



International Civil Aviation Organization

**THE FOURTH MEETING OF IONOSPHERIC
STUDIES TASK FORCE (ISTF/4)**

New Delhi, India, 05 – 07 February, 2014



Agenda Item 3: Review of Status of States' Activities

**CORRELATION OF SCINTILLATION AND LOSS OF LOCK
FOR GNSS SYSTEMS**

(Presented by India)

SUMMARY

This study tries to understand the relation between scintillations and the loss of lock of the receiver. The main purpose of this study is to continuously examine the scintillation data over the Indian region and gain a preliminary understanding of the relationship between loss of lock of the receiver and scintillations.

1. INTRODUCTION

1.1. India has ventured into satellite based navigation by the implementation of GPS Aided Geo Augmented Navigation (GAGAN) a Satellite-based Augmentation System . It has been certified for RNP 0.1 and will eventually provide Approach Precision Vertical (APV) 1.5 level of service (which corresponds to 40 meters horizontal and 50 meters vertical alert limit) over India and the surrounding region. India is also trying to implement GBAS in its region.

1.2. Indian region is prone to scintillations which in turn cause loss of lock of the GPS receivers. The scintillations affect the GAGAN INRES, INLUS receivers as well as the GAGAN user receivers and in turn effect the GAGAN system performance. In the future they may also affect the GBAS receivers. So it is very much essential to understand the relationship between the scintillations and loss of lock of the receivers.

1.3. A continuous study is being carried out to understand this relationship using the data from various receivers available in the Indian region which include the GPS Ionospheric Scintillation and TEC Monitor (GISTM) GSV4004TEC receivers stationed all over India and the GAGAN INRES receivers.

2. DISCUSSION

2.1. GAGAN system data along with the data obtained from the GPS Ionospheric Scintillation and TEC Monitor (GISTM) GSV4004TEC receivers stationed all over India is being used for this study. A detailed study of the relationship between the receiver loss of lock & the occurrence of scintillations is being carried out.

2.2. In general it has been observed from the analysis that the Receiver loss of lock is dependent on various factors like scintillations (S4 index value), Type of receiver, elevation angle, received frequency (L1 or L2). It has been observed that the probability of loss of lock is more on L2 than on L1 and at low elevation angles and at higher S4 values.

2.3. The plot below shows the no. of loss of lock of the GAGAN system receivers on 27/08/2012. This plot shows the relationship between the loss of lock and elevation angle.

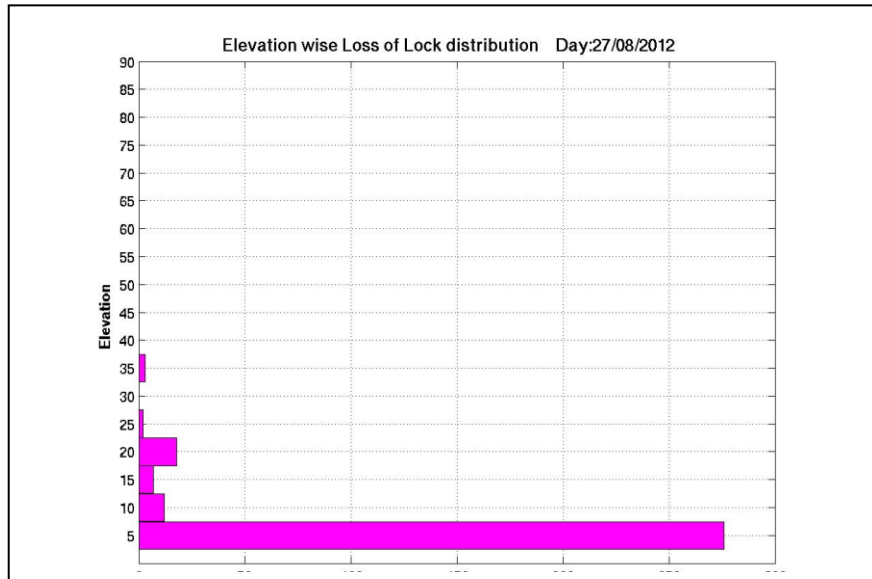


Figure 1

2.4. The below are the plots of two successive days from the Bangalore TEC receiver from the month of October 2013.

Figure 2a shows the Loss of lock and elevation wrt time dated 19/10/2013;

Figure 2b shows the S4 index values and elevation wrt time dated 19/10/2013;

Figure 2c shows the Loss of lock and elevation wrt time dated 18/10/2013; and

Figure 2d shows the S4 index values and elevation wrt time dated 18/10/2013

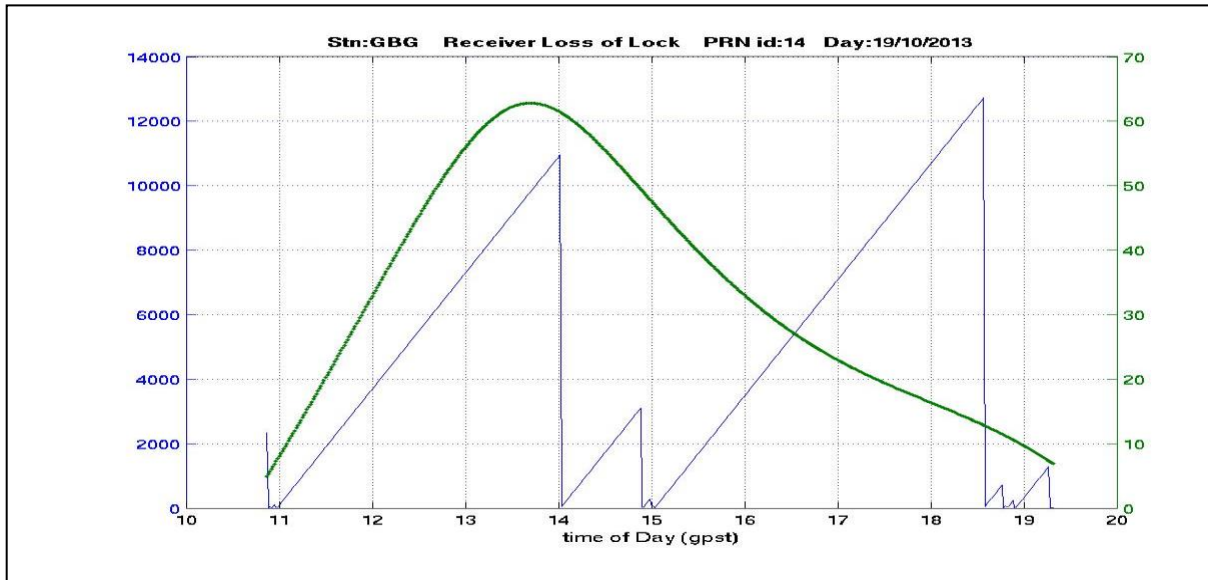


Figure 2a: Loss of lock and elevation wrt time

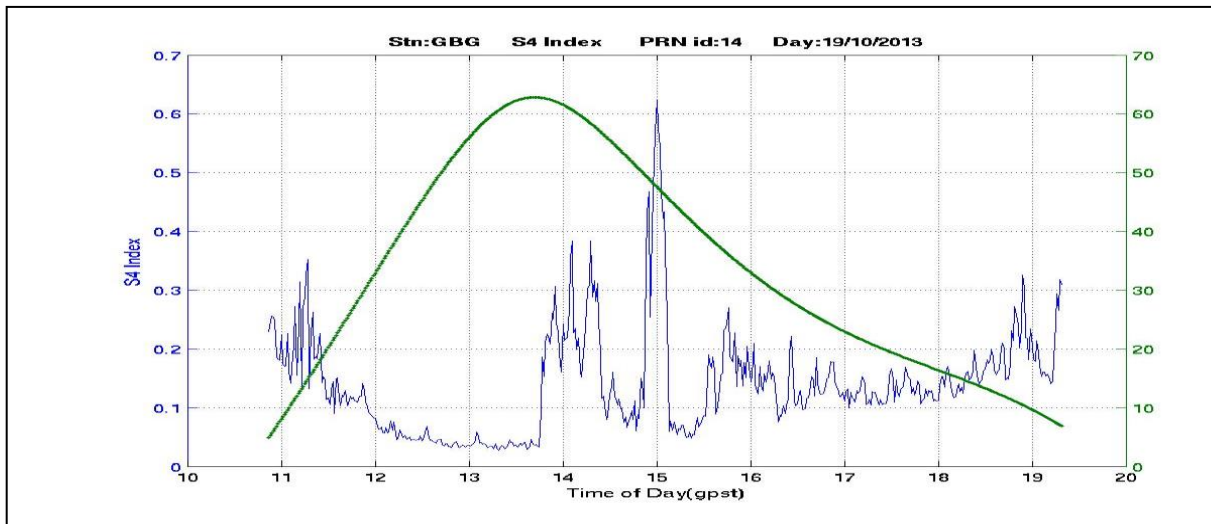


Figure 2b: S4 index values and elevation wrt time

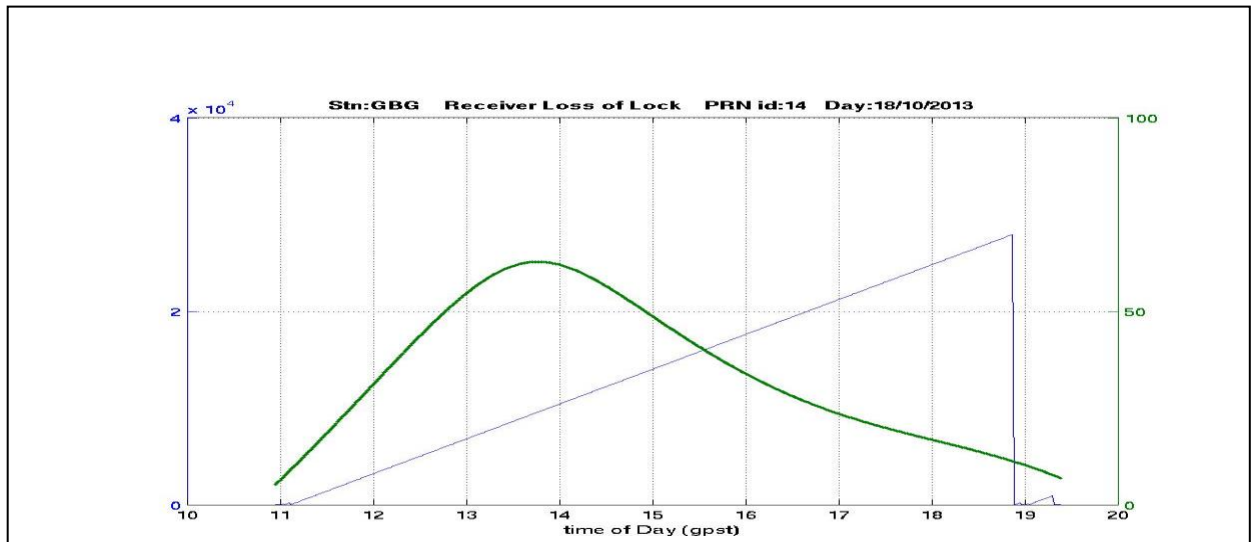


Figure 2c: Loss of lock and elevation wrt time

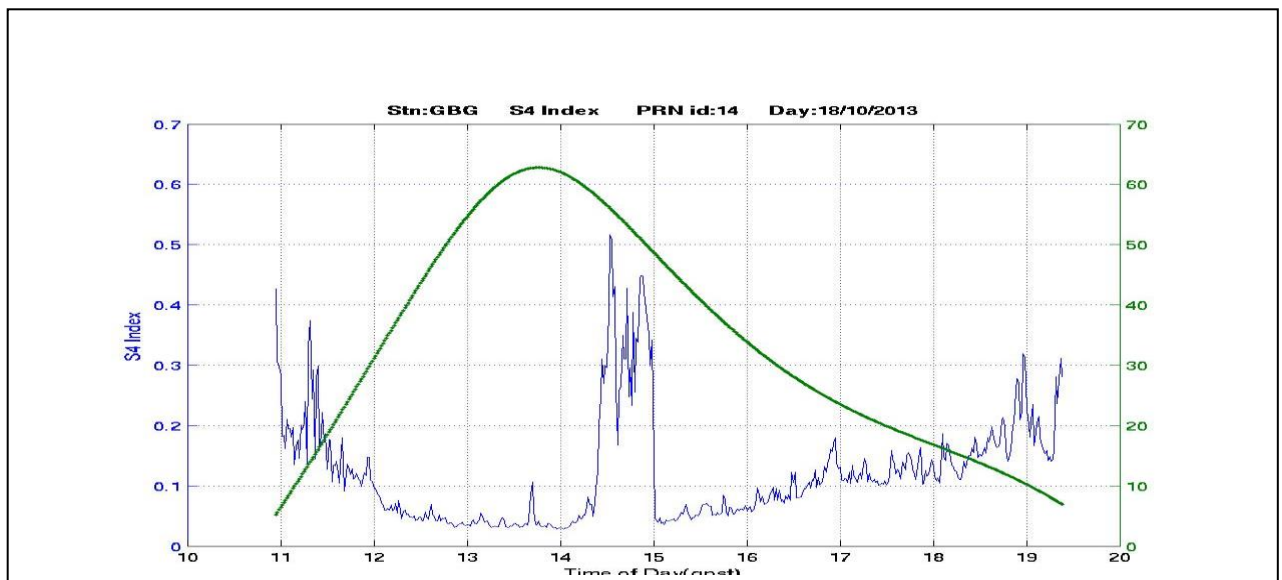


Figure 2d: S4 index values and elevation wrt time

2.5. It can be seen figure 2a and 2b that on 19/10/2103 there was a loss of lock of PRN id 14 at around 14 Hrs when the S4 index was around 0.4 .In figures 2c and 2d it can be seen that there was no loss of lock on 18/10/2010 even when the S4 was comparatively higher that of the next day at 0.5. There have been instances when the receiver has lost lock at lower S4 index values but sustained the lock at higher S4 values.

2.6. This phenomenon of loosing lock at a lower value of S4 index and not loosing lock even when S4 index is comparatively higher in similar conditions raises the question of the sufficiency of S4 index alone to understand the loss of lock phenomenon due to scintillations.

2.7. This needs to be investigated and the relationship between the S4 index and loss of lock needs to be further analysed. We need to understand if S4 index alone is sufficient to understand the loss of lock phenomenon due to scintillations.

3. CONCLUSION

3.1. Further analysis needs to be carried out on the sufficiency of S4 index.

3.2. Further analysis needs to be carried out on more proper definition of properties of scintillation which would define a Loss of lock in a receiver.

4. ACTION BY THE MEETING

4.1 The meeting is invited to:

- a) note the results and inferences of the study;
- b) discuss if the S4 index alone is sufficient for loss of lock analysis due to scintillation, or if there is a need to study an extended definition of properties of scintillation which would cause a Loss of lock of a receiver; and
- c) discuss any other relevant matters as appropriate.
