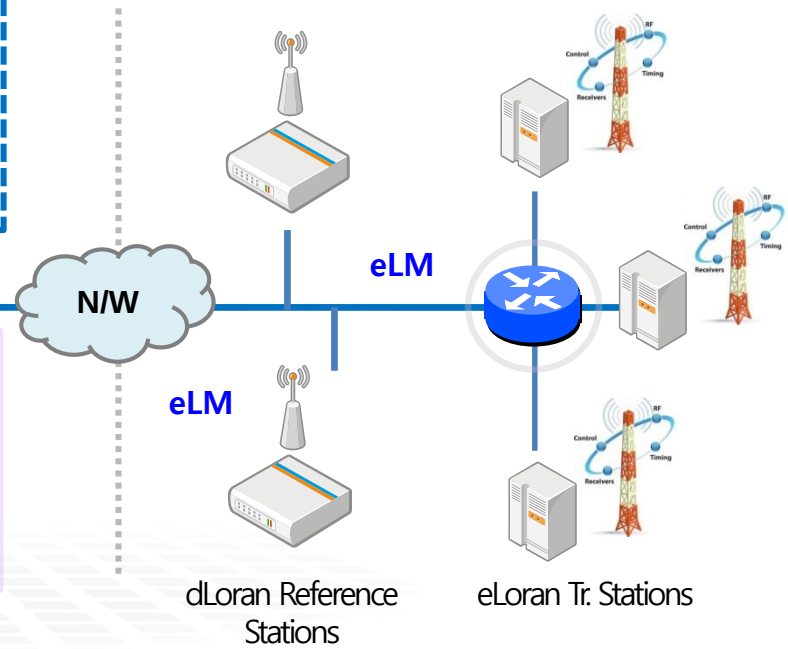


IOCS

eLM

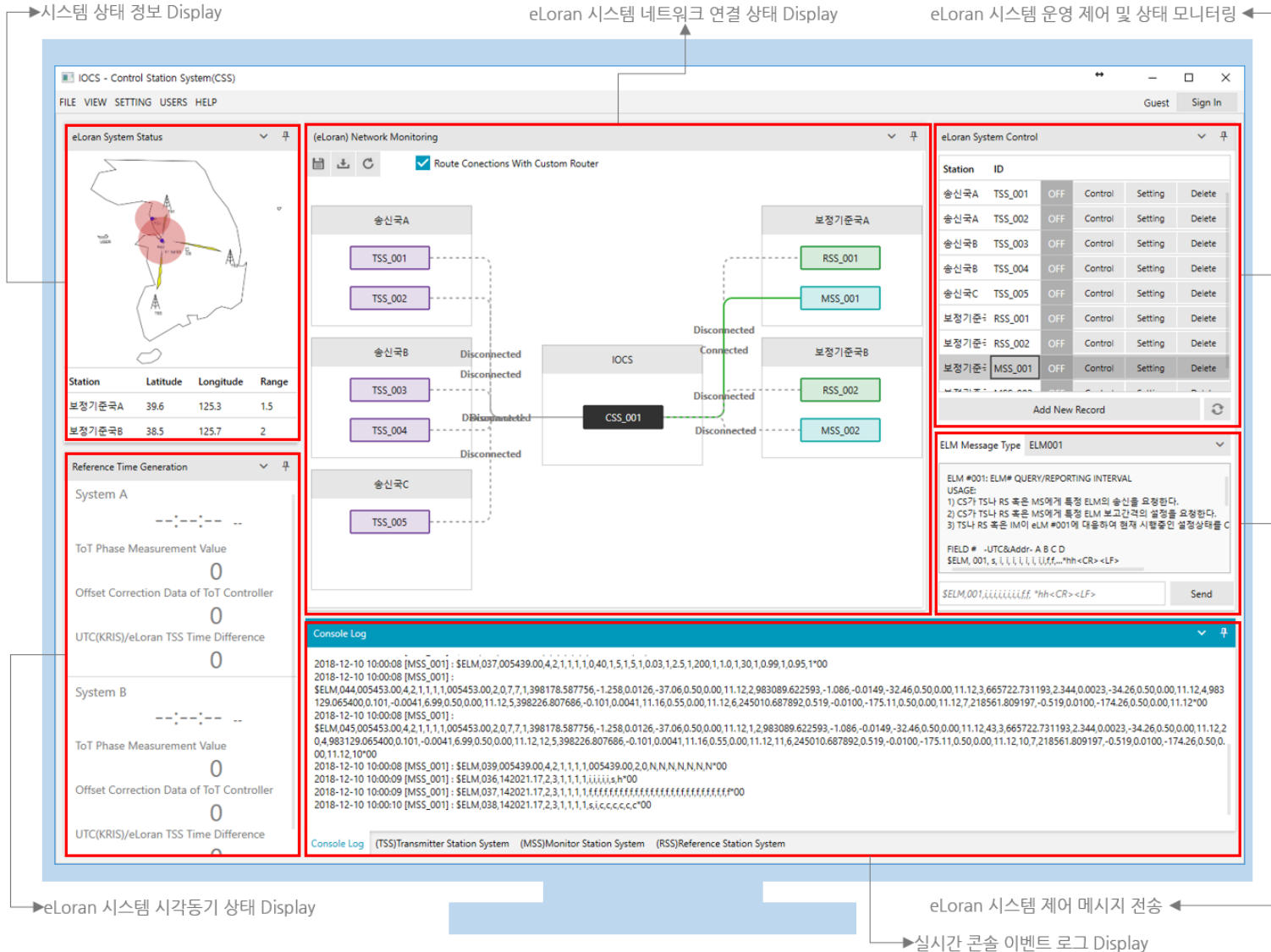


TCP/IP based Server - Client architecture
Temporal/Spatial ASF variation DB



<Configuration of Integrated Operation & Control System>

* IOCS : Integrated Operation & Control Server

❖ **IOCS – CSS** (Control Station System) **SW GUI**

<CSS GUI>

4. IOCS-RSS-MSS Interoperability Test

❖ RSS/MSS/IOCS Software

- Using real measurement, generation of eLM messages
- RSS, MSS, and IOCS operation using eLMs

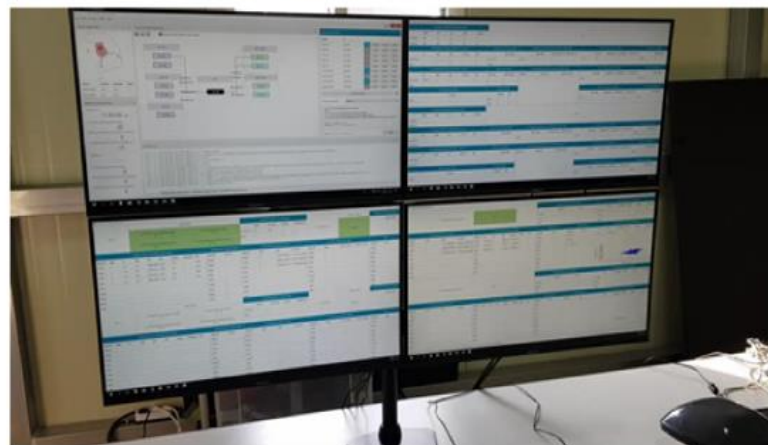
❖ eLoran Correction Procedure

- Exciter(eLoran signal) → RSS(corrections)
- TSS Exciter(LDC (9th pulse or Eurofix) modulation, and broadcast)
- eLoran receiver(demodulation, correction) → MSS(pre/post integrity check)



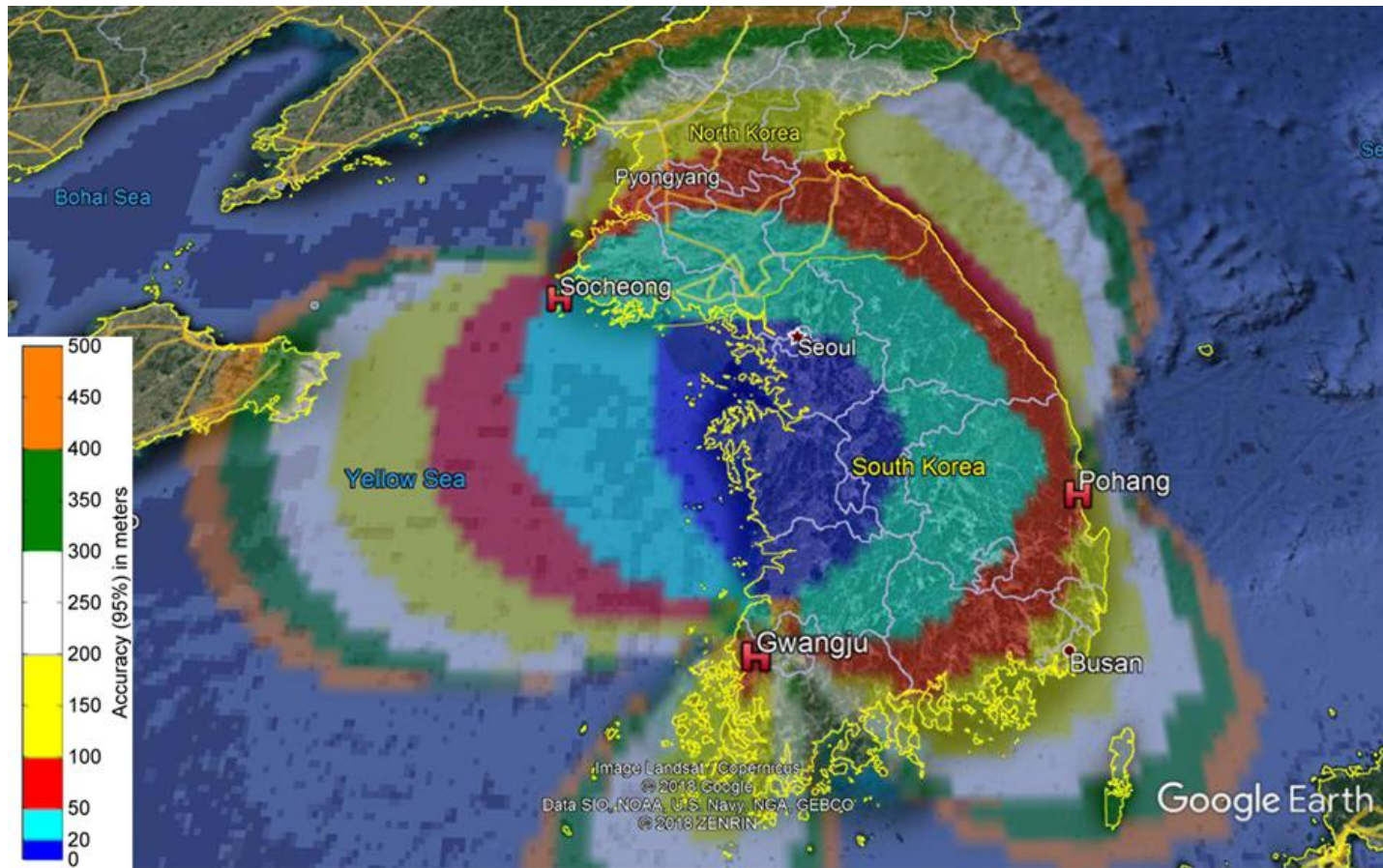
5. eLoran System Demo. : with MOF, eLoran TF & KRISO Consortium

(December 18th, 2018)



6. Performance Coverage of eLoran Testbed

✓ Pohang (150kW), Gwangju (50kW), Socheong-do (10kW)



<Position accuracy and signal strength>
(*Ref.: UrsaNav)

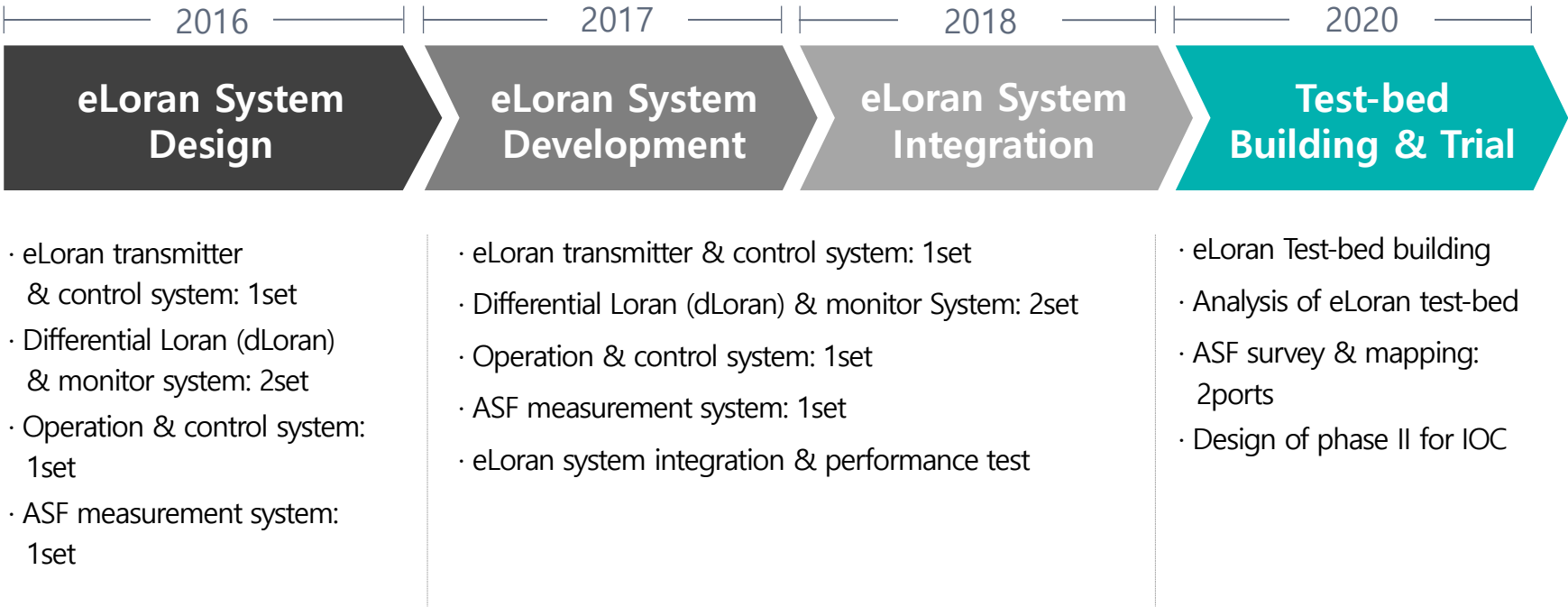
3

WHEN - eLoran

Project Timeline

Timeline for eLoran Service Implementation

✓ **PHASE I:** eLoran Development &Testbed Building / 2016 ~ 2020 (4.5yrs.)



✓ **PHASE II: eLoran Service Implementation for IOC / 2021 ~ 2023 (3yrs.)**



- eLoran trial service
=> test transmitting station

- Build up new eLoran transmitting station:
=> Antenna & system: Socheong-do
- Interoperation with dLoran systems and IOCS
- ASF survey & mapping
- eLoran system integration & performance test for IOC

- Design of phase II for FOC

4

IF – What is the future application

Applications of eLoran Service

Application plan of eLoran service

STEP 1

Adoption & application of developed eLoran system

- ✓ Implementation of Terrestrial Radionavigation System (Full Operation Capability)
- ✓ Commercialization of integrated eLoran/GNSS receiver 
- ✓ Application to time synchronized system of National infrastructure

Economic effect [Won]

Transmitter

95B

Receiver

5.6B

STEP 2

Expansion of application area for eLoran service

- ✓ Development of maritime P/N/T application system independent to GNSS (AIS / VTS / AtoN / V-Pass)
- ✓ Diversification of correction information service of DGNSS (RTCM information provision)
- ✓ Development of military tactical purposed navigation system
:: Mobile RS & Transmitter 
:: Encrypted Navigation Tech.
- ✓ Chip level eLoran receiver tech.
- ✓ Comm. channel for National disaster

Loss by jamming reduced
65.9B

STEP 3

Build up World Wide PNT system

- ✓ eLoran system buildup of Global PNT&D service available to arctic navigation



*Ref. eLoran planning report, MOF, 2015.

Final Goal:



For the Implementation of Independent Navigation System

**“Position, Navigation, Timing, & Data
(PNT&D) with Reliability”**

Special Thanks



thfang@kriso.re.kr

kyseo@kriso.re.kr

GPS signal applications

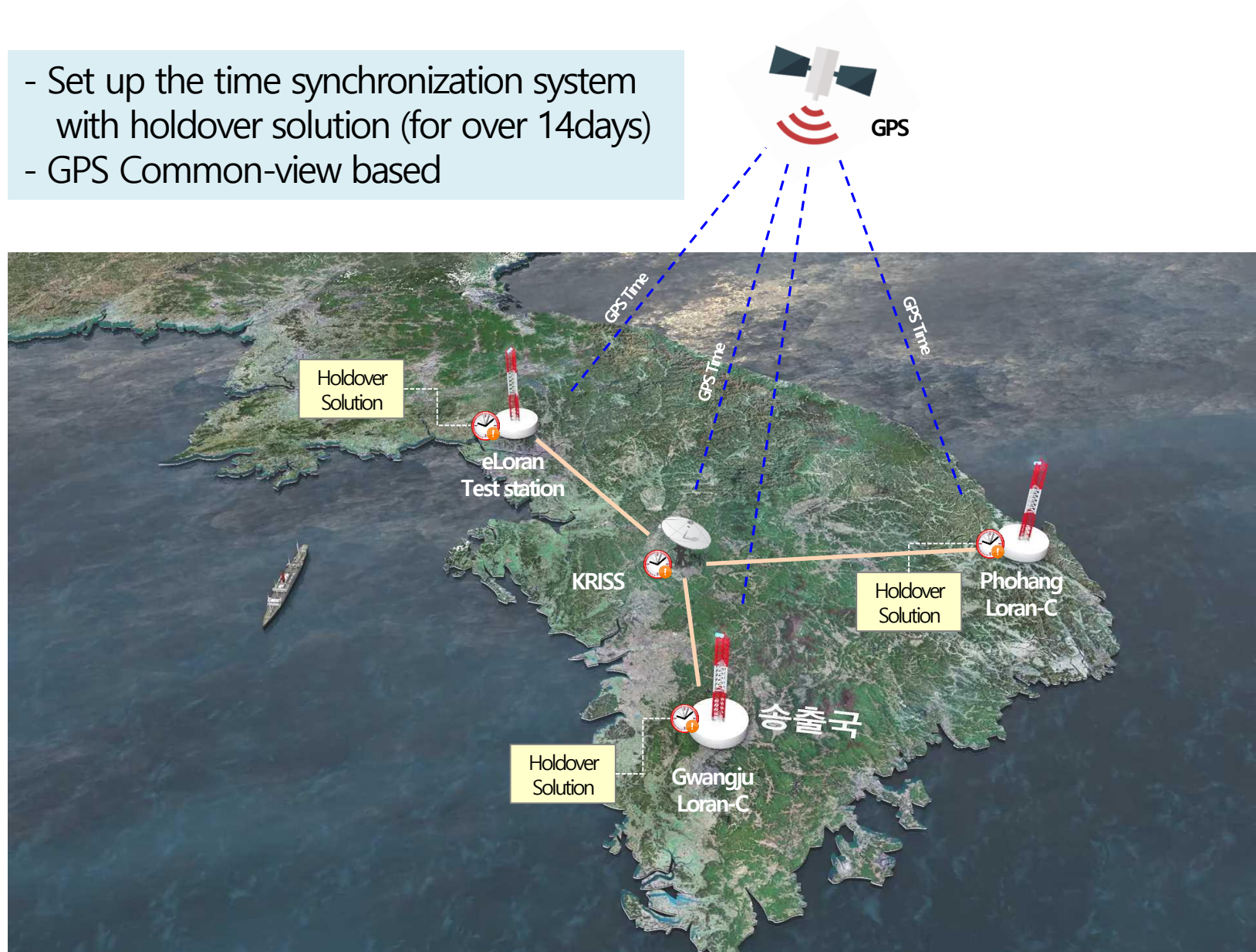
Category	Field	Contents
Time synchronization	Telecommunication	Synchronized system mobile communication base station
	Broadcast	T-DMB, Data Audio Broadcast (DAB)
	Finance	ATM service network, stock trading system
	Power	Smart grid
Positioning	Aviation	Navigation system, flight guidance or tracing system in airport
	Land traffic	Intelligent Transport System (ITS), vehicle position and logistics tracing system, automatic driving system
	Maritime	Navigation, sea fishing and fish tracing, port approach and traffic system
	Space	Satellite attitude control and orbit determination
	Etc.	Survey and mapping, vehide navigation, positioning on smartphone, emergency rescue, lost vehicles tracing, and farming

GPS signal interferences

Time	Region	Contents
August 23-26th, 2010	Gimpo, Paju and suburb area in northwest of Seoul	GPS loss cases occurred in airport, quality deterioration in communication base station (2G and WiBro)
March 3-14th, 2010	Suburb area in northwest of Seoul and Eastern oceanic region in Gangwon province	GPS loss on airplane and vessels, quality deterioration in communication base station
April 28th ~ May 13th, 2010	Northwest of Seoul	GPS loss on airplane, vessels, and boat

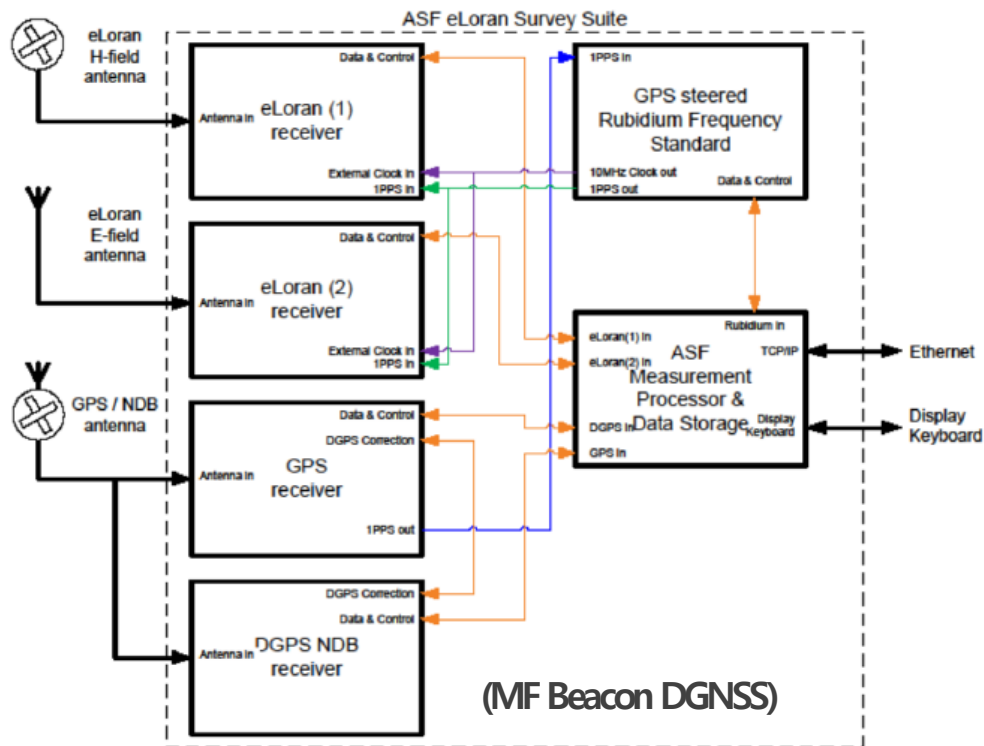
Implementation of Loran-C Time Synchronization System

- Set up the time synchronization system with holdover solution (for over 14days)
- GPS Common-view based



❖ Mobile ASF survey system

- ✓ Design of ASF surveying system
 - :: SBAS DGPS -> MF Beacon-based DGNSS



Block diagram of ASF survey system



ASF survey equipment