ELEVENTH AIR NAVIGATION CONFERENCE

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Agenda Item 6 : Aeronautical navigation issues

STUDIES ADDRESSING REASSIGNMENT OF DMEs TO ACCOMMODATE GPS L5 OPERATIONS

(Presented by the United States)

SUMMARY

The purpose of this paper is to provide information on preliminary results of work undertaken to determine the necessity of reassigning distance measuring equipment/tactical air navigation (DME/TACAN) systems in a high-density DME/TACAN region of the United States where high altitude GPS L5 interference free signal availability is desired.

1. INTRODUCTION

1.1 In support of the International Civil Aviation Organization (ICAO) Global Navigation Satellite System (GNSS), and as part of our Global Positioning System (GPS) modernization, the United States will be implementing 1176.45 MHz[1] as the center frequency for a new civil GPS aeronautical safety-of-life signal (L5). While in most regions of the world full utilization of GPS L5 can be accomplished with no change to existing emitters, initial studies indicated that in regions with high concentrations of in-band (1176±10 MHz) distance measuring equipment/tactical air navigation (DME/TACAN) systems, some frequency reassignment of those ground facilities might be necessary if high altitude GPS L5 interference free signal availability was desired. The purpose of this paper is to report on preliminary results of follow-on work undertaken to determine the necessity of making such a reassignment in a high-density DME/TACAN region of the United States.

[1] Studies in the International Telecommunication Union resulted in new Radionavigation Satellite Service allocations at the 2000 World Radiocommunication Conference.

2. DISCUSSION

2.1 Recognizing the challenging operational environment posed by the highly utilized 960-1215 MHz band[2], GPS L5 was designed to be extremely tolerant of pulsed signal environments. This was accomplished through careful code/signal selection, increased signal power (in comparison to existing GPS signals), and the incorporation of a "pulse blanker" receiver mechanism. Using this design information, together with national and ICAO databases of existing/planned ground system infrastructure, computer models were constructed to determine the compatibility of the planned GPS L5 signal with its operational environment. As noted above, those initial analyses indicated that in limited regions of the world, where high-density concentrations of 1164-1188 MHz DME/TACAN were found, some reassignment of ground facilities might be necessary in order to ensure operation of the GPS L5 signal at high altitude.

2.2 Since those early analyses, follow-on work has concentrated on refining the fidelity of the computer models to provide a better indication of GPS L5 compatibility. In particular:

a) measurements have been performed to confirm the radio frequency characteristics of interfering signals;

b) signal environment generators have been refined to provide a more accurate depiction of operational conditions (e.g., providing a more operationally realistic views of how multiple interference sources would add together). Limited flight tests have also been performed to validate model predictions; and

c) GPS L5 prototype receiver hardware and GPS L5 signal simulators have been constructed to allow for bench testing to verify receiver model simulation results.

2.3 This work has allowed the Federal Aviation Administration (FAA) to better quantify expected impacts of GPS L5 introduction on aeronautical ground system infrastructure.

3. CONCLUSIONS

3.1 In general, the initial follow-on results have indicated that early GPS L5 analyses were pessimistic in that they overstated potential requirements for DME/TACAN reassignment. This was driven largely by two main factors:

a) over-estimation of the pulsed interference environment; and

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[2] Existing systems in or around the band include distance measuring equipment (DME), Tactical Air Navigation (TACAN), secondary surveillance radar (SSR), the military Joint Tactical Information Distribution System (JTIDS) or Multifunctional Information Distribution System (MIDS), and air traffic and military surveillance radar.

b) under-estimating the ability of a GPS L5 receiver to function in high-interference environments[3].

3.2 Initial studies concluded that in the U.S. several hundred DME/TACANs might need to be re-frequencied to accommodate GPS L5. In contrast, with more-complete data allowing removal of some of the conservatism, follow-on studies are postulating considerably fewer stations will need to be changed in order to introduce GPS L5 in the United States. This conclusion is only preliminary however, and work is currently underway to provide validation. In addition, as more information on the Galileo system becomes available, the U.S. intends to evaluate both Galileo E5a and E5b to determine the feasibility of fully implementing those signals as well. It should be noted that this "interference issue" only affects the GPS and Galileo signals at high altitude where many DME/TACAN's are in sight. The expectation is that both GPS L5 and Galileo E5a/E5b will be fully usable at lower altitudes with no change to existing band utilization.

— END —

[3] Final details are currently being worked under the auspices of RTCA, Inc.