Presentation on iGMAS FOR WORKING GROUP A

International GNSS Monitoring & Assessment Service for OS (iGMAS)

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Presentation overview

1. Background
2. The Scientific Research Activities on GNSS Performance Monitoring
3. iGMAS: Objective, Methods and Infrastructure
4. International Cooperation proposals on iGMAS
5. Concluding remarks

1. Background

- **GNSS performance monitoring has become**
  - part of the work of ICG Working Group A
  - key issues in the pursuit of better service provision
- **Providers have agreed to consider proposals to**
  - widely monitor signals and service performance
  - provide timely updates to users regarding critical performance characteristics e.g. timing, positioning accuracy and service availability[ICG/PF/WP/SEP2009,item 6,item7]
- **iGMAS**
  - jointly proposed by co-chairs and ICRC of CSNO at the WG-A co-chairs intersessional meeting

- **iGMAS is**
  - complementary to IGS network etc. in terms of SIS quality and constellation status monitoring etc.
  - essential to ensure the interoperability of OS signals
  - able to promote service assurance and improve service performance
  - useful to study on developing international standards of OS

In summary, iGMAS will benefit a lot for

- not only users to get assured open services with an unified standards.
- but also Providers to make their own GNSS system sustainable development

2. Scientific Research Activities on GNSS Monitoring

A lot of scientific research work on GNSS monitoring and assessment have been done worldwide

2.1 BeiDou Monitoring and Assessment system

In 2007, a BeiDou tracking network was established:

In China

– with 6 tracking stations

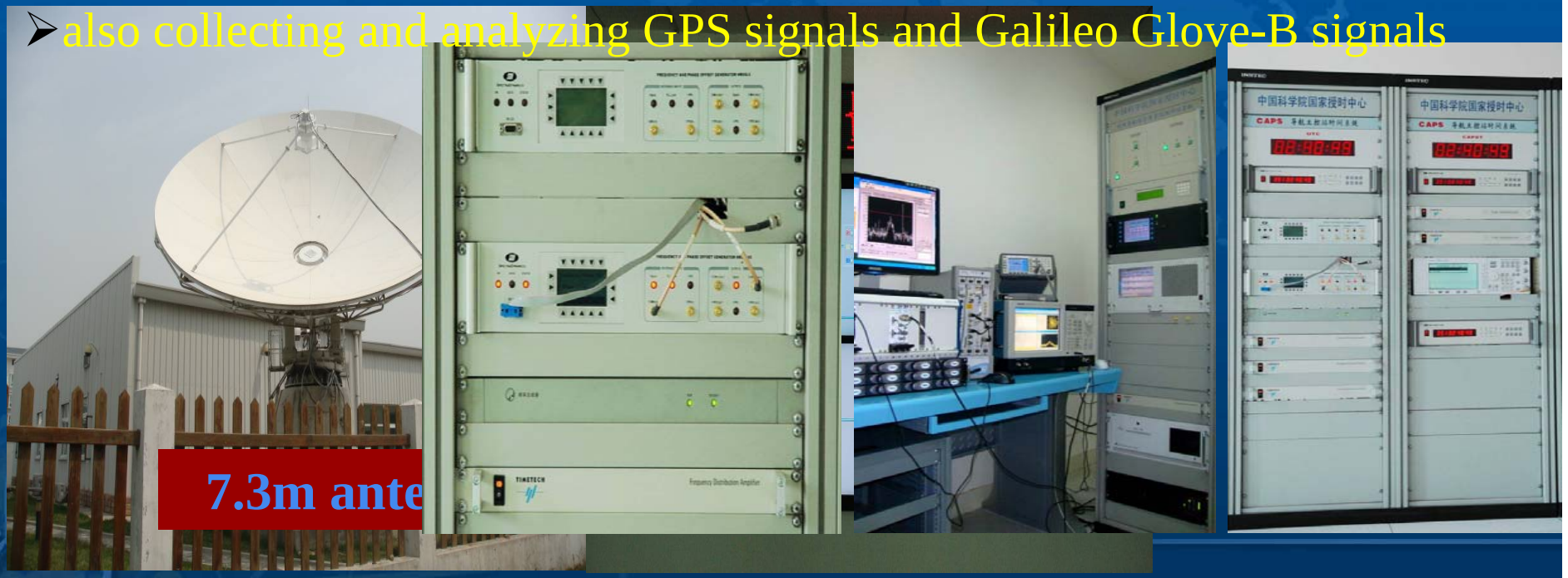
Antarctic station

Analyzing center

. In Feb. 2009, the BeiDou signal quality monitoring system was built by National Time Service Center, Chinese academy of sciences

Since April, 2009, this system have performed :

- signal quality monitoring and assessment for BeiDou GEOs and IGSOs successfully
- also collecting and analyzing GPS signals and Galileo Glove-B signals

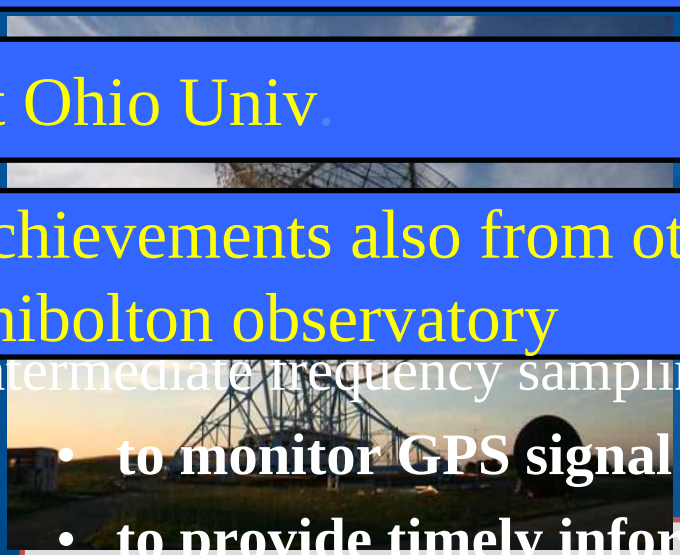


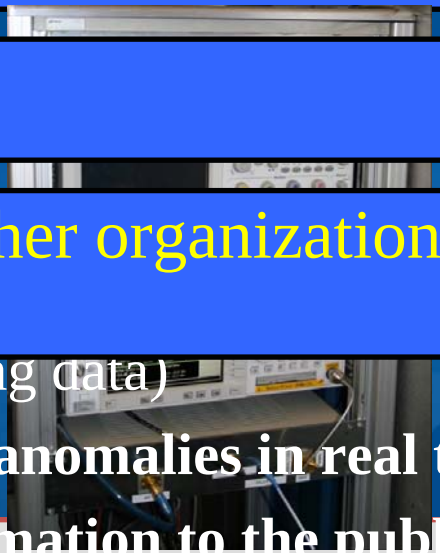
2.2 Other research activities of GNSS signal monitoring

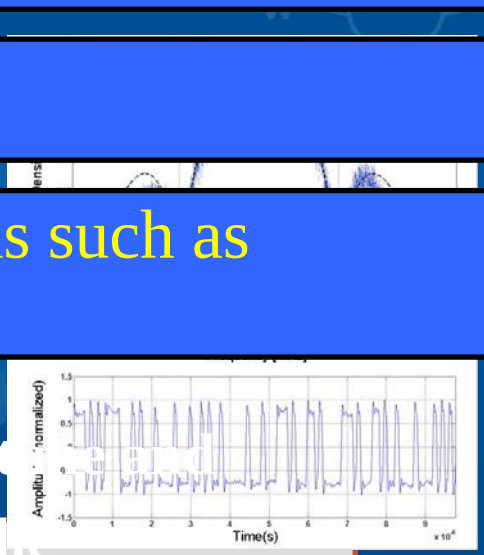
At Stanford Univ.and DLR of Germany

At Ohio Univ.

Achievements also from other organizations such as Chibolton observatory







Intermediate frequency sampling data)

- **to monitor GPS signal anomalies in real t**
- **to provide timely information to the publ**

high-gain antennas to monitor GNSS signals

2.3 Multi-GNSS Continuous Tracking Network

- IGS network with about 400 sites worldwide
  - serving GNSS world raw data and products for many years
  - Updating to Multi-GNSS currently, M-GEX
- recently proposed MGM-net by JAXA
  - designed with 60 sites

Benefits of iGMAS were demonstrated and confirmed by above activities.

3. iGMAS: Tasks, Methods & Infrastructure

3.1 main ideas:

- to setup a global tracking network
- to monitor the Multi-GNSS open signal and service performance with not only Multi-GNSS geodetic receivers but also high gain omni-directional antennas, multi-beam antennas
- to share information to public

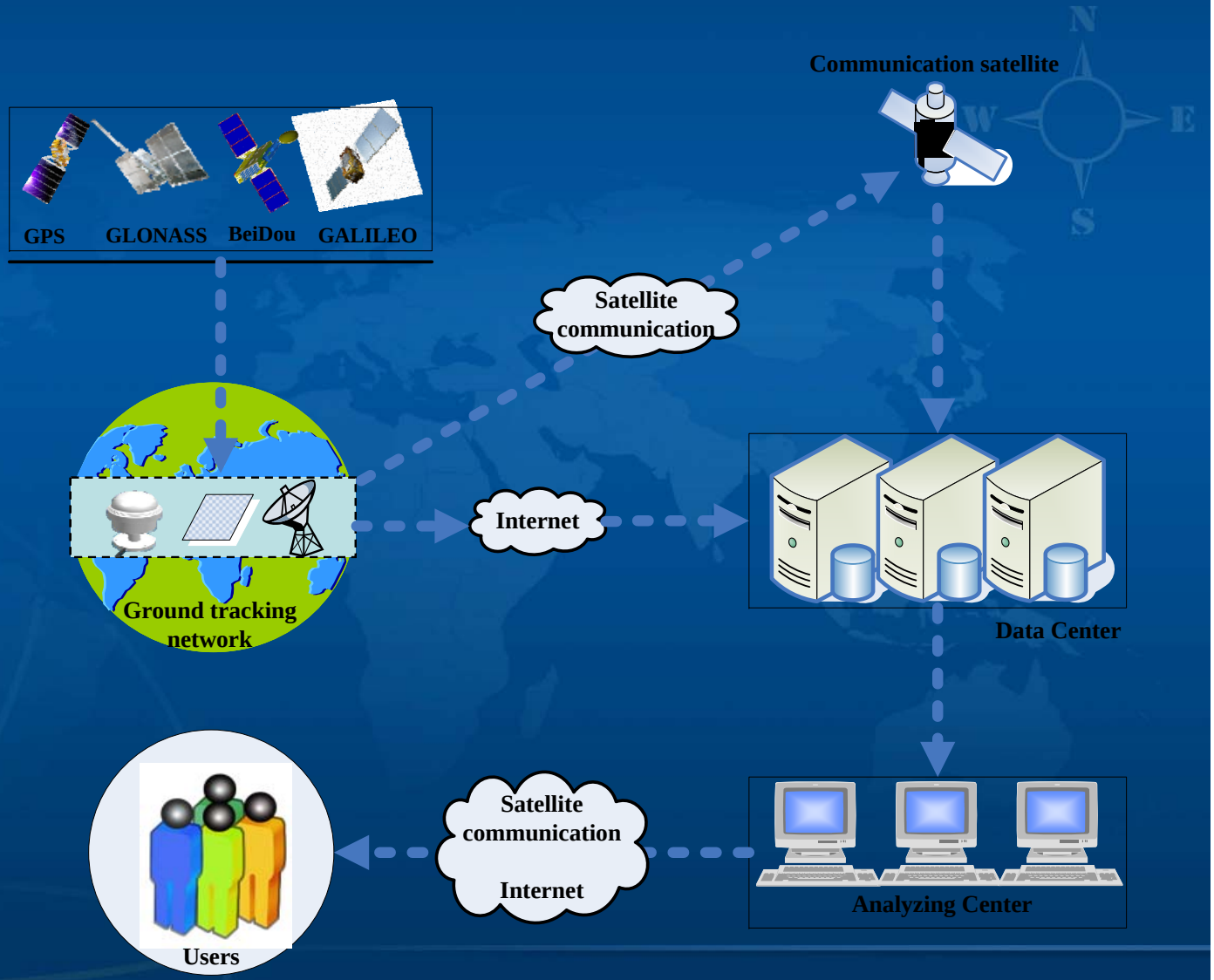
3.2 main tasks:

- to monitor multi-GNSS SIS, constellation status, navigation data, and serice performance
- to contribute to IGS and MGM network by co-location and data sharing
- To serve GNSS world with data, products, information
- To evaluate the parameters for interoperability

The elements for Monitoring and Assessment of GNSS

- **Constellation status**
  - Number of in-orbit satellites
  - Orbit distribution
  - Status of each satellite
  - Constellation DOP
- **SIS**
  - Time domain characteristics
  - Frequency domain characteristics
  - Modulation domain characteristics
  - Correlation domain characteristics
- **Navigation data**
  - Message validity
  - Ionosphere delay
  - GNSS time bias
  - Validity of Tgd
- **Service performance**
  - Accuracy
  - Availability
  - Integrity
  - Continuity

3.3 Infrastructure of iGMAS



four main components:

The basic functions modules of iGMAS include：

1）**Data monitoring and collecting**

2）**Data communication**

3）**Data store**

4）**Data analyzing and information release**

3.4 iGMAS's Complementary aspects to IGS & MGM networks

	iGMAS	IGS network	MGM net
Common points	dealing with OS signals tracking Multi-GNSS signals based on int. cooperation providing data and product sharing information etc.		
Complementary	√Mainly Co-location with IGS.MGM stations √ code + carrier+SIS quality+constellation status etc. √ providing RINEX formatted data to the IGS in support of its multi-GNSS project		

3.4 iGMAS's Complementary aspects to IGS & MGM networks

	iGMAS	IGS network	MGM net
Data and products	sharing with IGS, etc.		
Precise ephemeris, clocks	√	√	√
PM parameter.	√	√	√
Station coordinates, velocities	√	√	√
Constellation status monitoring	√		
Navigation signal power anomalies	√		
navigation data monitoring etc	√		

4. International Cooperation proposals on iGMAS

4.1 cooperation issues regarding iGMAS

- Recommendations: to set up a technical working group or subgroup to deal with issues of iGMAS
  - To optimize existing and planed capabilities
  - To identify additional activities,and operational models
  - To deal with the technical things regarding iGMAS, such as:
    - OS Performance parameters,
    - elements for monitoring,
    - information sharing,
    - jointly setting up stations, etc.

4.2 recent activities suggested for the TWG

- **A workshop scheduled during Vienna meeting in Dec.**
  - to receive valuable inputs to iGMAS from Providers to user community, academic organizations and manufacturers etc.
  - to give Providers, industry, and user communities the chance to provide their views on iGMAS

- **International BeiDou/GNSS demostration Campaign is recommended(initial service in Asia and Pacific region)**
  - to test and demonstrate the capabilities of BeiDou/GNSS systems
  - to provide an opportunity to develop potential new GNSS applications enabled by BeiDou/Multi GNSS systems.
  - order to contribute to the above campaign activities.

    Other
  - All sites will be required to make available RINEX

6. Concluding remarks

1. iGMAS is beneficial to all sides:
   - for the Providers improving their own system,
   - for users, enterprises , academic organizations etc.
2. iGMAS is complementary to IGS and MGM-net etc.
3. iGMAS is a long-term work, needing international cooperation
   - A TWG or subgroup needed.
   - All sides encouraged to take part in this group

Thanks for your attention.

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Mandatory requirements: for iGMAS station selection

- ✓ tracking stations installed with high-gain antennas should meet 1-overlap coverage to satellites at least;
- ✓ those tracking stations for SIS monitoring should meet 4-overlap coverage to satellites;

Intended number of sites : 30 at least,
Mainly Co-location with IGS.MGM stations
Provision of RINEX formatted data to the IGS in support of its multi-GNSS project.