The 7th meeting of International Committee on GNSS
—Work group A meeting

Comprehensive monitoring and information sharing of GNSS interference

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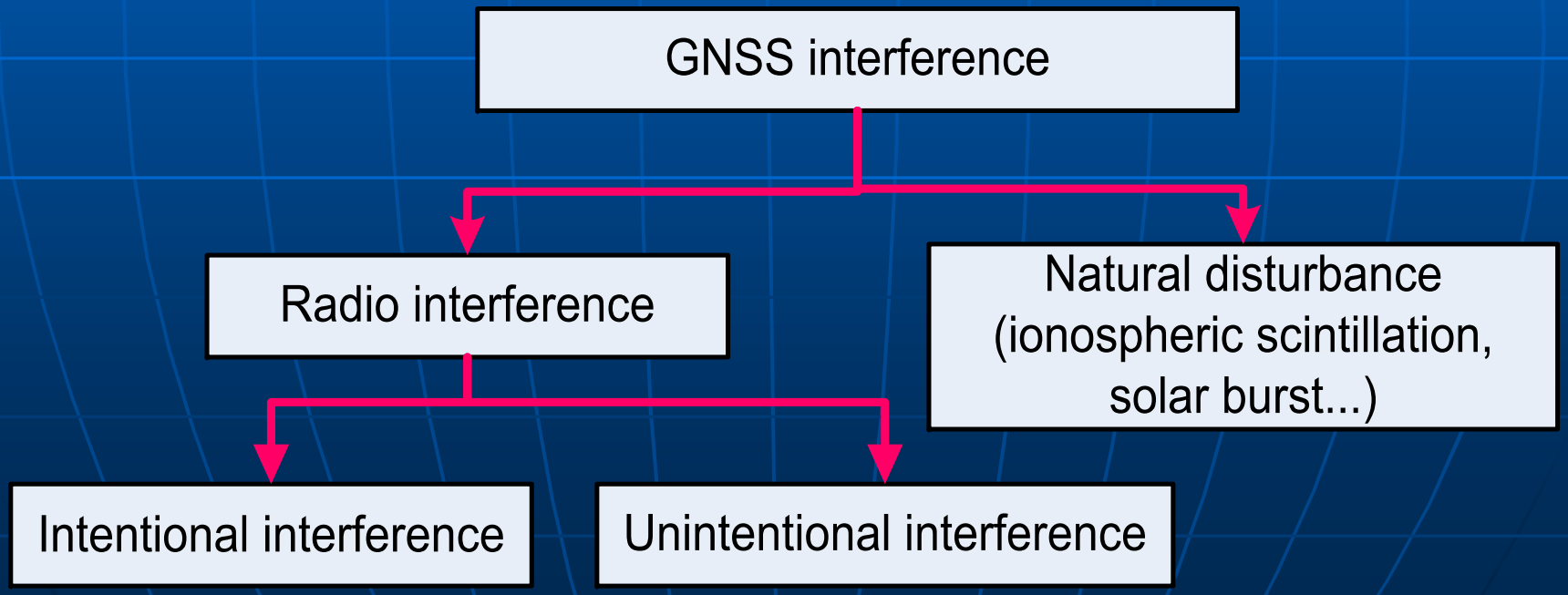
1 Comprehensive monitoring of GNSS interference

1.1 GNSS Interference

- **Radio interference (Interference from radio systems)**
  - Intentional interference
  - Unintentional interference
- **Natural Disturbance (mainly ionospheric scintillation and solar burst)**



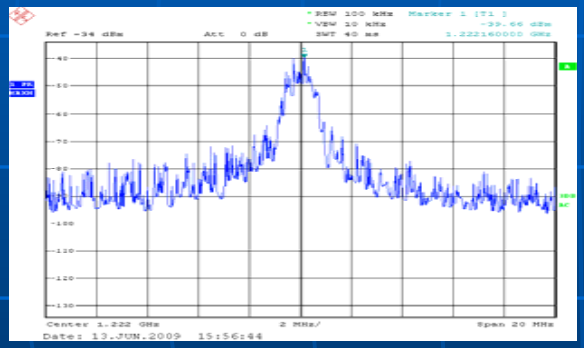
Intentional interference

Intentional interference means all deliberate interference of GNSS signal from GNSS interferer for purpose of commerce, politics or military (navigation war).

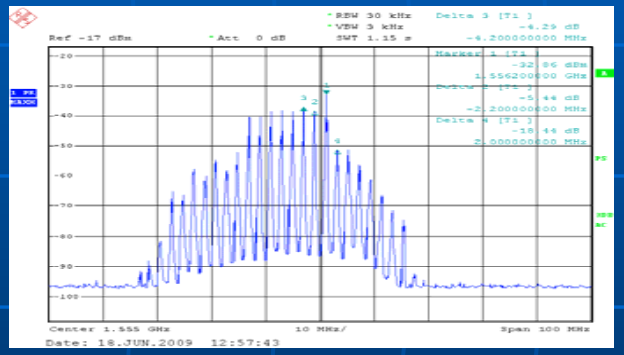
Intentional Emitters

Unintentional interference

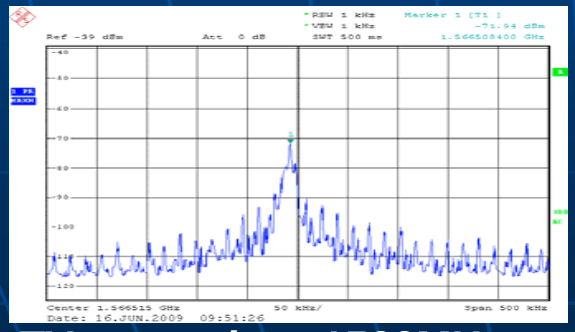
- Unintentional interference arises from electronic devices which emit at or near the frequency of GNSS signals, or at other bands (Harmonics, intermodulation etc.), which may degrade the reception of GNSS signals.
- Emitted by those device of bad design, aging or test.



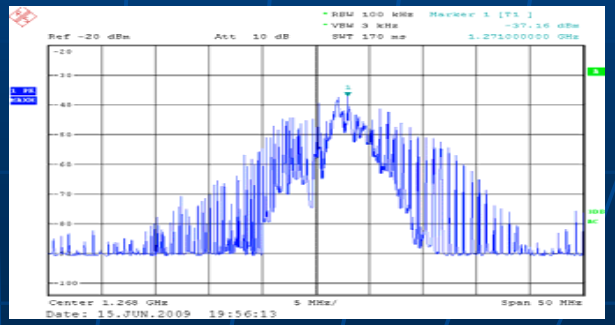
Microwave device 1222MHz



Mobile transmitter 1556MHz



TV transmitter 1566MHz



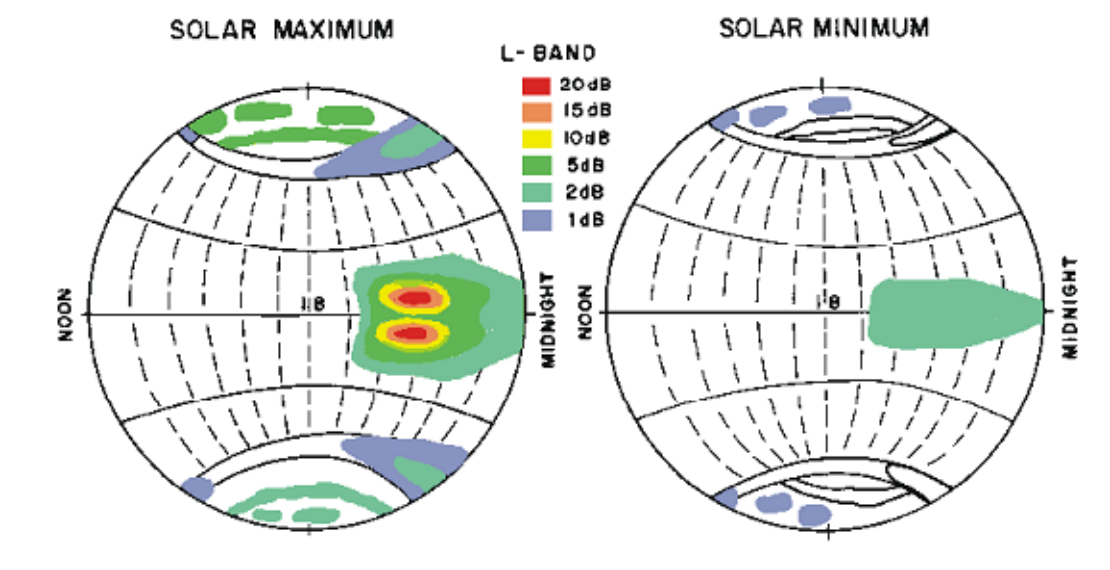
Aircraft radar 1268MHz

Cases of Beidou interference

Natural Disturbance

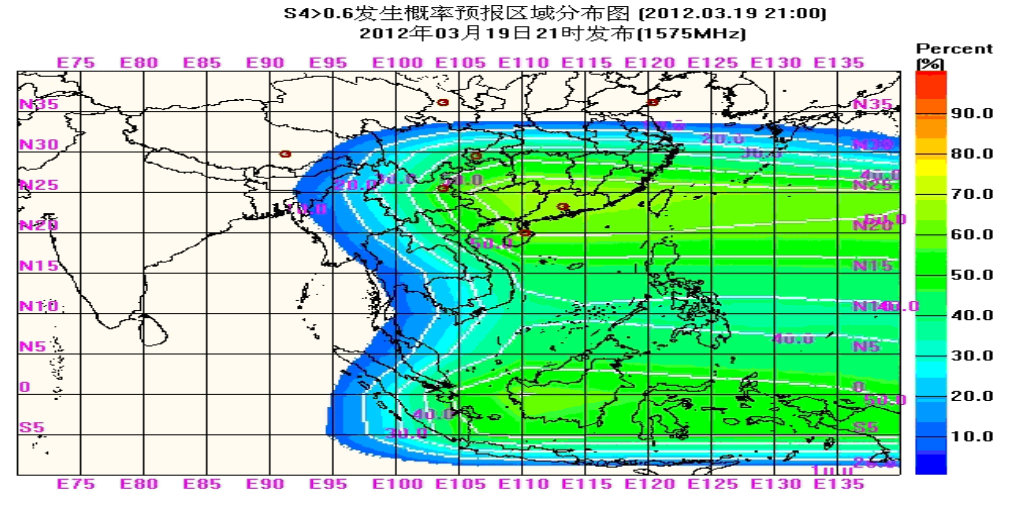
Ionospheric scintillation

- Two areas of the global particularly troubled by scintillation are high latitudes and a belt surrounding the geomagnetic equator. Ionospheric scintillation generally occurs after sunset.
- The degradation of GNSS signals is most severe for users in the high and low geomagnetic latitude regions.

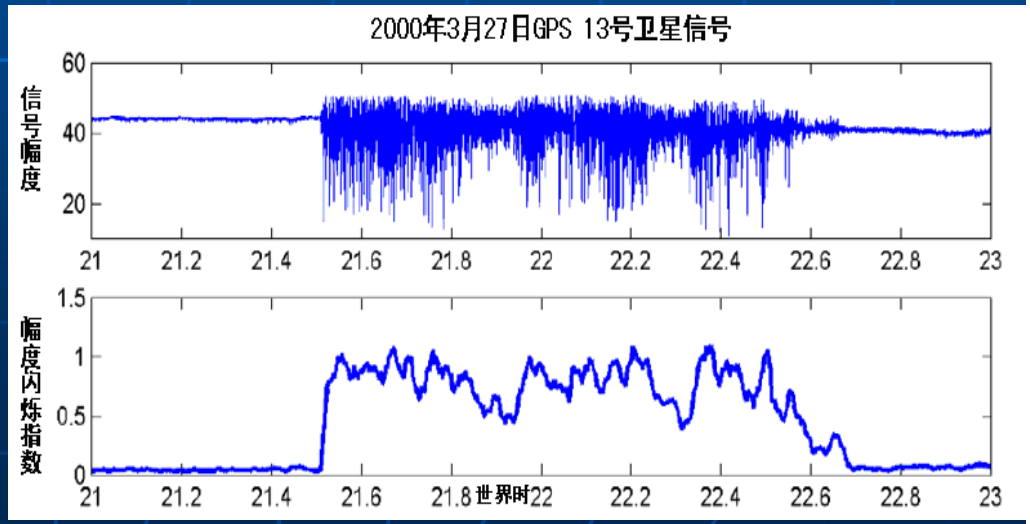


Global distribution of the worst-case fading depth at L-band

- The low latitude of China (also in the low geomagnetic region) is affected much by ionospheric scintillation.



Distribution of ionospheric scintillation effects

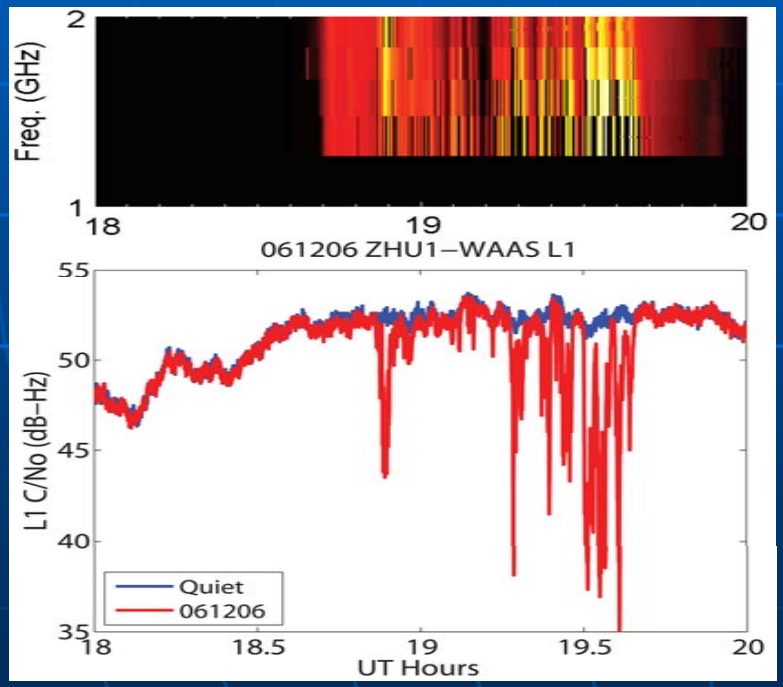


GPS signals affected by ionospheric scintillation observed in low latitude region of China

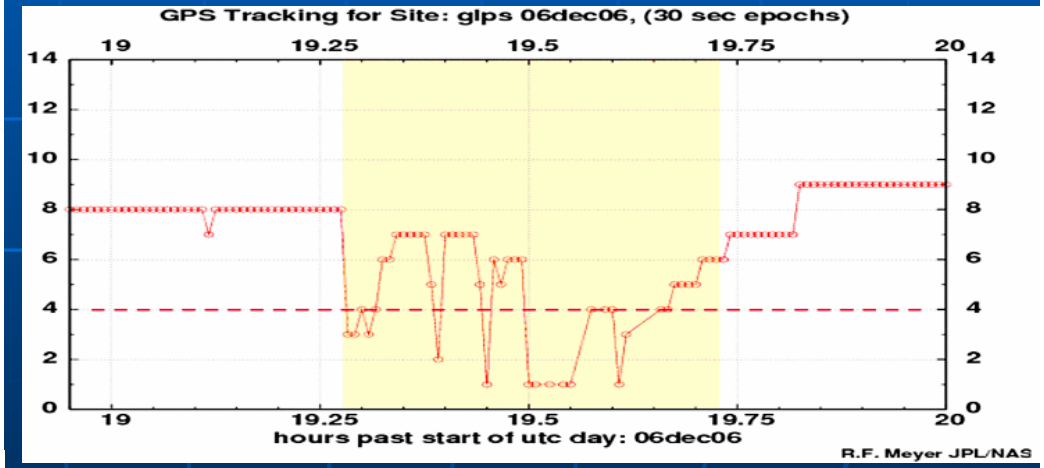
Natural Disturbance

solar burst

- Main effect of solar burst to GNSS receiver is degradation of carrier noise ratio, which may cause degradation of positioning accuracy and even loss of lock.



C/N degradation of GNSS signal caused by solar burst



Effects of visible satellite number due to solar burst

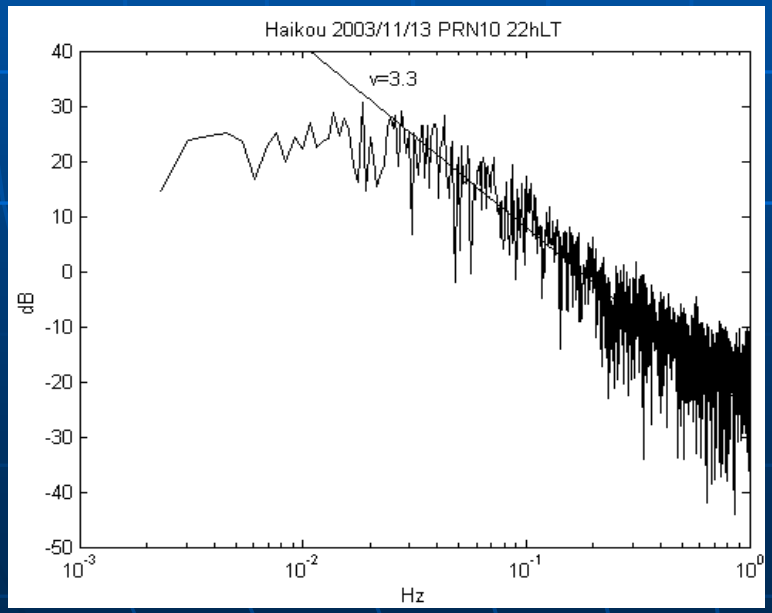
1.2 Comprehensive monitoring of GNSS interference

- Comprehensive monitoring device of GNSS interference was developed. It can monitor radio interference signal and GNSS signal at the same time.
- Comprehensive GNSS monitoring is to deploy the monitor device at multi stations.
- Comprehensive GNSS monitoring is very important to IDM since it can distinguish radio interference and natural disturbance (ionospheric scintillation, solar burst).

Distinguish between radio interference and natural disturbance

Comprehensive understanding of information from multi sources is necessary for distinguishing between radio interference and natural disturbance.

- Spectrum characteristics of GNSS signals
- Characteristics of interference signals
- Size and location of affected region

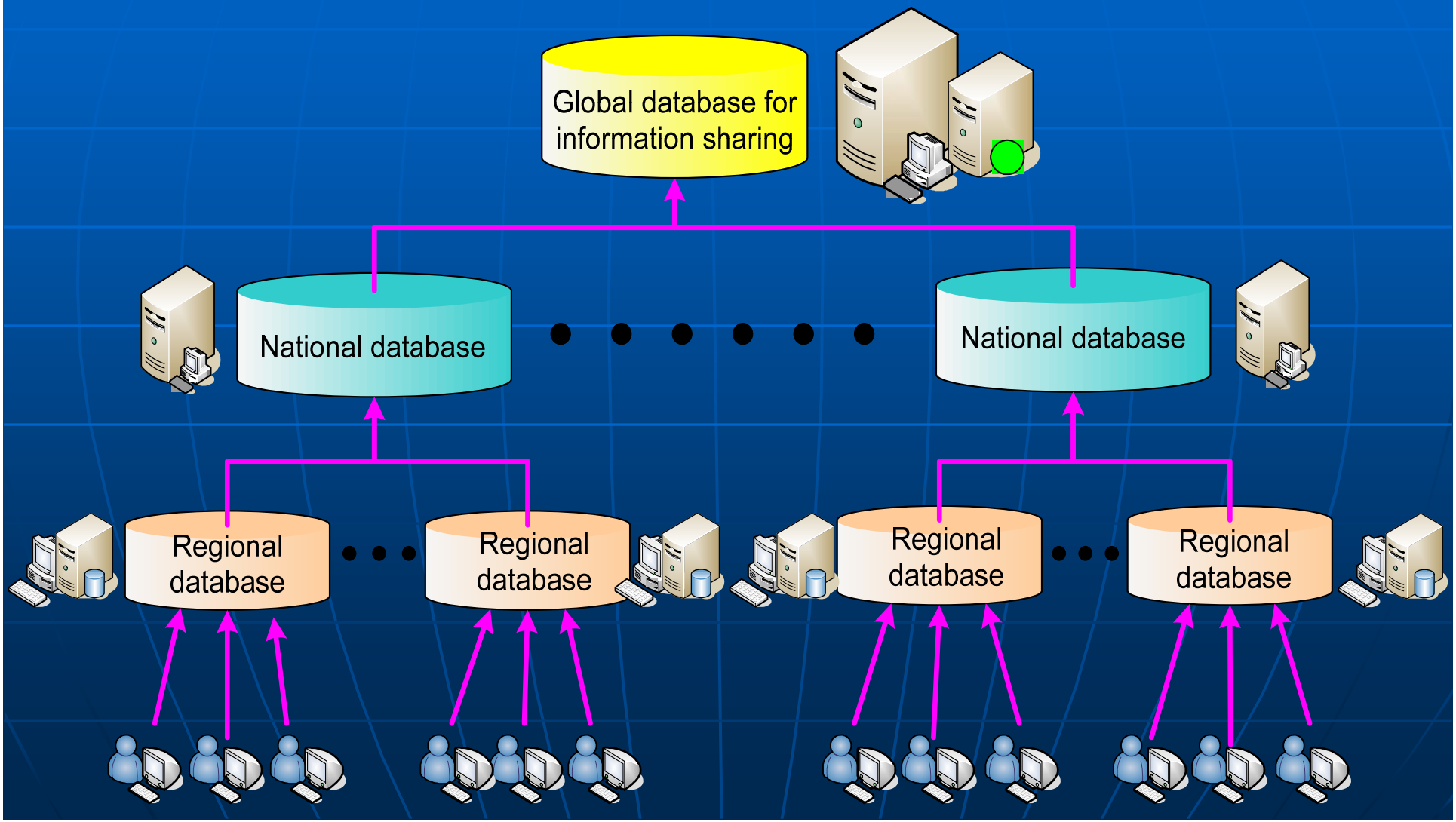


Spectrum of scintillation

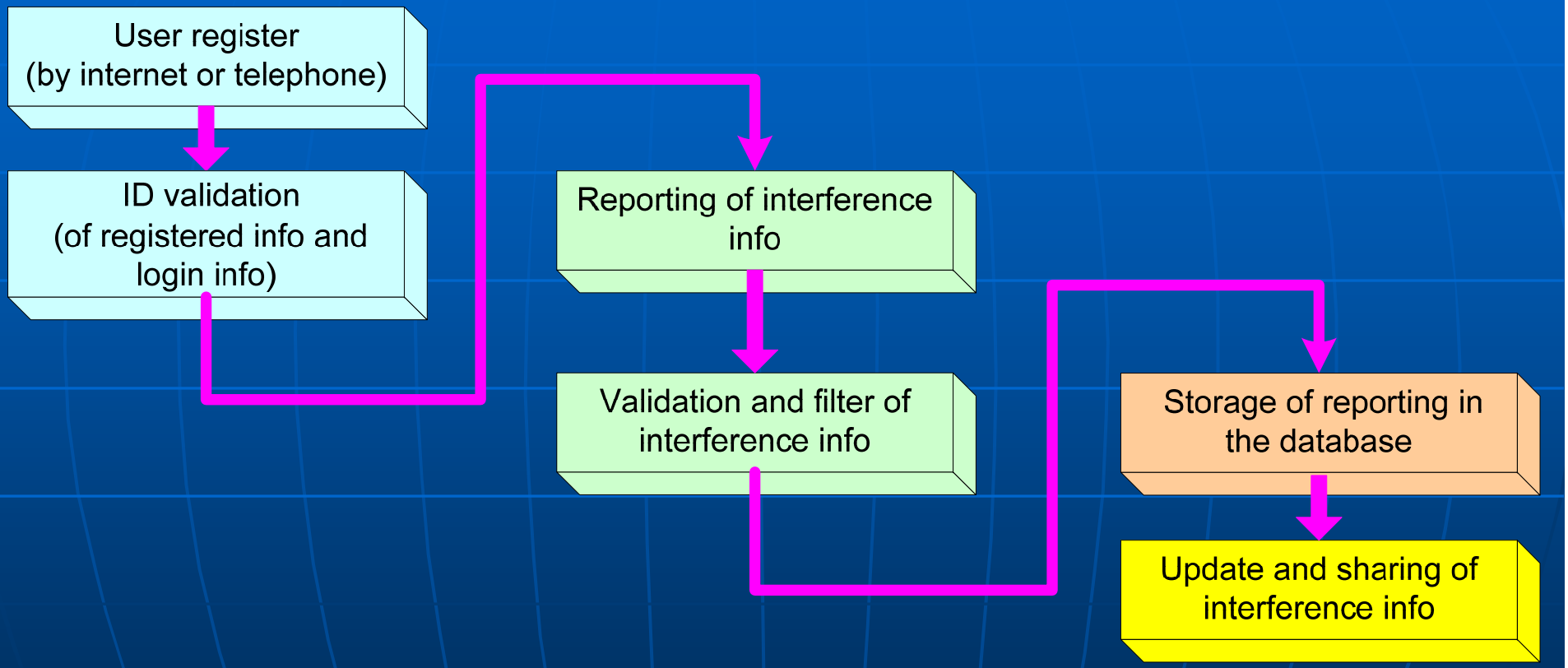
Distribution of GPS receiver affected by strong solar burst

2 Information sharing of GNSS interference

Suggested Procedure of interference information Sharing



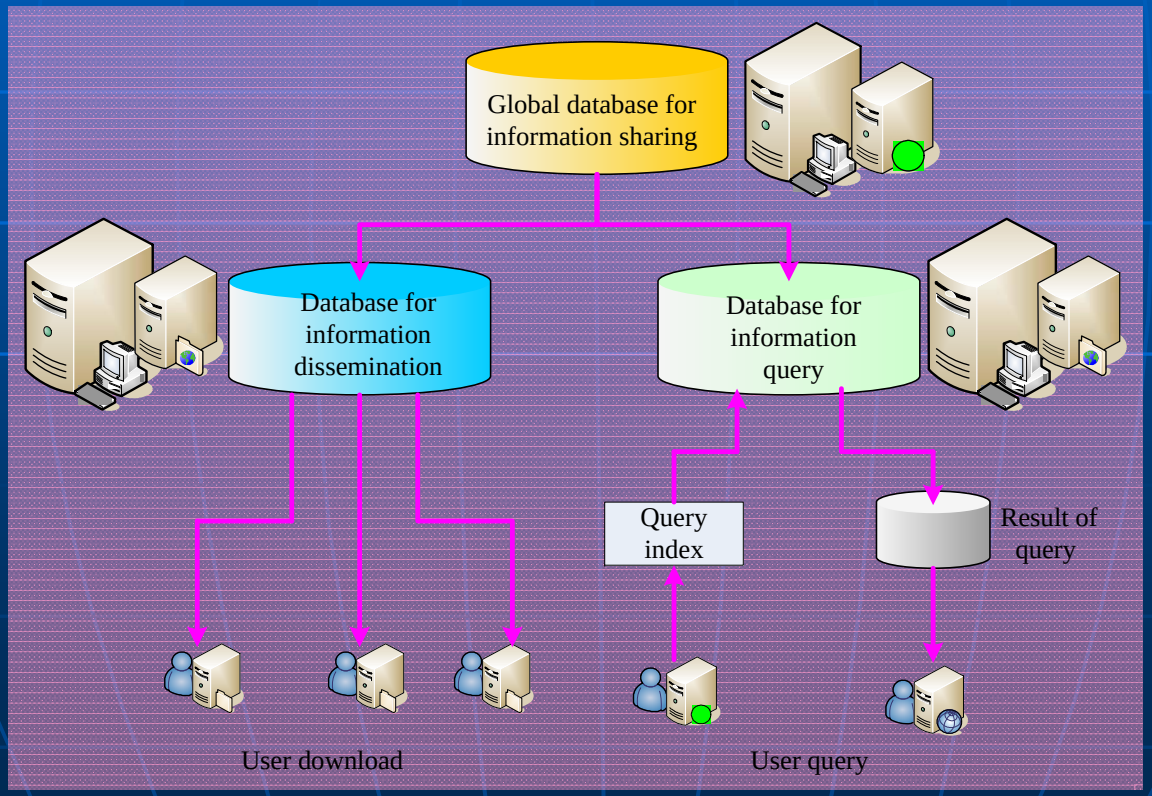
Report procedure of interference information



Query of interference information

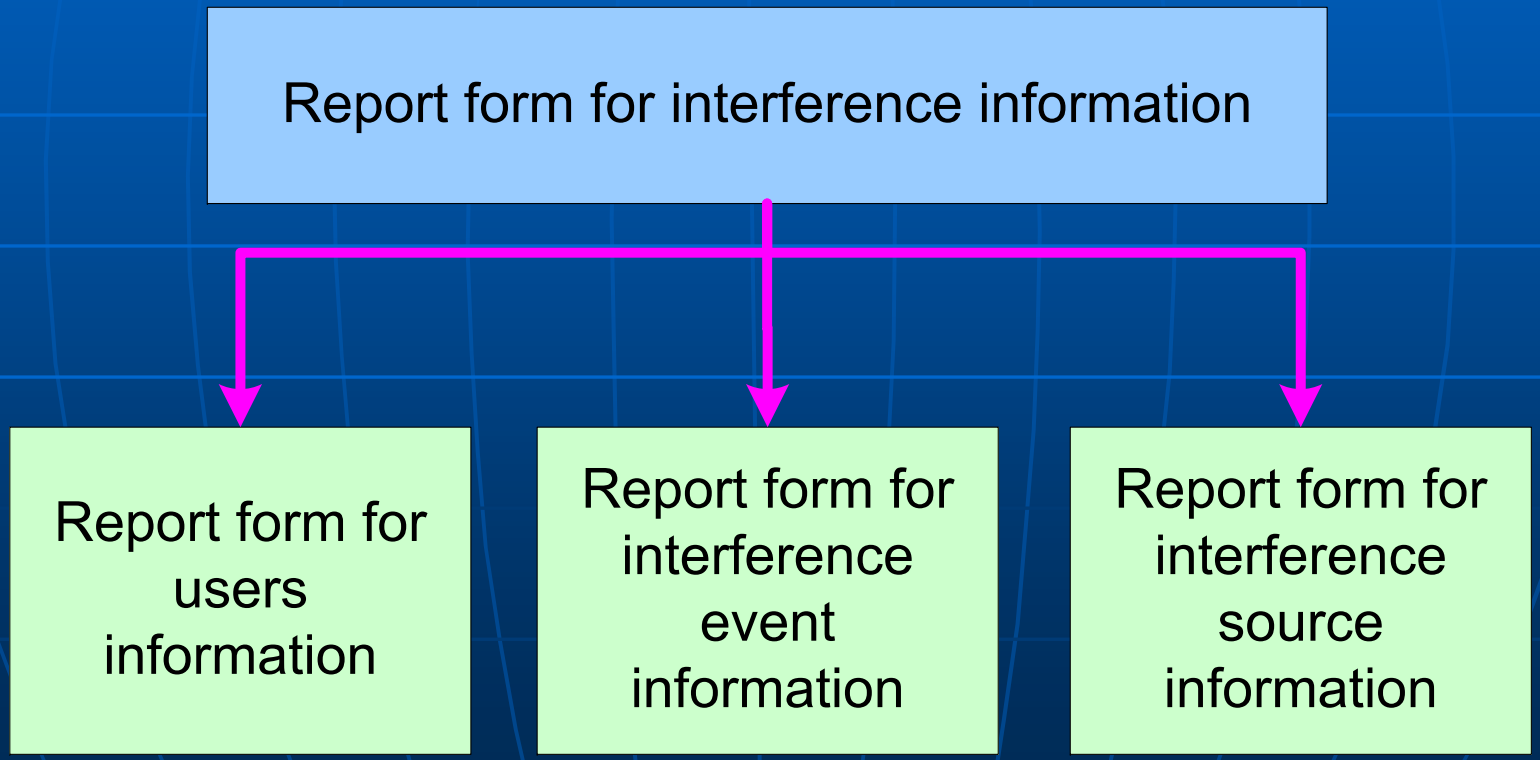
Registered user can query by internet the interference information what he concerns.

- Query of interference info
- Dissemination and download of interference info



Suggested Interference information report form

Information sharing depends on development of a reasonable interference information report form, which is based on suitable classification of GNSS interference.



Suggested report forms are given in the following.

Form for user information

No.	type	content	Remarks
1	Registered name	Name of company or person	
2	Users type		
3	ID number of registered user	Only for personal user	
4	Name of contact person		
5	Phone of contact person		
6	Email		
7	Address		
8	Remarks		

Form for interference event

- Information of interference event include: spatial and temporal info of event and status info of interfered objects.

No.	type	content	Remarks
1	Type of interference	Radio interference or natural disturbance	
2	Report time		
3	Users interfered		
4	Location interfered	Latitude, longitude	
5	Signals interfered		
6	Status of the receiving terminal	Loss of all satellites/ failure of timing /failure of positioning /loss of part satellites	Not limited to one option
7	Status of satellite signal	▪C/N：stable/ increase/decrease/unknown ▪Phase： stable/jitter/ unknown	
8	Spatial distribution and status of interference event	Distribution: ground/ space/unknown Status: static/ varying/ increasing/decreasing/unknown	
9	Time distribution and status of interference event	Start/stop time Distribution: continuous/ periodical/random/unknown status：stopped/ continuing	
10	Polar diagram of antenna	Omni directional/ directional/ unknown	
11	Ionospheric scintillation information	Intensity	
12	solar burst information	Intensity	
13	Remarks	The info that is not mentioned can be detailed in remarks.	

Form for interference source

- Interference source information includes: parameters of interfering signal in or near the working band of GNSS, parameters of interference and spatial distribution source.

No.	Data fields	Options	Remarks
1	Number of sources		
2	Report time		
3	User interfered		
4	Interfering signal information	Central frequency, bandwidth, modulation ,power etc.	
5	Interference source information	Direction of interfering, location etc.	
6	Remarks	The info that is not mentioned can be detailed in remarks.	

3 Summary

❶ Comprehensive GNSS monitoring can distinguish radio interference and natural disturbance, and is important to IDM.

❷Interference report form for user information, interference event and interference source during interference information sharing is suggested.

Thank you for your attention!

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