



The 8th meeting of International Committee on GNSS
—Work group A meeting

Suggestion on standardized reporting form of GNSS interference

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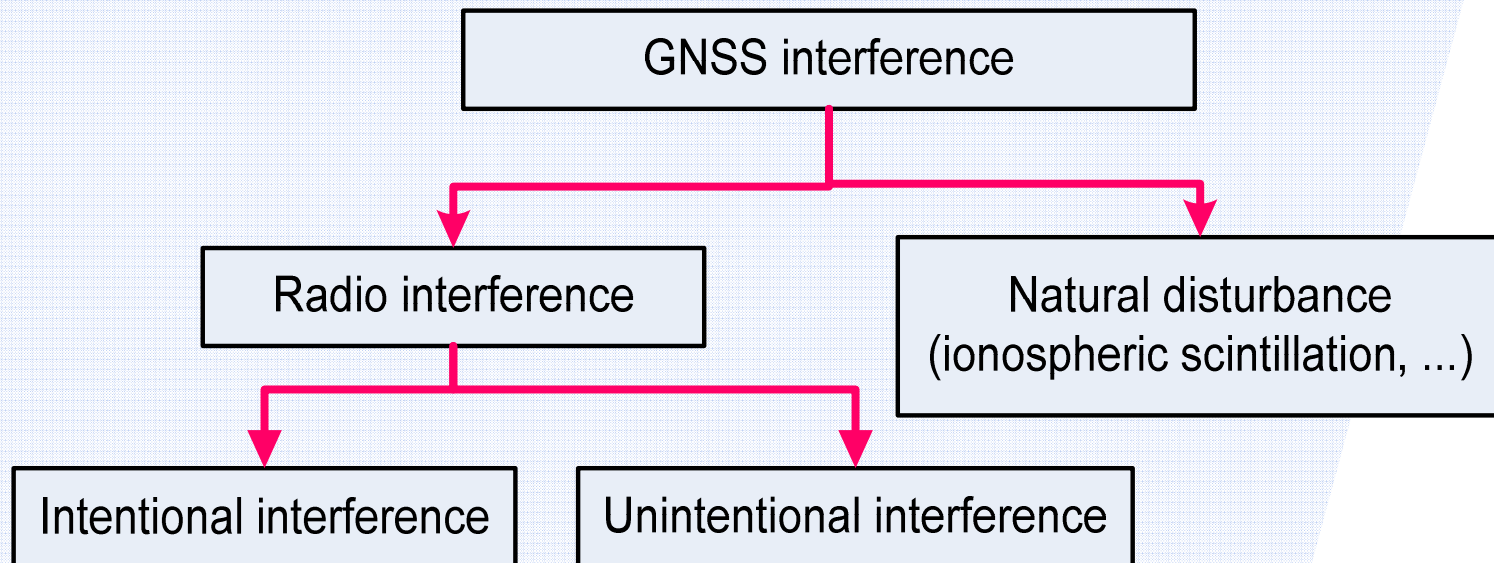
I. Background

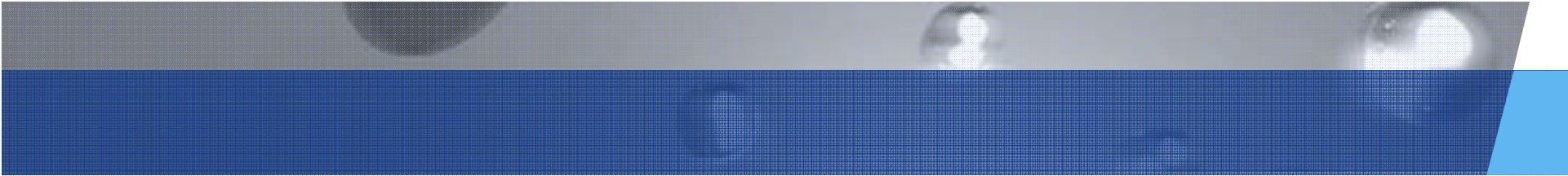
- **GNSS has been widely used in many fields; thus, the security of GNSS has been widely noticed;**
- **Interference is one of the key factors effect GNSS security mostly.**

1). Classification of GNSS interference

GNSS interference include:

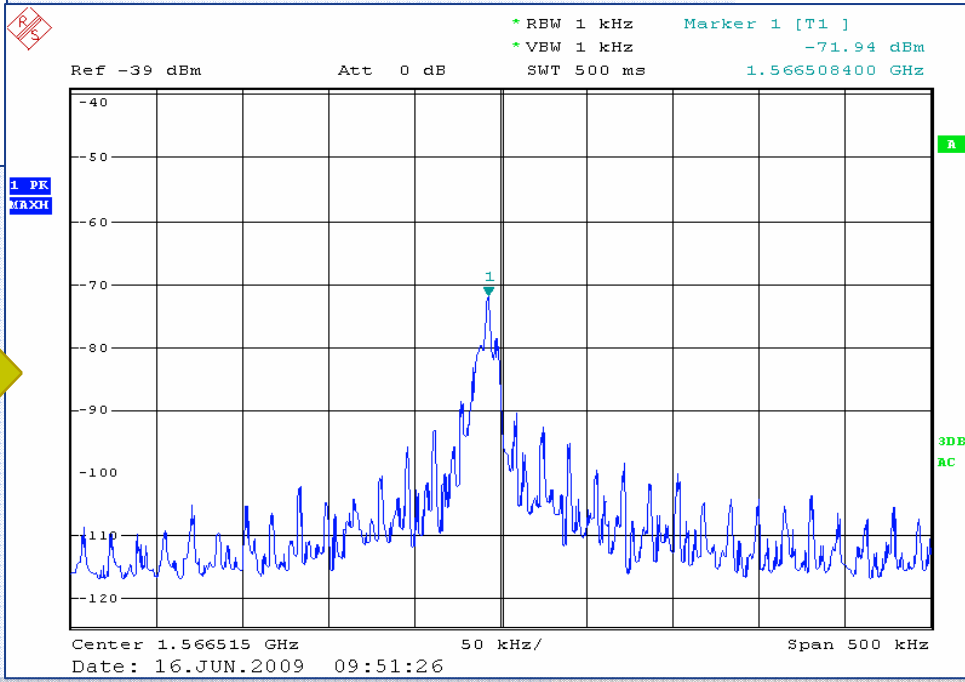
- **Interference from radio systems**
 - ✓ Intentional interference
 - ✓ Unintentional interference
- **Natural Disturbance (mainly ionospheric scintillation)**





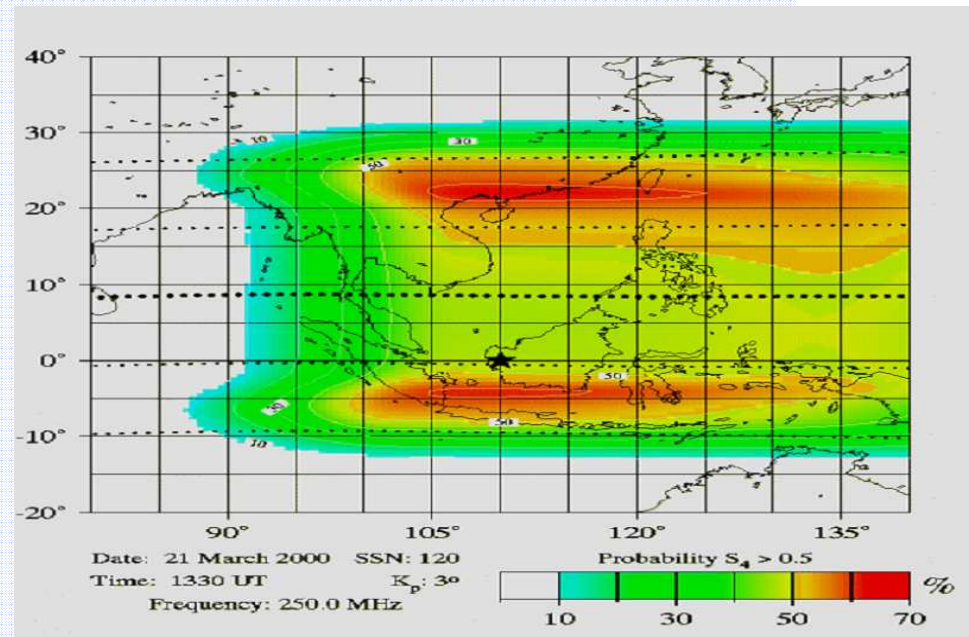
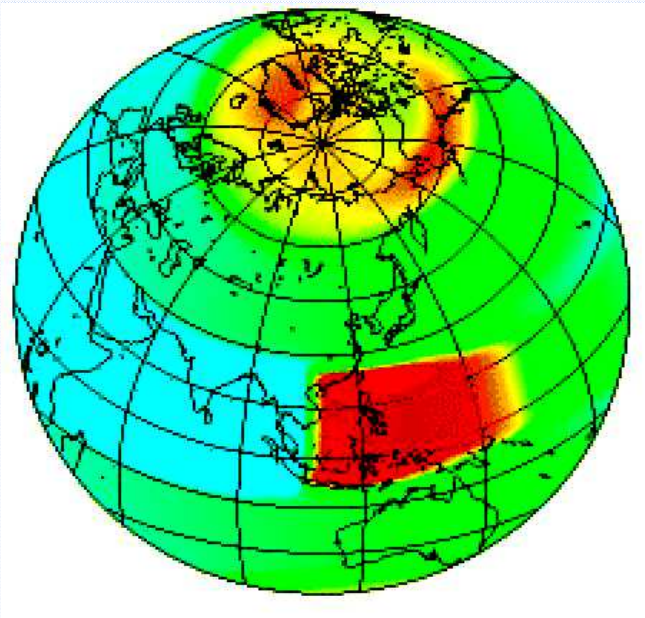
Intentional interference
(can be bought from internet)

Intentional interference
(BDS B1)
(TV transmitter 1566MHz)



Ionospheric scintillation

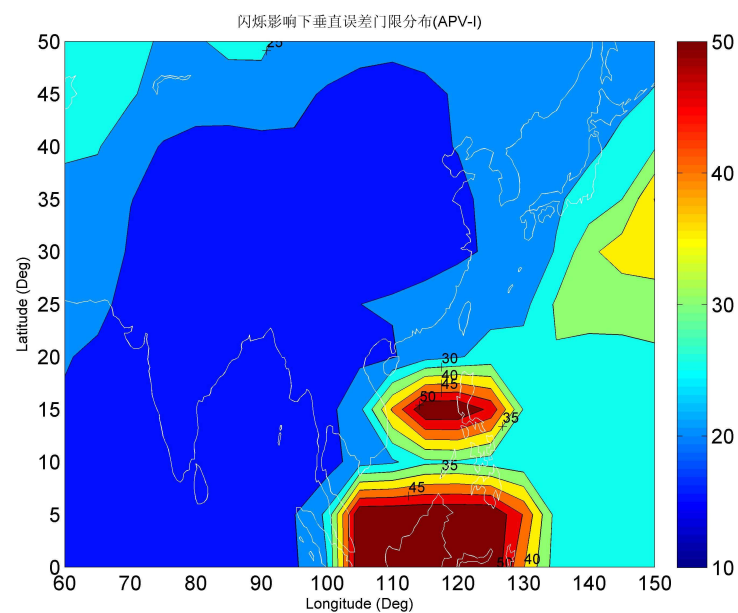
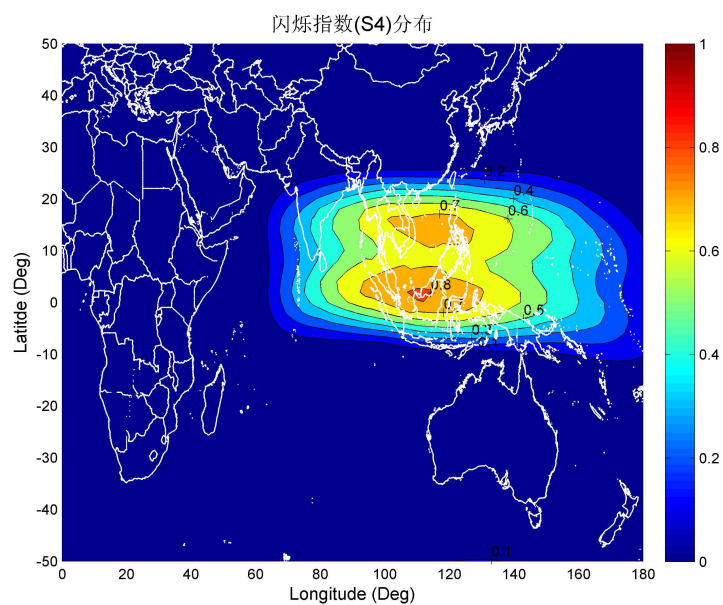
- **GNSS interference may also be caused by natural disturbance. Among which ionospheric scintillation effects is most important.**
- **Ionospheric scintillation varies with many factors such as time, season and geomagnetic position.**



Distribution of ionospheric scintillation

Ionospheric scintillation

- **Ionospheric scintillation will cause dramatic decrease of GNSS positioning accuracy, and even loss of lock.**

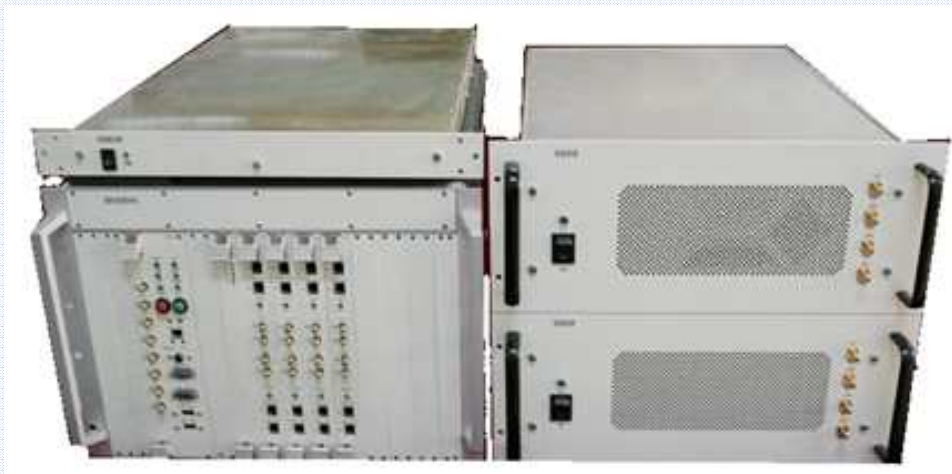


Simulation of ionospheric effects to BDS (2012.09.27)

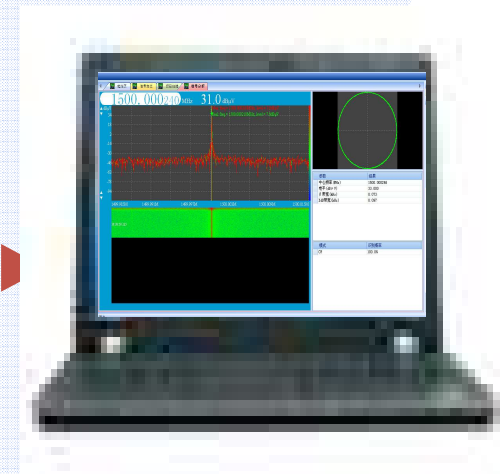
2) Comprehensive monitoring

It is important to conduct comprehensive monitoring of RF interference and ionospheric scintillation(*especially in the low and high latitude region*).

It can provide detailed information of GNSS signal anomaly for mitigation of interference in time.



Host for integrated interference monitoring and direction finding device



Terminal for operation and manifest

II. Suggested reporting form

- **The suggestion on GNSS interference reporting form from U.S., China, Russia and ITU has been introduced.**
 - ✓ GPS problem reporting of USCG NAVCEN (***U.S.***);
 - ✓ Report of Harmful Interference (***ITU AP10***);
 - ✓ Interference reporting form in Russian (***Russia***);
 - ✓ Suggested GNSS interference reporting form (***China***);
 - ✓ ...

GPS problem reporting of USCG NAVCEN (U.S)

GPS PROBLEM REPORTING

*Denotes a required field

1) *Your Name :

2) *Email Address:

3) *Telephone number: [ie. (703)313-5900]

4) Preferred method and time to be contacted if additional information is necessary:

Email/Telephone	Morning/ Afternoon/Evening/Anytime
-----------------	------------------------------------

5) *What was the start time and date of the GPS outage?

Date: Time: Zone:

6) *Is the GPS outage ongoing?

7) *Where did the outage occur?(LAT/LONG:Nearest City or landmark)

Lat: Long:

City/Landmarks:

8) GPS user equipment make and model(receiver manufacturer and model antenna type,etc...)?

9) GPS installation type(aviation, marine, surveying, agriculture, transportation, timing)?

Other:

10) What was the elevation of the GPS antenna?

11) What GPS frequency are you using?(Press Ctrl while selecting to select multiple satellites)

12) How many satellites were being tracked at the time of the outage?

13) Which satellites were being tracked at the time of the outage?(press Ctrl while selecting to select multiple satellites)

14) What was the GPS receiver being used for at the time of occurrence?

15) Summary(Please provide any additional information, unusual screen display indicating a problem and/or operator intervention that may have helped)?

 (Audio)

Enter Displayed Code

 (Reload Image)

Send problem Report

Report of Harmful Interference of ITU

–General form for radio interference, but not special for GNSS

Report of HI (AP10 to RR)



No. **15.27** § 19 Full particulars relating to harmful interference shall, whenever possible, be given in the form indicated in Appendix **10**.

APPENDIX 10 (Rev.WRC-07)
Report of harmful interference
 (See Article 15, Section VI)

Particulars concerning the station causing the interference:

- a* Name, call sign or other means of identification
 - b* Frequency measured
 - Date:
 - Time (UTC):
 - c* Class of emission¹
 - d* Bandwidth (indicate whether measured or estimated)
 - e* Measured field strength or power flux-density²
 - Date:
 - Time (UTC):
 - f* Observed polarization
 - g* Class of station and nature of service
 - h* Location/position/area/bearing (QTE)³ (WRC-07)
 - i* Location of the facility which made the above measurements
- Particulars concerning the transmitting station interfered with:*
- j* Name, call sign or other means of identification
 - k* Frequency assigned

- l* Frequency measured
 - Date:
 - Time (UTC):
 - m* Class of emission⁴
 - n* Bandwidth (indicate whether measured or estimated, or indicate the necessary bandwidth notified to the Radiocommunication Bureau)
 - o* Location/position/area
 - p* Location of the facility which made the above measurements
- Particulars furnished by the receiving station experiencing the interference:*
- q* Name of station
 - r* Location/position/area
 - s* Dates and times (UTC) of occurrence of harmful interference
 - t* Bearings (QTE)³ or other particulars (WRC-07)
 - u* Nature of interference
 - v* Field strength or power flux-density of the wanted emission at the receiving station experiencing the interference⁵
 - Date:
 - Time (UTC):
 - w* Polarization of the receiving antenna or observed polarization
 - x* Action requested

NOTE – For convenience and brevity, telegraphic reports shall be in the format above, using the letters in the order listed in lieu of the explanatory titles, but only those letters for which information is provided should be used. However, sufficient information shall be provided to the administration receiving the report, so that an appropriate investigation can be conducted.

¹ The class of emission shall contain the basic characteristics listed in Appendix 1. If any characteristic cannot be determined, indicate the unknown symbol with a dash. However, if a station is not able to identify unambiguously whether the modulation is frequency or phase modulation, indicate frequency modulation (F).
² When measurements are not available, signal strengths according to the QSA scale should be provided.
³ See the most recent version of Recommendation ITU-R M.1172. (WRC-07)

⁴ See footnote 1.
⁵ See footnote 3.
⁶ See footnote 2.

Suggestion

Considering the future interference information sharing, international GNSS jointly monitoring and actions for interference mitigation, the form should include as much optional information as possible:

- Refer to the frame of “ITU Report of HLAP10 to RR)”, a general reporting form special for GNSS interference report is suggested here, which includes **four parts**:**
- 1. Information of GNSS user (*required*);**
- 2. Information of GNSS anomaly (*required*);**
- 3. Information of interference source (*optional*);**
- 4. Analysis of interfering and actions (*optional*).**

Suggested GNSS interference reporting form

GNSS INTERFERENCE REPORTING FORM

No: _____

Information of GNSS user	Name *		Email*		
	Nationality		Address		
	Telephone number*	Fixed	Preferred method for necessary contact		<input type="checkbox"/> Email <input type="checkbox"/> telephone
		Mobile	Preferred time for necessary contact		<input type="checkbox"/> morning <input type="checkbox"/> afternoon <input type="checkbox"/> evening <input type="checkbox"/> no restriction
	Equipment name		Equipment installation type		
	Equipment model		GNSS frequency using		
	Antenna elevation of receiver		Polarization of the receiving antenna or observed polarization		
Information of GNSS anomaly	Start time *(date/time/zone)		Position*(longitude/latitude)		
	Current status of interference*		<input type="checkbox"/> continuing <input type="checkbox"/> stopped <input type="checkbox"/> Intermittent	Time duration of interference	
	Occurrence of interference		<input type="checkbox"/> occasionally <input type="checkbox"/> frequently	Frequency of interfering signal	
	GNSS system interfered(BDS,GPS...)		Signal interfered(B1,B2,B3,L1,L2,L5...)		
	Satellite being tracked when interfered		Satellite interfered		
	Class of emission		Bearings or other particulars		
	Signal status (Location Fault, Time fault, accuracy decreasing...)		Field strength or power flux-density of the wanted emission at the receiving station experiencing the interference		
Ionospheric scintillation occurs during interference		<input type="checkbox"/> yes <input type="checkbox"/> no	Ionospheric scintillation index		
Information of interference source	Name of source		Organization		
	Frequency measured (frequency/date /time of measurement)		Class of emission		
	Bandwidth (measured or estimated)		Observed polarization		
	Measured field strength or power flux-density		Class of interfering source and nature of service		
	Location/position/ area/bearing		Location of the facility which made the above measurements		
Analysis of interfering and actions	Record of the interference sources detection		Connection graph of used equipment for interferer detection, parameters setting, detection procedure etc.		
	Analysis of interfering		Interfering characteristics, how is the interfering formed, Spectrum measurement plot of interfering signal etc.		
	Action requested *				
Remark					

Remark: * Denotes a required field

Suggested GNSS interference reporting form

GNSS INTERFERENCE REPORTING FORM		No:
Information of GNSS user	Name *	<div style="border: 2px solid red; border-radius: 15px; padding: 10px; text-align: center;"> <h2 style="color: red; margin: 0;">1. Information of GNSS user (Required)</h2> </div>
	Nationality	
	Telephone number* <input type="checkbox"/> Fixed <input type="checkbox"/>	
	Equipment name	
	Equipment model	
	Antenna elevation of receiver	
Information of GNSS anomaly	Start time *(date/time/zone)	<div style="border: 2px solid blue; border-radius: 15px; padding: 10px; text-align: center;"> <h2 style="color: blue; margin: 0;">2. Information of GNSS anomaly (Required)</h2> </div>
	Current status of interference*	
	Occurrence of interference	
	GNSS system interfered(BDS/GPS...)	
	Class of emission	
	Signal status (Location Fault, Time fault, accuracy decreasing...)	
Information of interference source	Ionospheric scintillation occurs during interference	<div style="border: 2px solid green; border-radius: 15px; padding: 10px; text-align: center;"> <h2 style="color: green; margin: 0;">3. Information of interference source (Optional)</h2> </div>
	Name of source	
	Frequency measured (frequency/date/time of measurement)	
	Measured field strength or power flux-density	
Analysis of interfering and actions	Location/position/area/bearing	<div style="border: 2px solid orange; border-radius: 15px; padding: 10px; text-align: center;"> <h2 style="color: orange; margin: 0;">4. Analysis of interfering and actions (Optional)</h2> </div>
	Record of the interference sources detection	
Remark	Action requested *	

Remark: * Denotes a required field

1 Information of GNSS user (Required)

GNSS INTERFERENCE REPORTING FORM				No:	
Information of GNSS user	Name *		Email*		
	Nationality		Address		
	Telephone number*	Fixed	Preferred method for necessary contact		<input type="checkbox"/> Email <input type="checkbox"/> telephone
		Mobile	Preferred time for necessary contact		<input type="checkbox"/> morning <input type="checkbox"/> afternoon <input type="checkbox"/> evening <input type="checkbox"/> no restriction
	Equipment name		Equipment installation type		
	Equipment model		GNSS frequency using		
	Antenna elevation of receiver		Polarization of the receiving antenna or observed polarization		

The * items (include: Name, Email, Phone etc) are required;

– Other information are optional.

2 Information of GNSS anomaly (Required)

Information of GNSS anomaly	Start time *(date/time/zone)		Position*(longitude/latitude)	
	Current status of interference*	<input type="checkbox"/> continuing <input type="checkbox"/> stopped <input type="checkbox"/> Intermittent	Time duration of interference	
	Occurrence of interference	<input type="checkbox"/> occasionally <input type="checkbox"/> frequently	Frequency of interfering signal	
	GNSS system interfered(BDS,GPS...)		Signal interfered(B1,B2,B3,L1,L2,L5...)	
	Satellite being tracked when interfered		Satellite interfered	
	Class of emission		Bearings or other particulars	
	Signal status (Location Fault, Time fault, accuracy decreasing...)		Field strength or power flux-density of the wanted emission at the receiving station experiencing the interference	
	Ionospheric scintillation occurs during interference	<input type="checkbox"/> yes <input type="checkbox"/> no	<u>Ionospheric scintillation index</u>	

Considering the classification of GNSS interference and the important effects of ionospheric scintillation (space weather) especially in low and high latitude region, Ionospheric scintillation information should be included as optional items in the information of GNSS anomaly .

3 Information of interference source (Optional)

Interference		EIRP	
Information of interference source	Name of source		Organization
	Frequency measured (frequency/date /time of measurement)		Class of emission
	Bandwidth (measured or estimated)		Observed polarization
	Measured field strength or power flux-density		Class of interfering source and nature of service
	Location/position/area/bearing		Location of the facility which made the above measurements

Information of interference source should be optional.

For the users who are not able to obtain the information, it is not required to fill this part.

4 Analysis of interfering and actions(Optional)

Analysis of interfering and actions	Record of the interference sources detection	Connection graph of used equipment for interferer detection, parameters setting, detection procedure etc.
	Analysis of interfering	Interfering characteristics, how is the interfering formed, Spectrum measurement plot of interfering signal etc.
	Action requested *	
Remark		

Remark: * Denotes a required field

Information of Analysis of interfering and actions should be optional.

For the users who are not able to obtain the information, it is not required to fill this part.

III. Summary

Considering the future interference information sharing, international GNSS jointly monitoring and actions for interference mitigation, the form should include as much optional information as possible:

- Refer to the frame of “ITU Report of HI (AP10 to RR)”, a general reporting form special for GNSS interference report is suggested here, which includes **four parts**:
 1. Information of GNSS user (***required***);
 2. Information of GNSS anomaly (***required***);
 3. Information of interference source (***optional***);
 4. Analysis of interfering and actions (***optional***).

III. Summary

Considering the classification of GNSS interference and the important effects of ionospheric scintillation (space weather) especially in low and high latitude region.

It is suggested that ionospheric scintillation information should be included as optional items in the information of GNSS anomaly .



**Thank you for
your attention!**

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