Comments on draft letter for RTCA/SC-159 to inform our activities

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Summary

This paper is a brief report on an action item that was generated at the MNWG meeting in Tampa on May, 2006. The author has pointed out the issues on the effect of multipath echoes with regarding its impact on the signal environment in GPS-L5 channel at this meeting. Mr. John Banks from UK-NATS took an action to contact RTCA regarding concerns over the assessment of radio frequency interference on GNSS L5/E5A receivers. Mr. John Banks has drafted a letter to RTCA to inform on our activities and on this issue with suggesting the review of related RTCA documents.

This paper summarizes on this action item with technical background, brief history of actions and comments on his letter to avoid possible confusions of readers on the data measured by ENRI.

References

S. Ozeki: “Onboard measurement for multipath echo”, MNWG06, Tampa, May, 2006
Introduction
This paper is a brief summary on the issue of multipath echo to discuss about pulse signal interference onto GPS-L5 signal. This paper includes technical background, its history and current status of action item to contact RTCA. The author adds some comments on the coordination letter for RTCA to avoid possible confusion about the result of experiments by ENRI.

Technical background
The performance of GPS-L5 receiver will be degraded by pulse interference in its receiving band. The primary sources of interference are DME, TACAN and JTIDS. The possible resolutions to avoid interference onto GPS-L5 signal have been discussed at MNWG meetings. Basically, the AGC, Automatic Gain Control, of GPS-L5 receiver have to keep the receiver gain to capture the GPS-L5 signal in its dynamic range. The AGC will deviate the receiver dynamic range to higher power range falsely in the signal environment with higher power interference.

The pulse blanker is applied to resolve this problem. The pulse blanker is required to keep lock on the GPS-L5 signal under the pulse signal interference with exceeding the power level of GPS-L5 signal. The pulse blanker rejects the pulse interference to keep receiver lock on to low power GPS-L5 signal without deviation to higher power by strong pulse interference. The pulse blanker inhibits input to AGC and signal decoder during pulse interference with exceeding a threshold.

The duty ratio of this blanking is one of the parameters to calculate the equivalent SN ratio at the decoder input. The higher blanking duty ratio, i.e. longer blanking time, results lower SN of the decoder input signal.

It should be noted that the multipath echoes should be taken into account to evaluate the duty ratio of pulse blanker, if they are received with exceeding the threshold of pulse blanker and with delay time longer than its pulse width. This means that the multipath echoes may degrade the GPS-L5 receiver performance lower than that of current estimation without taking its effect into account.

In the real world, pulse signal are observed with its associating multipath echoes. The multipath echoes are observed by onboard receiver with exceeding assumed blanker threshold, for example -80 or -90 dBm, even at thousands feet high.

The author has been pointing out this issue to improve the accuracy of receiver performance estimation at the meetings including MNWG. Because, the author could not find the discussion about the contribution of multipath echo onto the equivalent duty ratio of pulse blanker in the RTCA DO-292 Assessment of Radio Frequency Interference Relevant to the
GNSS L5/E5A Frequency Band.

History of actions
The author has pointed out the issues on the effect of multipath echoes with regarding its impact on the signal environment in GPS-L5 channel at the NMWG and related meetings including MNWG06 meeting in Tampa.
There was another pointing out by the members from German on the issue of assumed antenna polarization loss to estimate the impacts of interference on GPS-L5 receiver performance.
After some discussions, meeting members have agreed to coordinate with RTCA on these issues.
Mr. John Banks from UK-NATS took an action to contact RTCA regarding concerns over the assessment of RFI on GNSS L5/E5A receivers.
Mr. John Banks reviewed the RTCA DO-292 Assessment of Radio Frequency Interference Relevant to the GNSS L5/E5A Frequency Band.  Then, he agreed that there were concerns over multipath echoes and L5 antenna polarisation and orientation losses. He and the author have concluded that it is most likely that multipath echoes have not been considered in the study. These related primarily to interference from DME/TACAN as this has the largest potential for interference.
Mr. John Banks drafted the letter to RTCA.  It was distributed GNSSSG members with inviting comments on it. The draft letter to RTCA is attached to this paper. It is the original draft on late September, 2006

Comments on this letter
The author of this paper has already sent the comments on this letter to Mr. John Banks as follows.

Original:
"A paper was presented by ENRI, Japan (Shigeru Ozeki) at the MNWG detailing tests carried out in the vicinity of Sendai airport."

Suggested correction
from: "in the vicinity of Sendai airport."
to : "in the vicinity of Kochi and Sendai airport."
comment: If "vicinity" means in 300 NM, LOS, then the route is covered. The data in last presentation was measured in the airspace close to the Kochi Airport.
An experimental aircraft flying at 8000ft detected a large number of multi-path echoes, some of which appear to be at power levels only 10dB below the incident signal.  

Suggested correction

from: "10dB"
to : "15dB"

comment: 10dB is observed at lower altitude, for example at 2500ft.

Conclusion

This paper is a brief summary of the issue of multipath echo to improve the performance estimation of GPS-L5 receiver under pulse signal interference. This paper includes the technical background and the history of actions to coordinate with RTCA on this issue. This paper suggests members on revising the letter to RTCA to avoid possible confusion.