

GNSS Vulnerability Issues in Korea

May 14, 2013

Sang Jeong Lee
National GNSS Research Center
Chungnam National University
eesjl@cnu.ac.kr

Contents

- **GPS jamming in Korea**
- **GoK policy**
- **GBAS deployment plan**
- **JLOC as a National Agenda Program**

GPS Jamming in Korea

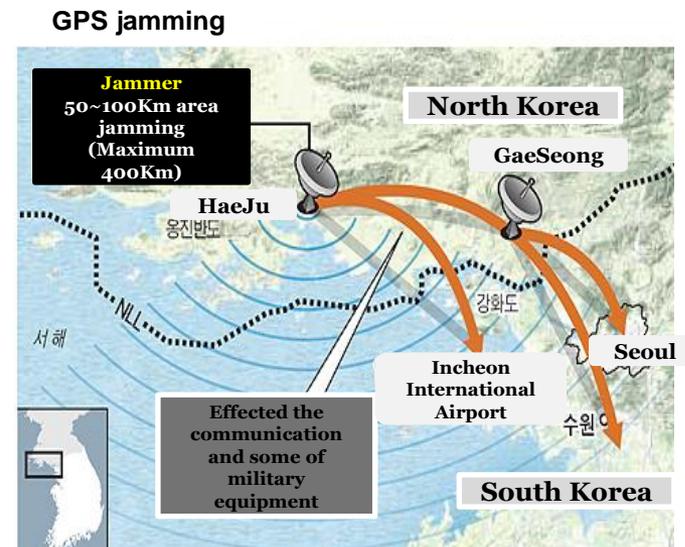
■ GNSS Vulnerability

- *Critical issue especially for infrastructure, e.g. airport, wireless communications network*

■ GPS jamming in Korea

- **GPS disruptions for the past three years due to North Korean jamming (reported by the Central Radio Management Office of South Korea)**

Dates	Aug 23–26, 2010 (4 days)	Mar 4–14, 2011 (11 days)	Apr 28 – May 13, 2012 (16 days)
Jammer locations	Kaesong	Kaesong, Mountain Kumgang	Kaesong
Affected areas	Gimpo, Paju, etc.	Gimpo, Paju, Gangwon, etc.	Gimpo, Paju, etc.
GPS disruptions	181 cell towers, 15 airplanes, 1 battle ship	145 cell towers, 106 airplanes, 10 ships	1,016 airplanes, 254 ships



GoK Policy

- **GNSS vulnerability issues in civil applications**
 - **GBAS deployment plans**
 - **Widely deployed wireless communications network**

- **Governmental policy**
 - **International cooperation**
 - **ICAO, ITU**
 - **Development of countermeasures**
 - **Field manuals in case of jamming**
 - **Jammer location technology**

International Cooperation

■ **ITU(2012.05.11)**

- **the problem about ‘whether the North Korea jamming violate or obey the international regulation’**

■ **ICAO(2012.07.05)**

- **Expressed serious concern about North Korea's GPS jamming and urged to prevent recurrence of similar incidents**
- **ITU and ICAO will conduct joint research about the impact of GPS jamming in the international civil aviation**
- **Notice the decision of the board of directors for all 191 ICAO member states**

National Countermeasures

- **Ministry of Security and Public Administration (2012.12, 2013.02)**
 - **prepare the field manual in case of GPS jamming**

- **Korea Communications Commission (2013.02.18)**
 - **operate the warning system and GPS emergency response team**

- **Development of Countermeasure for Safety of Life application**
 - **GBAS Development plans (2010~2014)**
 - **JLOC as National Agenda Program (2010~2015)**
 - *To protect integrity, ground facilities must quickly detect the presence of any hazardous interference falling within the restricted band used by GNSS*
 - *To protect availability, ground personnel must be able to quickly locate and deactivate the interference source*

GBAS Deployment Plans

■ Issues and Needs in Korea

- Amount of the Air traffic increases 5% per year in Korea
- Mountainous terrain over 70%, Airspace & Route are restricted due to MOA
- Difficult to implement two-way ILS service in some airports
- Demand for new green technologies for the aircraft operation

* MOA : Military Operating Area



GBAS CAT-I Operational Technology Development Program

● Purpose

- Establish the GBAS Approval Process for Korea
- Build up the National Research Infrastructure and the GBAS Demo. Airport
- Develop the Research Capability for GBAS Technology

● Schedule

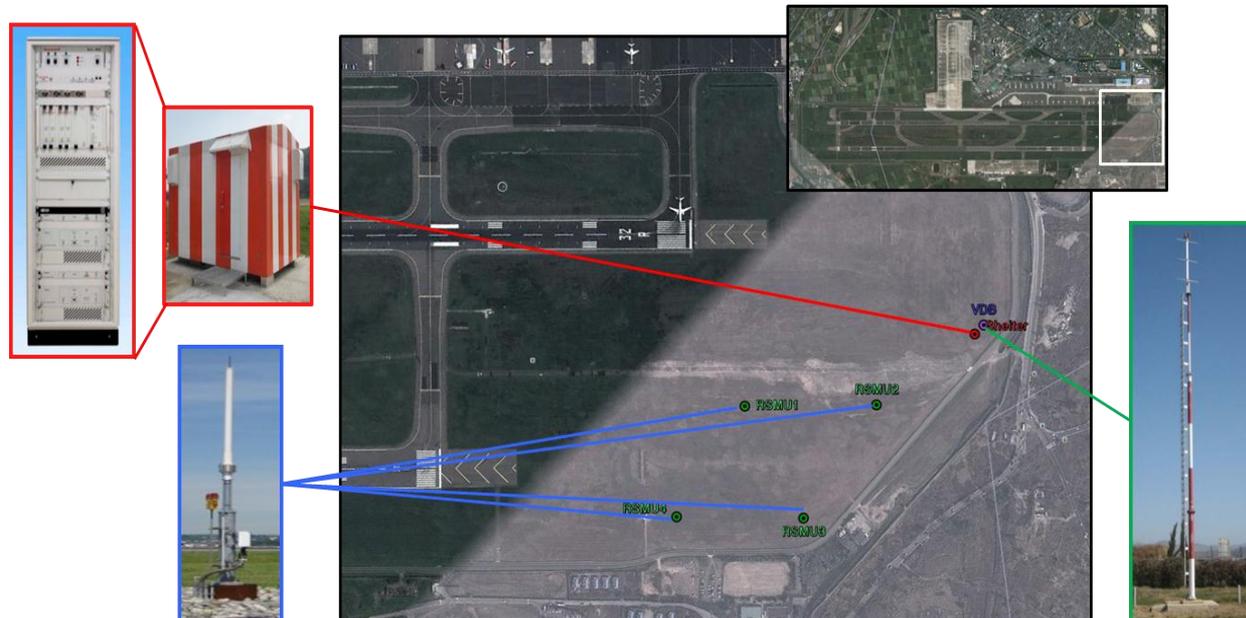
- 2010. 10. ~ 2014. 8. (3 Years and 11 Months)

● Supported by MLTM (*Ministry of Land, Transport and Maritime Affairs*)

● Scope

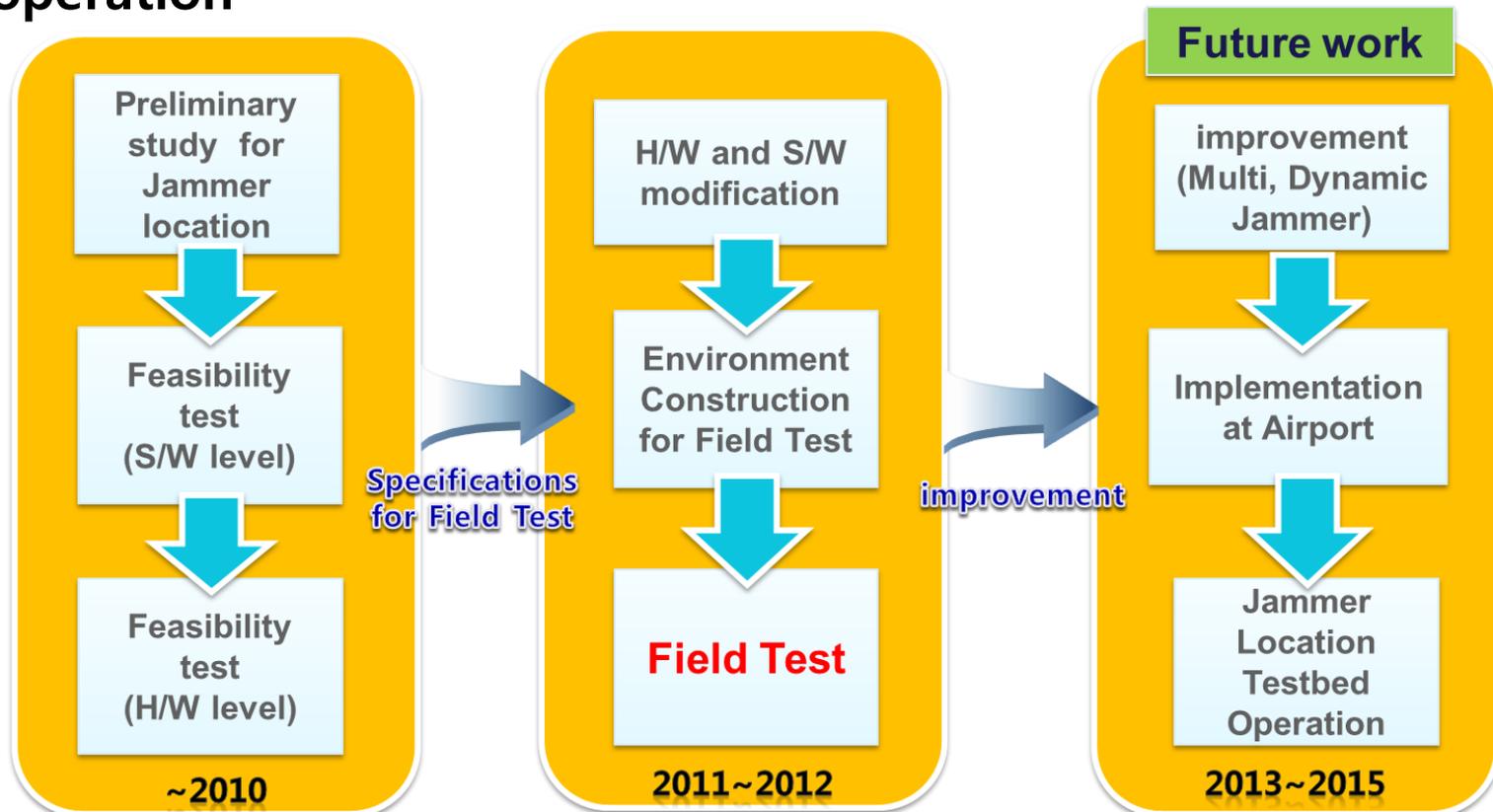
- Establish the FAA Certified System at the GBAS Demonstration Airport
- Develop the T&E Equipment and System for Approval Activities; SDA, FA, OA
- Build up the Government Approval Process and TDP
- Establish the Korean Ionosphere Threat Model
- Improve the Integrity S/W with Field Data Verification

- Finished Site Survey/Site selection and started civil work for installing GBAS Ground system at Gimpo Airport.
- Developed Test Equipment and decided Testing/Inspection Requirements for Ground/Flight testing and inspection of GBAS
- Designed GBAS Flight Procedure(ILS-like) for GLS
- GBAS Ground system will be installed into Gimpo Airport by the 2nd Quarter of this year.



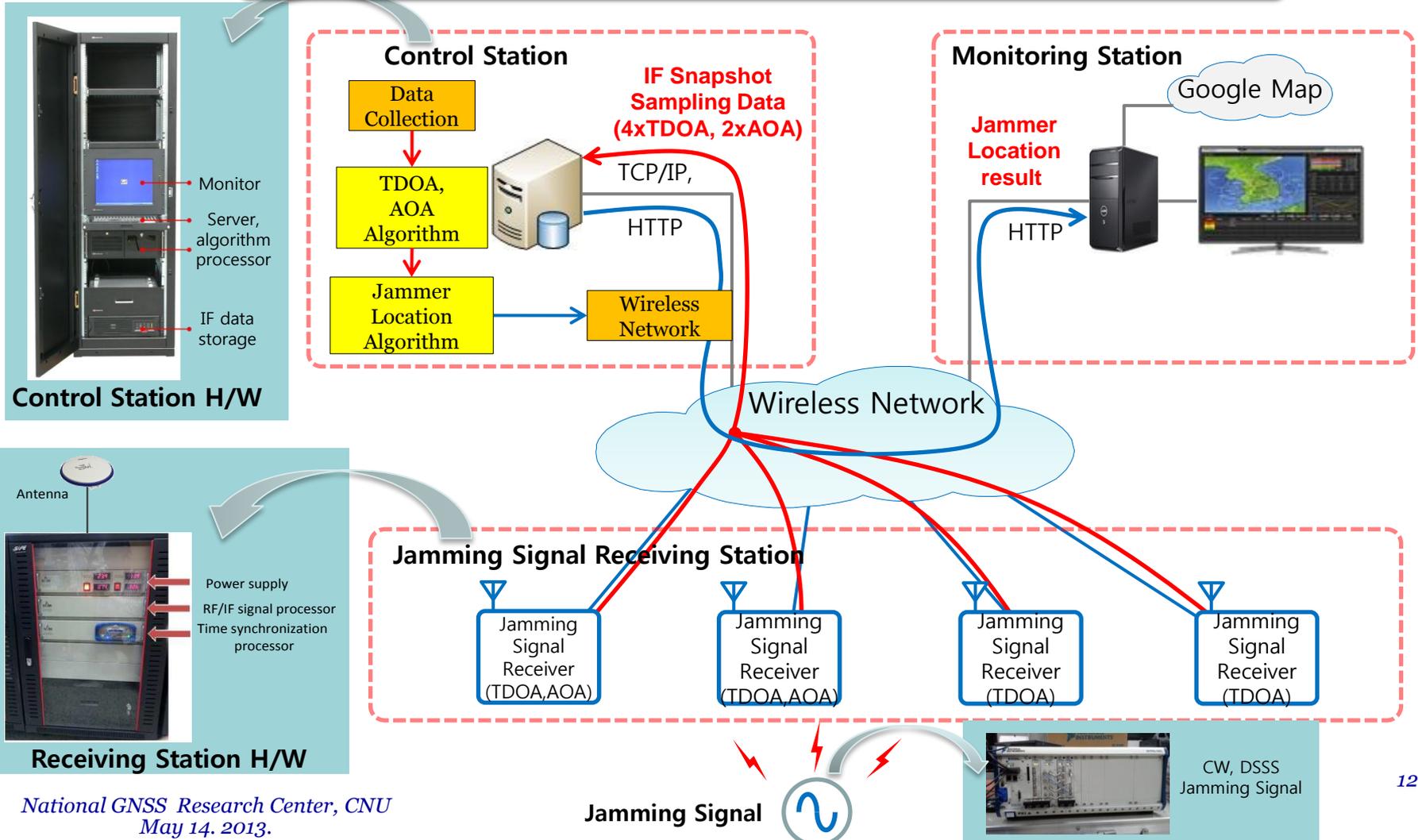
Jammer Location Technology as a National Agenda Program

- Funded by Korea Research Council of Fundamental Science Technology in 2010~2015
- Development of Jammer location technologies for GBAS operation

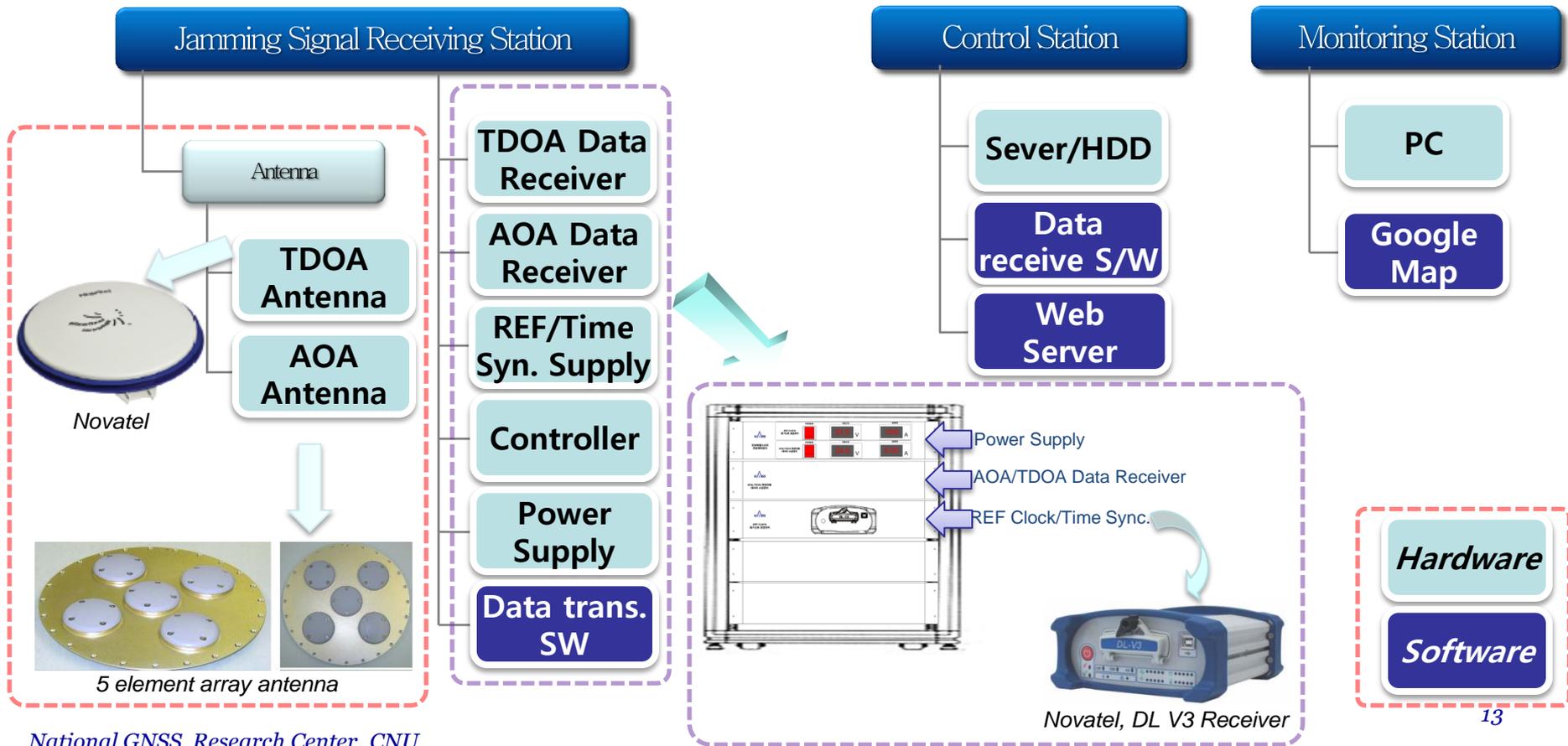


System configuration for field test

Field Test Equipment Configuration & information flow



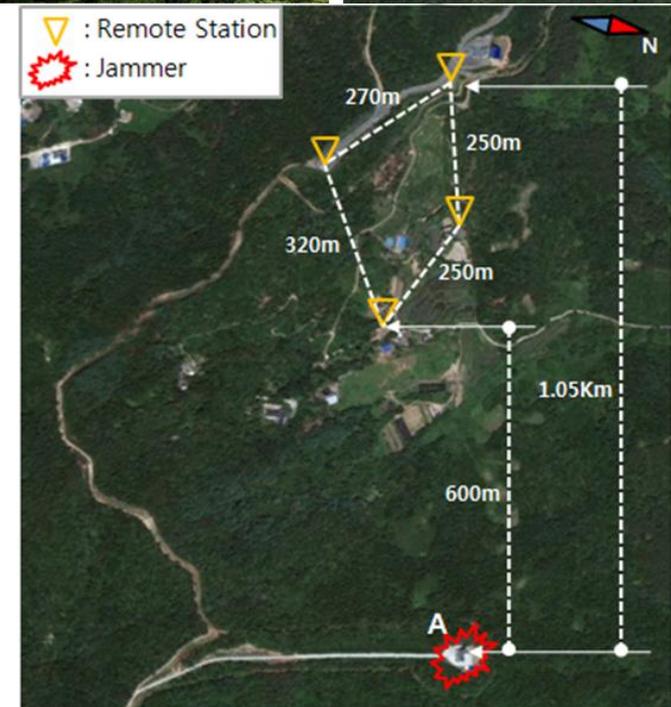
Functional Block of Field Test Equipment



Field test environment

Field test Procedure

- **System operation confirmation**
 - *GPS receiver operation confirmed*
 - *Wireless Network confirmed*
- **Jamming signal transmission(A site)**
 - *Jammer location operation confirmed*
- **Jamming signal shutdown(A site)**
 - *GPS receiver reoperation confirmed*



Experimental field

Field test environment

- *Location : a radio test site of a national research center*



4th signal receiving station



Control Station



3rd signal receiving station

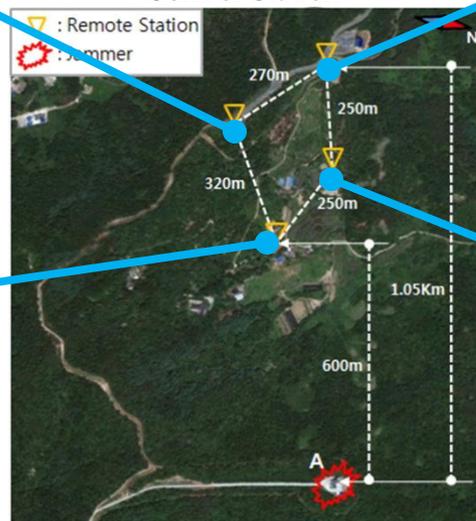


1st signal receiving station

Reference station (for TDOA)

National GNSS Research Center, CNU

May 14, 2013.

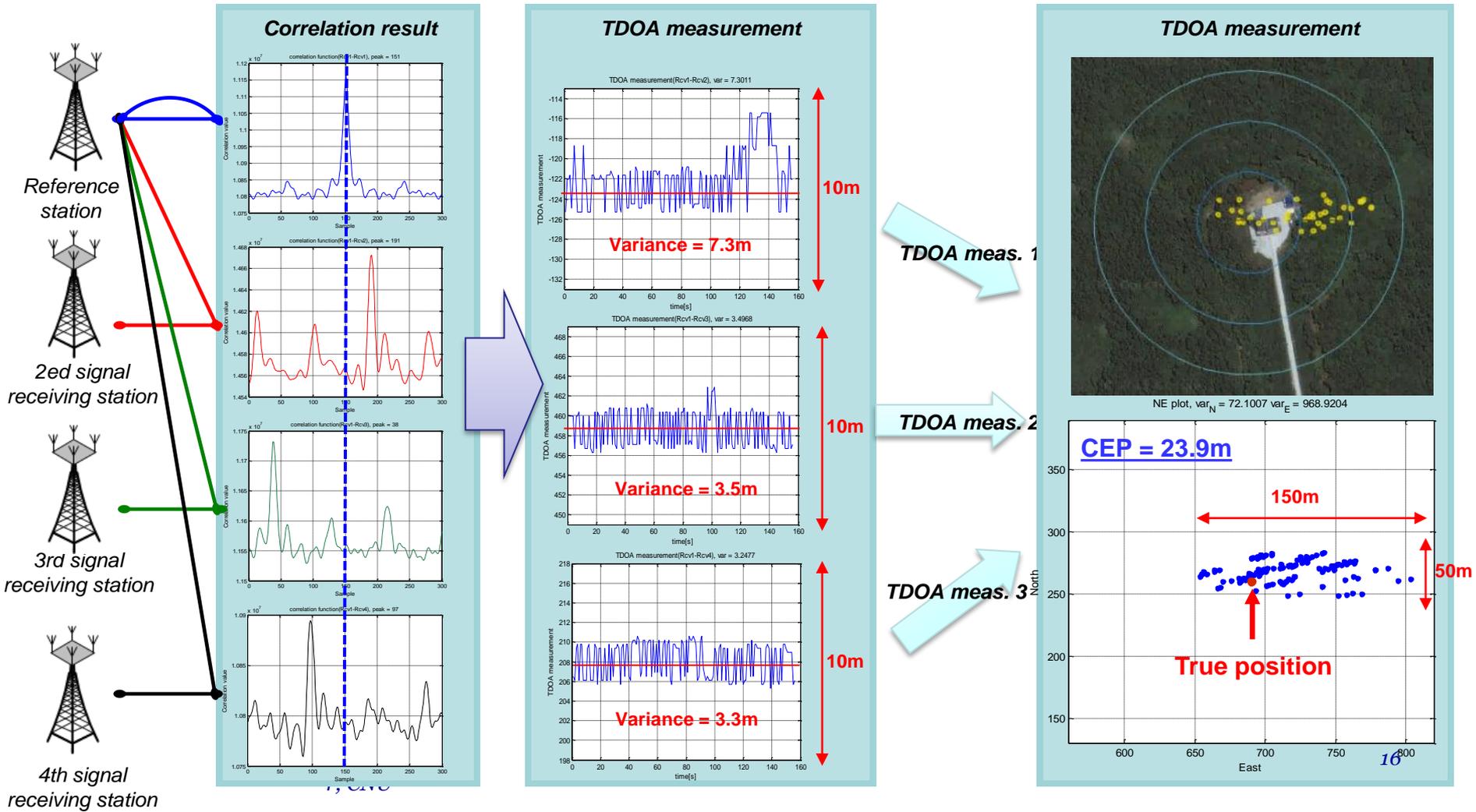


Experimental environment

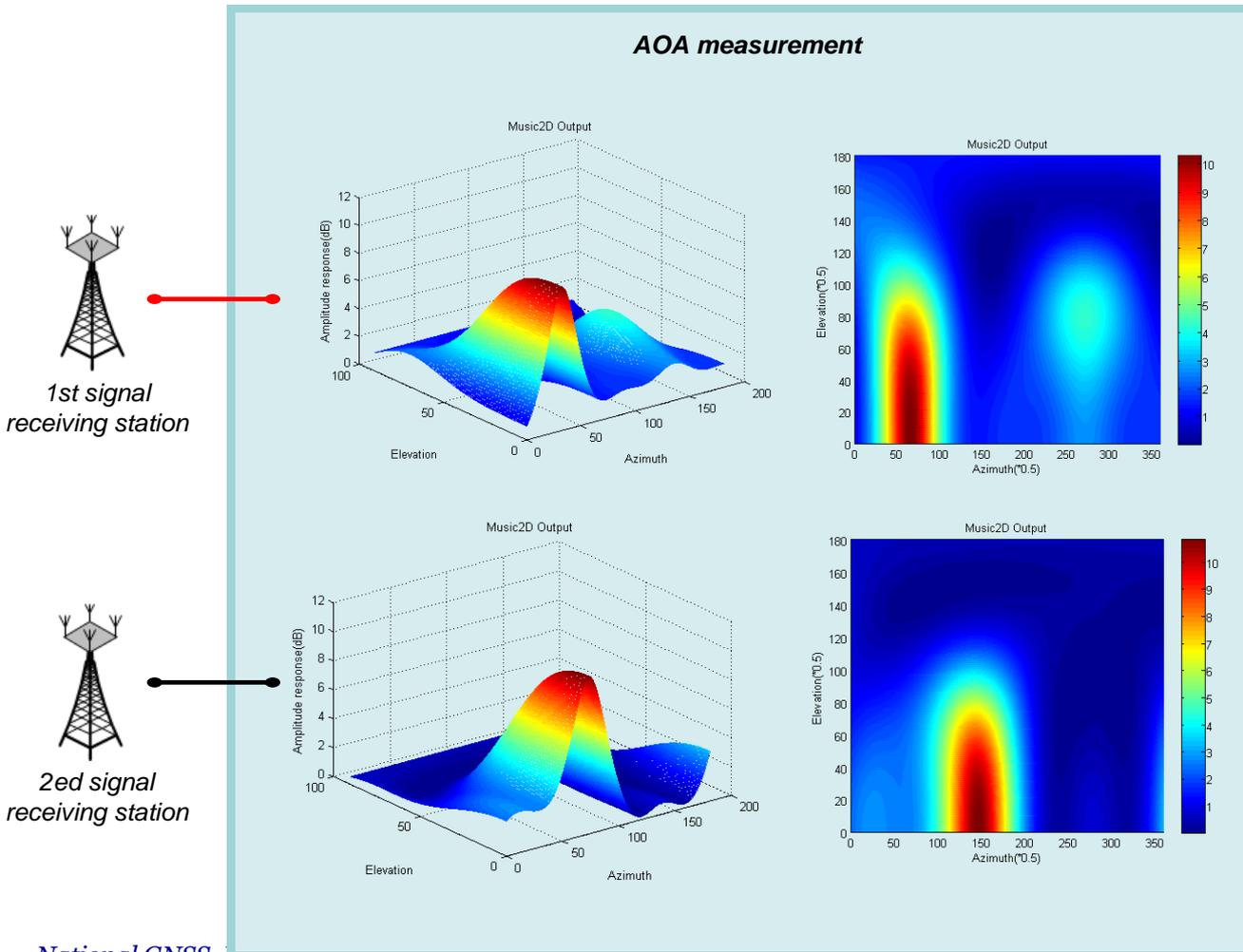


2nd signal receiving station

TDOA algorithm



■ AOA algorithm



Determining absolute azimuth

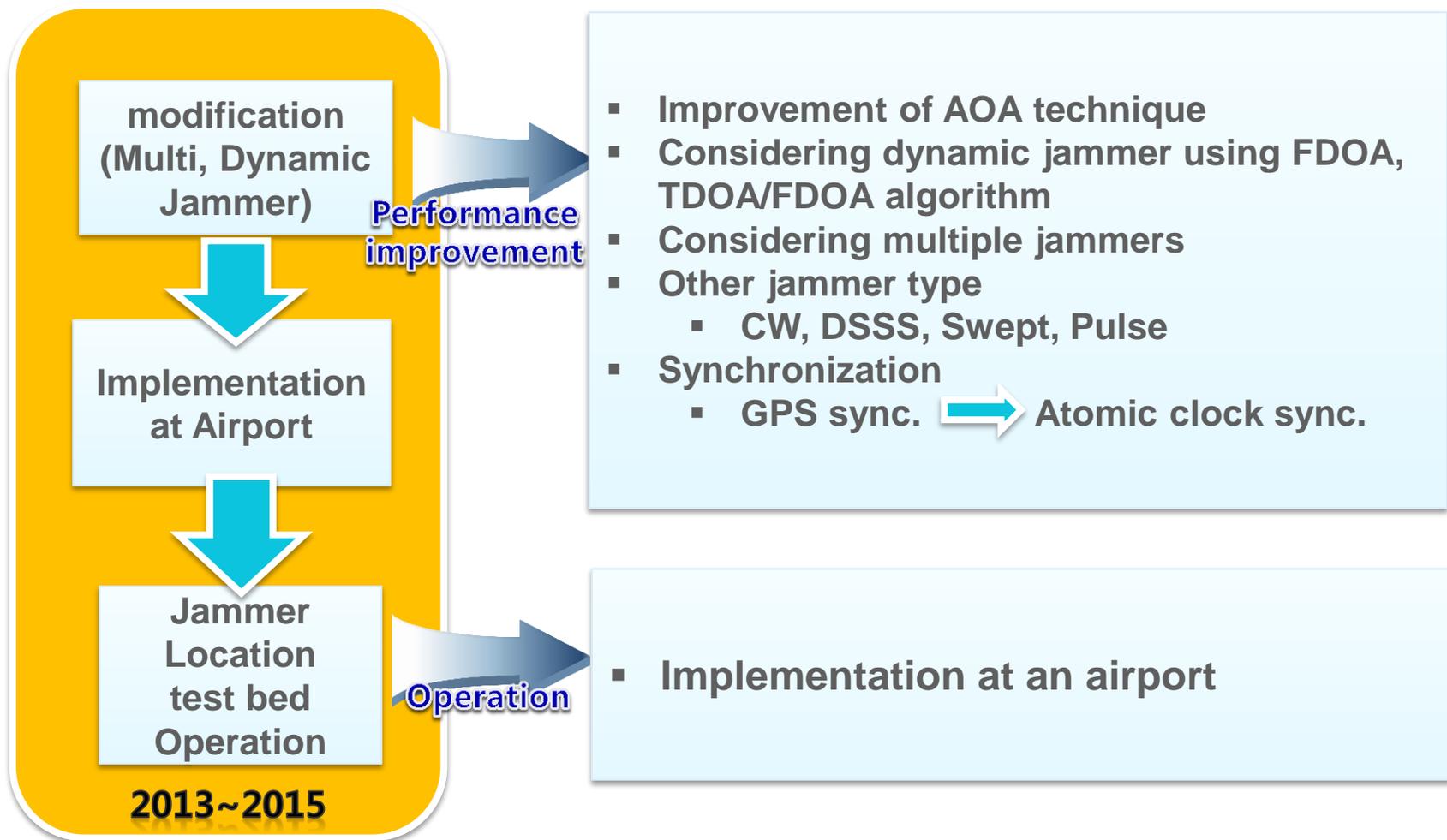
Phase bias between array antenna elements



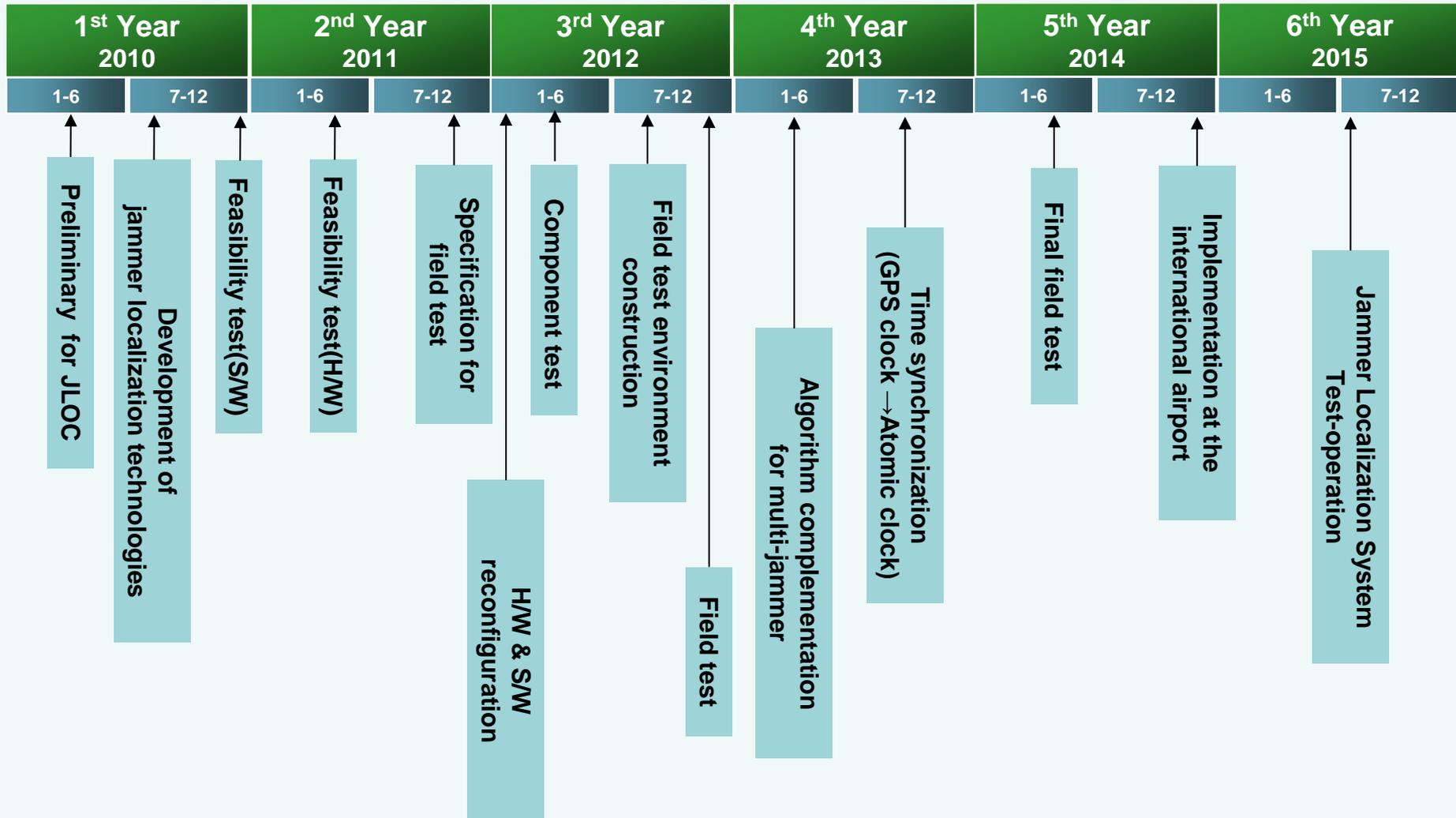
AOA measurement performance degradation (accuracy : 5 degree)

Improvement is being done

Future work



Milestone of NAP



Thank you for your attention