

**The 6th meeting of International Committee on GNSS
—Work group A meeting**



**IDM for GNSS open service
in China**

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Contents

- GNSS Interference Events in China
- Interference Detection and Mitigation Plan in China
- Recommendation in ICG



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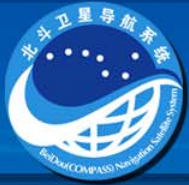


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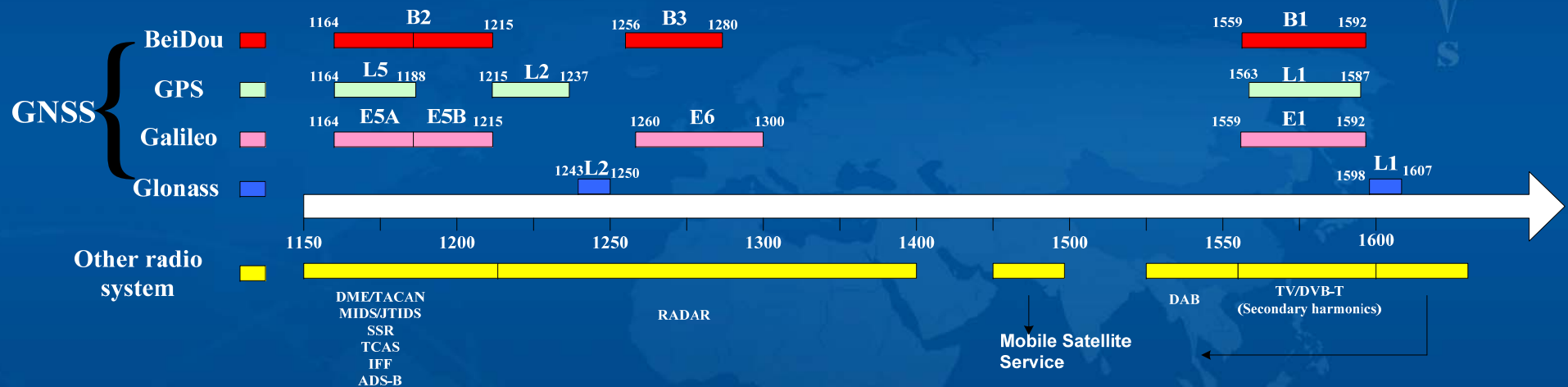
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GNSS is vulnerable to INTERFERENCE

Interference to GNSS :

- Interference from Radio systems
- Effects of space weather



Potential interference source to GNSS in L band

■ Interference from Radio system :

- L-band Radio systems (DME/TACAN、JTIDS/MIDS、RADAR、wireless broadband network (LightSquared) etc.)
- Low band radio systems with harmonics in L band (TV、FM...)



- GPS is often reported to be interfered by intentional and unintentional RF interference.
- GPS jammer can be easily bought from internet.



GPS and GSM Jammer

U.K. £150

1 Watt Jammer

Links between Criminal & Terrorist activity are indisputable

GPS Navigation Devices Can Be Duped

WA Post Aug 08

Police Turn to Secret Weapon: GPS Device

Aug 08, FCC cites Colorado business for selling GPS jammers to counter GPS vehicle trackers



Report of interference to GPS from newspaper

GNSS(GPS) jammer





Cases of unintentional interference to GPS in China

- Data anomaly in IGS reference station in Changchun.
- Failure of time synchronization in mobile communication network in Henan province.
- Aerial GPS signal interrupted caused by interference in Shenzhen city and Henan province, etc. Backup system has to be resorted to.

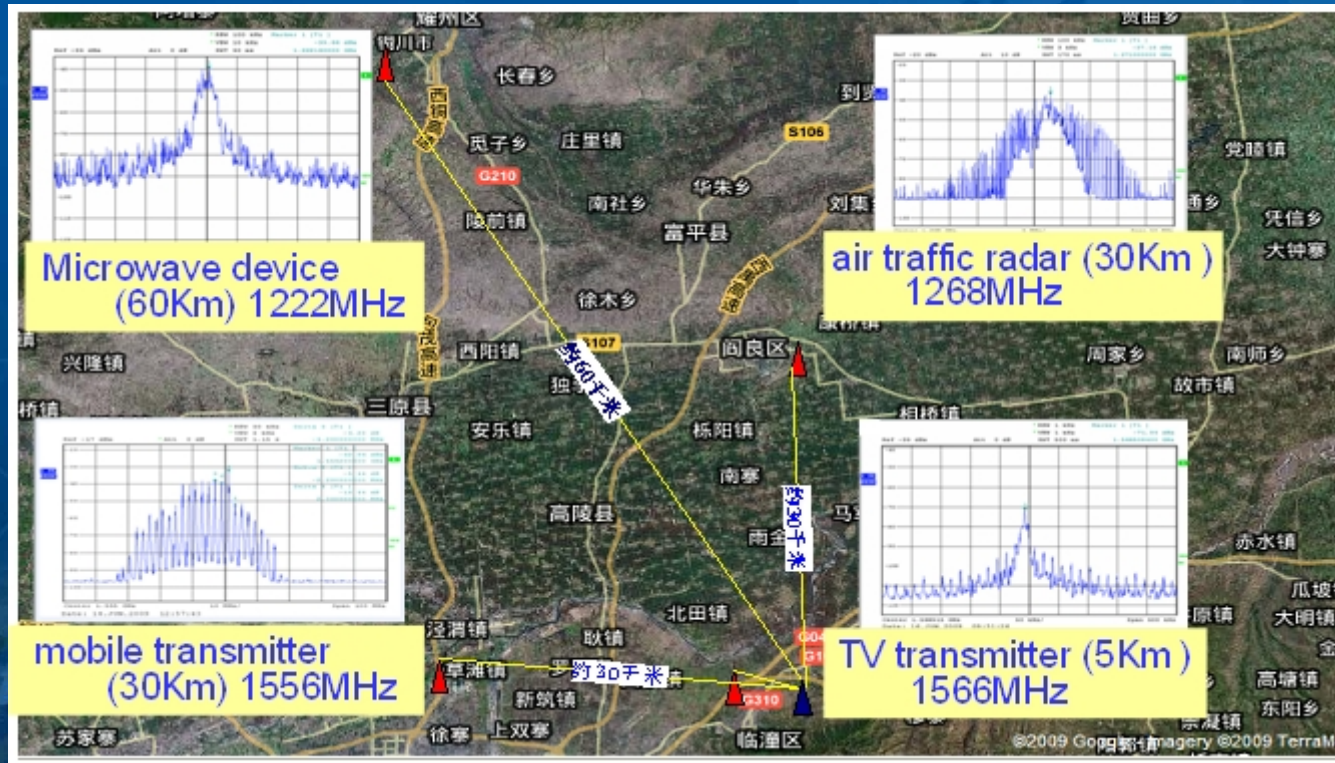
**Failure of GPS time synchronization
system in mobile station**





Cases of unintentional interference to GPS in China

- interference in B2 frequency in a BeiDou master station in Beijing
-----source: wireless video transmission device in a company nearby.
- Interference in B3 frequency in a BeiDou master station in Beijing
-----source : air traffic radar (high-power, wideband).
- Interference in B1,B2 and B3 in a BeiDou data analysis station in Shan Xi province
-----sources: (1)TV transmitter, (2)mobile transmitter for communication, (3)microwave device in a electric transform station ,(4) air traffic radar.

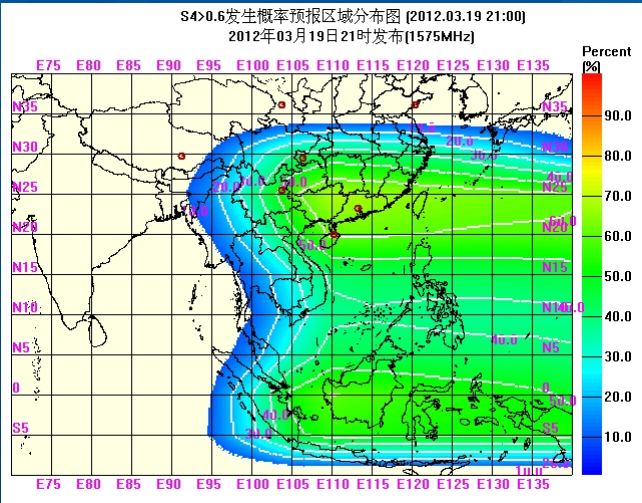
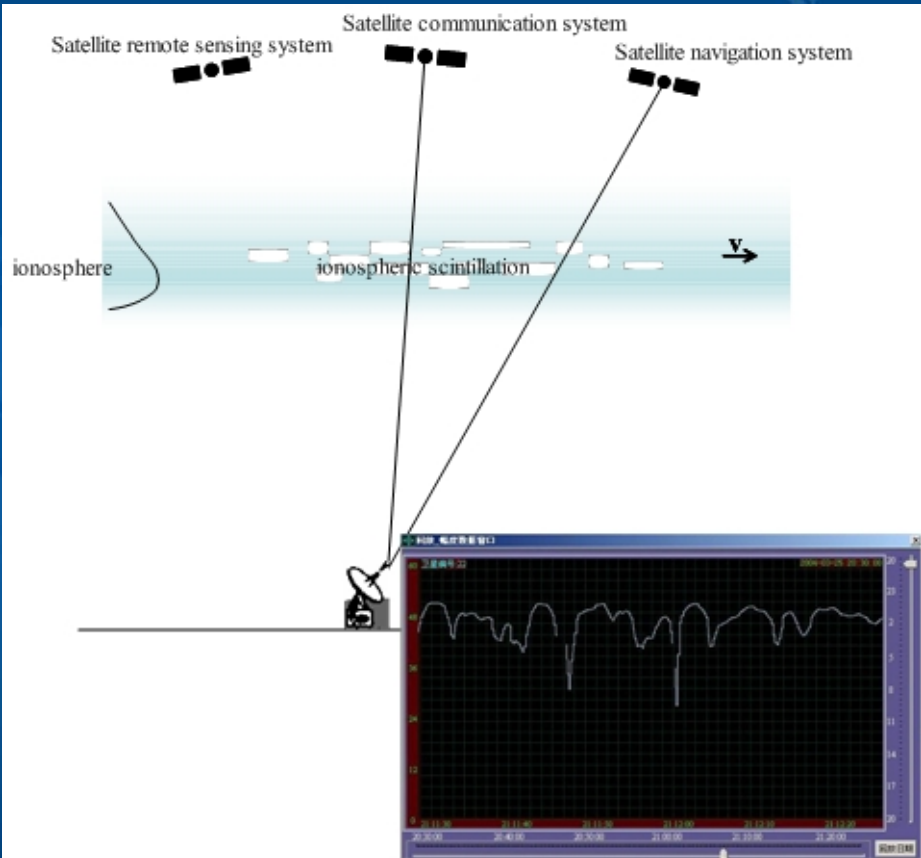


Cases of interference
in BeiDou system
(Shan Xi)



Space Weather (Ionospheric effects) causes GNSS signals disruption

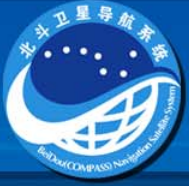
Ionospheric scintillation may degrade the positioning accuracy of GNSS and even cause loss of lock during severe scintillation activities, especially in the low latitude region of China.



Affected area of ionospheric scintillation

Loss of lock of GPS signal caused by scintillation





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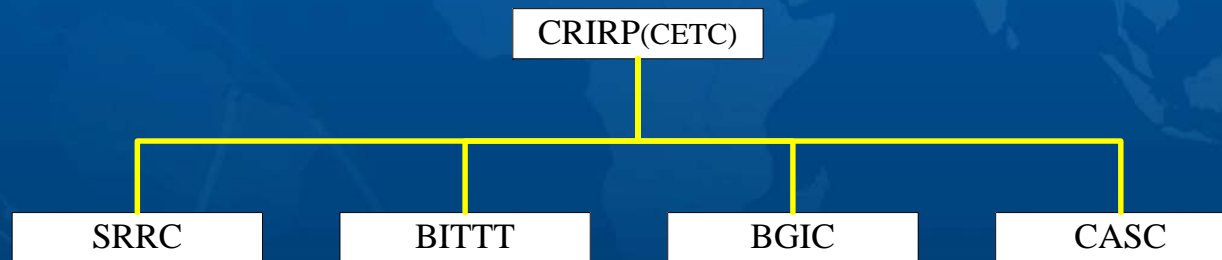


- China has recognized the significance of RF interference effects on GNSS. An interference detection and mitigation plan in China has been developed.

Mission of the plan:

- Protect BeiDou infrastructure from RF interference
- Protect use of Chinese GNSS open service
- Protect use of BeiDou public regulated service

- A technical group has been set up to research on IDM for GNSS open service.



CRIRP—China Research Institute of Radiowave Propagation

CETC—China Electronics Technology group Corporation

SRRC—The State Radio Monitoring Center

BITTT—Beijing Institute of tracking and telecommunication technology

BGIC—Beijing Global Information Center

CASC—China aerospace science and technology corporation



Tasks

1. Investigation and threat assessment of GNSS interference in China
2. Development of IDM structure and interference report procedure in China
3. Research of IDM key issues
4. Countermeasure for the GNSS interference



Task 1: Investigation and threat assessment of GNSS interference in China

- Interference investigation of BeiDou system
- Vulnerability analysis of critical infrastructure caused by BeiDou interference
- Interference investigation of other GNSS signals
- Ionospheric effects on GNSS systems

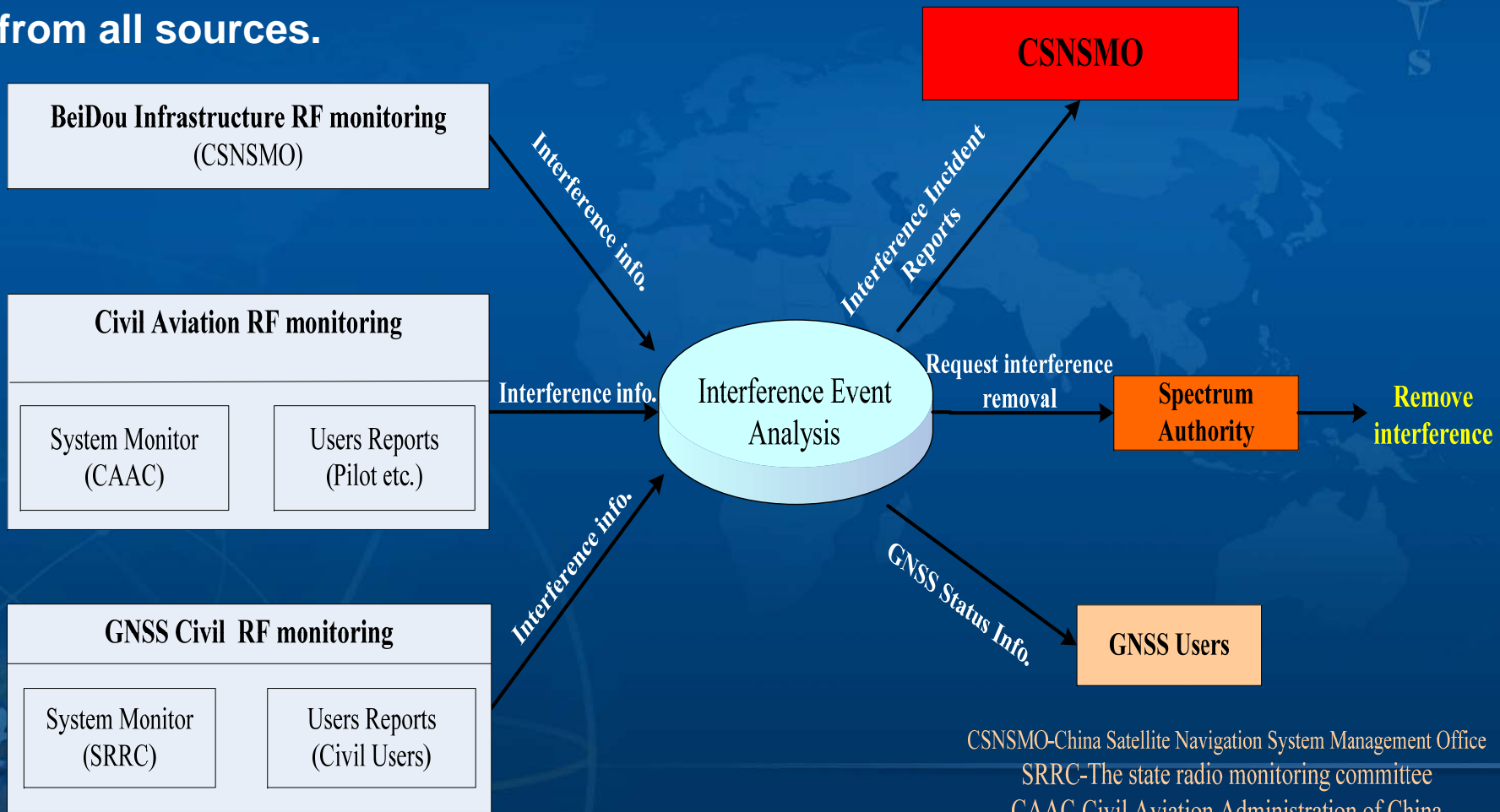


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Task 2: Development of IDM structure and interference report procedure in China

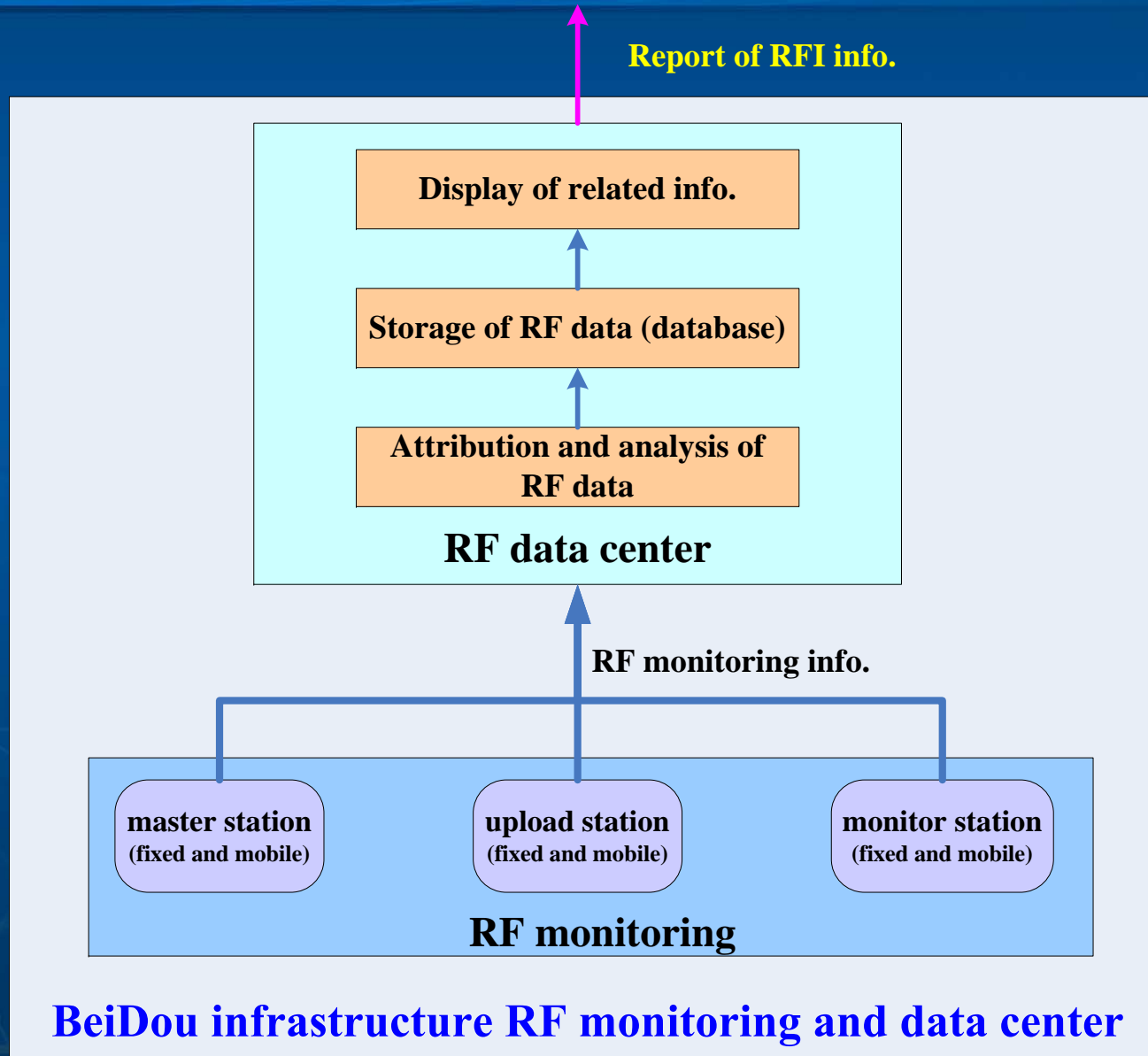
(1) Provide the capability to identify, analyze, locate, attribute, and mitigation sources of interference to GNSS. (2) Establish an IDM report procedure to collect, analyze, store and disseminate interference reports from all sources.



CSNSMO-China Satellite Navigation System Management Office
SRRC-The state radio monitoring committee
CAAC-Civil Aviation Administration of China



BeiDou Infrastructure RF monitoring (in planning)



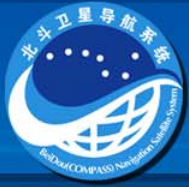


Task 3: Research of IDM key issues

- Development of RF interference monitoring detection device
- Evaluation of interference effect
- Localization and management of RF interference source



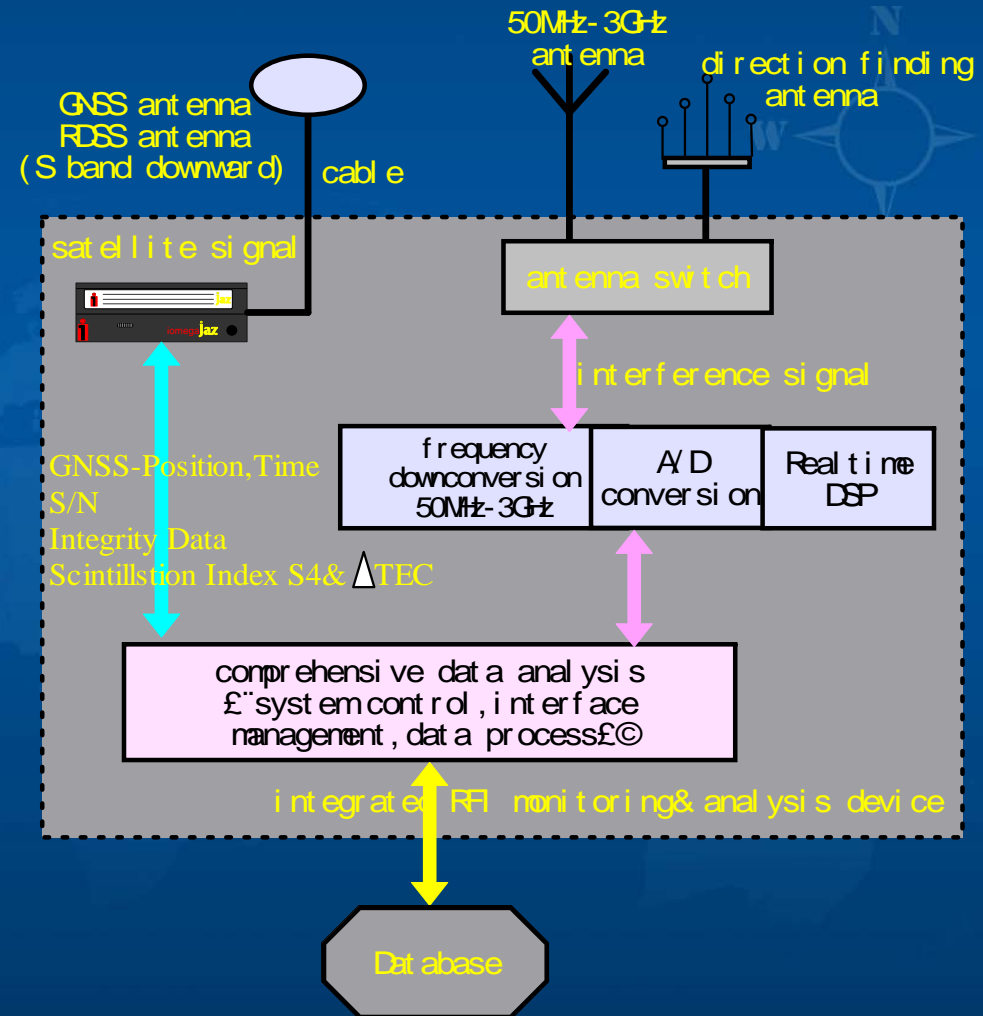
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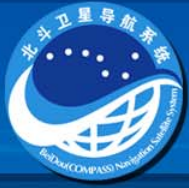
Development of interference monitoring detection device

Output parameter:

- Signal to noise ratio: S/N
- Spectrum of interference signal
- Ionospheric info: S4, delta-TEC
- Integrity info.
- Other...

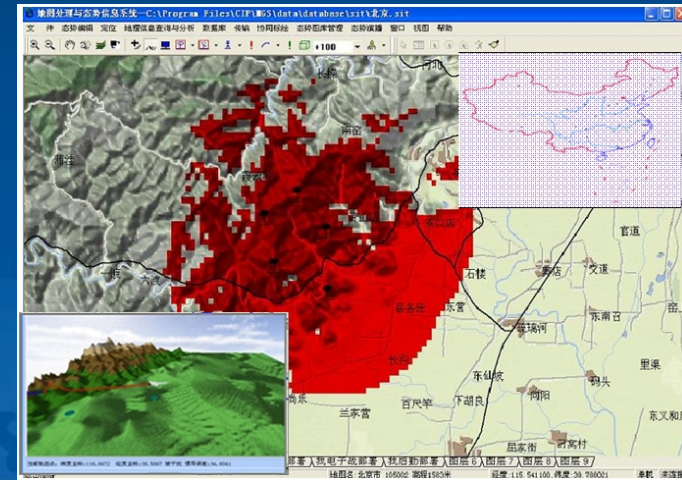


Architecture of interference monitoring detection device

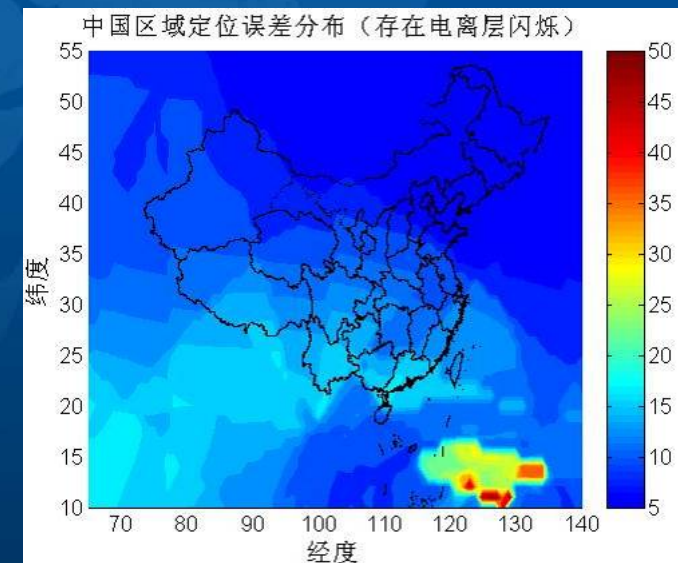


Evaluation of interference effect

- Identification of RF interference information
- Evaluation of RF interference to different GNSS signal receiver
- Evaluation of RF interference effects based on GIS
- Forecasting, warning of space weather and response to the effects



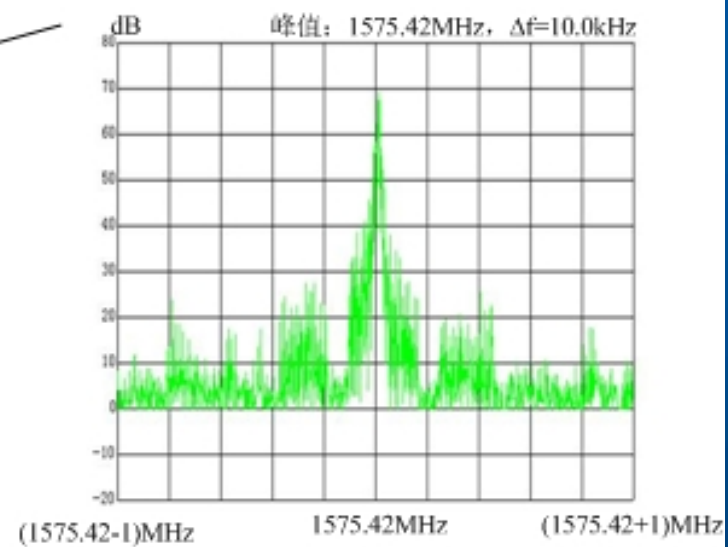
interference evaluation based on GIS

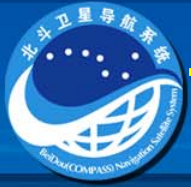


evaluation of space weather (scintillation) effect



Localization and management of interference source



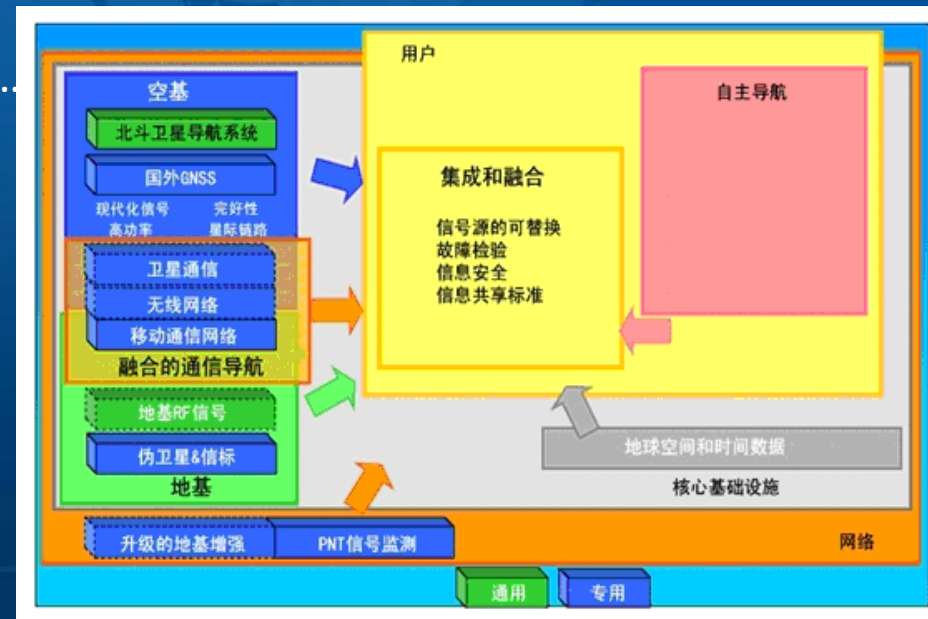


Task 4: Countermeasure for the GNSS interference

- Interference-resistant technique research at receiver level
 - Antenna: CRPAs...
 - Data processing techniques: interference detection, filter...
 - Mitigation of scintillation effects
- National PNT structure
 - Space-based system
 - Ground-based system
 - Backup system (eLoran...)
 - Autonomous navigation system(INS...)
 - Fusion with communication system(WiFi...)



Planning structure of PNT in China





Laws and regulations on RF interference management at present in China:

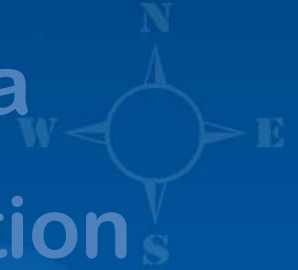
- RADIO REGULATIONS OF THE PEOPLES REPUBLIC OF CHINA chapter 5, chapter 9, article 43
- CRIMINAL LAW OF THE PEOPLE'S REPUBLIC OF CHINA Article 288,
- Law of the People's Republic of China on Penalties for Administration of Public Security Article 28
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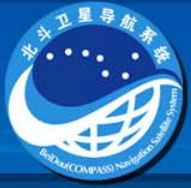


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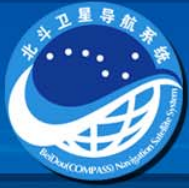
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Recommendation --- Establish an IDM joint lab

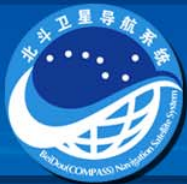
-----China recommends to establish an IDM joint lab among ICG members, dedicating to interference detection and mitigation.-----

- Conduct jointly research on scheme of GNSS IDM.
- Exchange and share interference monitoring data and information.
- Establish (recommended) standards for interference detection device and others.
- Conduct jointly research on space weather (forecast and effects of ionospheric scintillation and storm) and related activities.



Format for Data exchange (recommended)

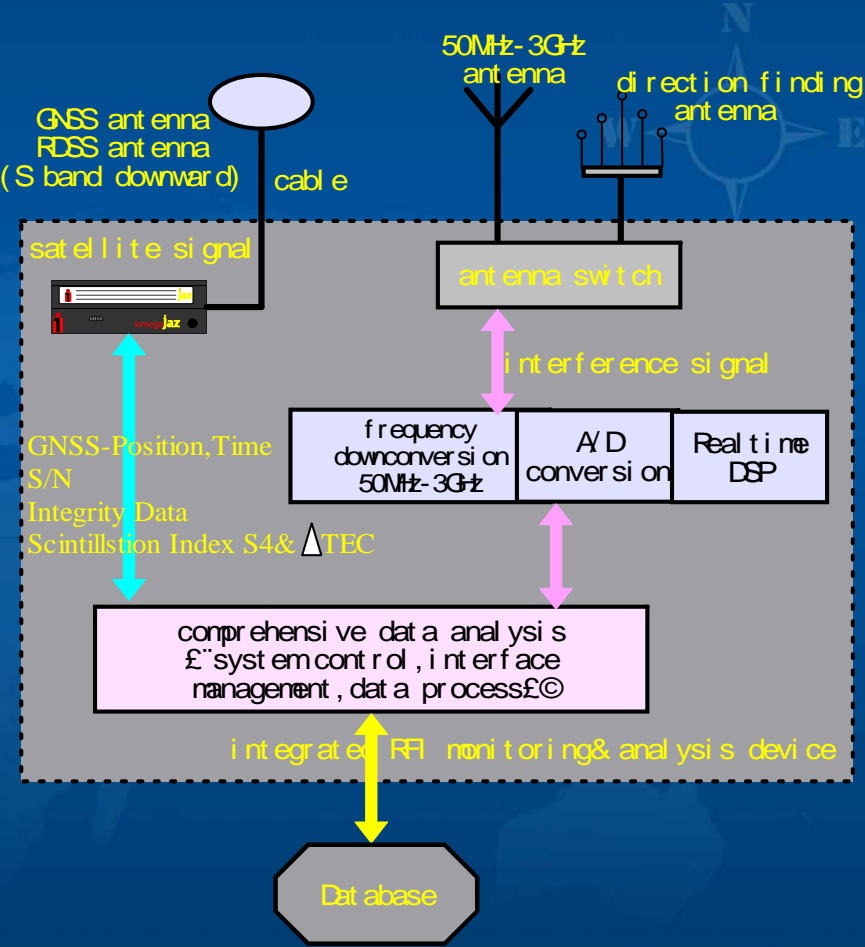
Data exchange format for GNSS RFI source (recommended)			Comments
Name	Description		Comments
Head	Version 1:		Format (TBD)
	Interference monitor info:		
	Interference monitor agency info		
	Time Span of Data		
	Area (agency belongs to)		
	Other info		
Data Block 1: Characteristics of RFI source	Frequency (Hz) :		Format (TBD)
	Bandwidth:		
	magnitude:		
	Location:		
Data Block 2: Characteristics of Interfered Devices	Interfered Frequency:		Format (TBD)
	Level of Interfered:		
	Interfered Band:		
	Location:		
Data Block 3: Description of Interfered Circumstance	Interfered Time Length:		Format (TBD)
	Direction of Interference:		
	Characters of Interference:		
	Antenna Type:		
	Interference Power:		
Data Block 4: Ionospheric info.	Epoch:		Format (TBD)
	S4:		
	TEC:		
	Delta TEC:		



Standards for interference monitoring detection device (recommended)

Standards of RF interference detection device (recommended)

Interference detection device		Comments
Function	Interference monitoring	
	Space weather monitoring	
	Fusion of information	
	Direction finding of RFI	
	Warning	
	Communication	
	Other	
Performance	Bandwidth	
	Sensitivity	
	Accuracy	
	other	
Calibration of interference detection device		
others		



Thank you for your attention!



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