



Montreal, 27 Nov 2020

Problem statement - 5G interference with radar altimeter frequency band

Reference:

Problem statement and industry response to the ICAO FLTOPSP/7 information paper IP03 "5G frequency interference" and agenda item 5.4 "5G interference"

Introduction

Radar altimeters (RA), operating at 4.2-4.4 GHz, are the only sensors onboard a civil aircraft which provide a direct measurement of the clearance height of the aircraft over the terrain or other obstacles (i.e. the Above Ground Level - AGL - information).

The RA systems' input is required and used by many aircraft systems when AGL is below 2500 ft. Any failures or interruptions of these sensors can therefore lead to incidents with catastrophic outcome, potentially resulting in multiple fatalities. The radar altimeters also play a crucial role in providing situational awareness to the flight crew. The measurements from the radar altimeters are also used by Automatic Flight Guidance and Control Systems (AFGCS) during instrument approaches, and to control the display of information from other systems, such as Predictive Wind Shear (PWS), the Engine-Indicating and Crew-Alerting System (EICAS), and Electronic Centralized Aircraft Monitoring (ECAM) systems, to the flight crew.

There is a major risk that 5G telecommunications systems in the 3.7–3.98 GHz band will cause harmful interference to radar altimeters on all types of civil aircraft—including commercial transport airplanes; business, regional, and general aviation airplanes; and both transport and general aviation helicopters. If there is no proper mitigation, this risk has the potential for broad impacts to aviation operations in the United States as well as in other regions where the 5G network is being implemented next to the 4.2-4.4 GHz frequency band.

An example listed further below shows, that the identified risk has materialized during certain airline operations impacted by similar interference.

List of potential equipment failures:

Interference to RA operations can affect:

1. **Autoland functions:**

This is particularly critical in low visibility auto approach like Cat II or III conditions. Pilots cannot conduct CAT II and III approaches if RA is malfunctioning.



2. EICAS/ECAM:

Nuisance warning after take-off or during approach which will distract crew from their tasks at hand. This will lead to deterioration of operational safety levels.

3. False or missing GPWS alert:

Anywhere in proximity to ground, this could inhibit some functionalities of the TAWS (Terrain Alerting Warning System) reactive modes which would remove a safety net in case against CFIT (Controlled Flight Into Terrain).

Additional distractions for crews from tasks at hand, – “too low gear” and “too low flaps”, “don’t sink”, “terrain and pull up warning” and other alerts.

A big concern is GPWS not triggering an alert when it should have done so, because of interference which can result in CFIT event!

4. Unreliable instrument Indications:

This could contribute to an increased number of hard landings because of errors in automatic altitude indications and voice announcements.

5. Abnormal behaviours in Automatic Flight Systems:

- a. Autoland system
- b. Flight Control Laws (e.g. failure to transition to Flare law resulting in a higher than expected pitch on the flare; Retard function, etc.)
- c. Auto-throttle automatic stall protection.
- d. Auto Speedbrake deployment

Most low-visibility operations are predicated on radio altimeter decision-height (DH). The USA does permit some Cat II approaches with barometric DH; the EU does not. All Cat III approach procedures and consequent auto-land are predicated on radio DH. In particular, the flare logic is completely dependent on input from the radio altimeter. Consequently, any disruption to the signal close to the ground could easily cause a crash.

EGPWS is predicated on use of radar altimeter. Erroneous information could either cause false pull-up warnings, which is undesirable, or no warning when one would otherwise be required, which could be catastrophic.

Predictive wind-shear detection also uses RA input. The PWS will only provide guidance up to a certain height above an airfield, so incorrect information could result in wrong PWS commands. Likewise, TCAS RAs are inhibited below 900 feet AAL. Since the normalised rate of TCAS RAs is an order of magnitude higher in the USA than anywhere else in the world, failure of the RA logic would result in an increase in the possibility of mid-air collision.

For approach and landing operations which are flown with auto-throttle engaged, erroneous commands could cause the auto-thrust to retard the power too early, which could result in low energy state close to the ground. That is probably more of an issue in Airbus aircraft which do not have moving thrust levers.

Example of an actual autopilot failure due to radar altimeter frequency interference:

During the “iron dome” activations near Tel Aviv airport, one airline experienced several radar altimeter interference events which resulted in either inappropriate activations of EGPWS terrain warnings or an autopilot



landing flare maneuver being erroneously activated at around 1500 feet above ground level. Had the flight crews not disengaged the autopilot and taken control of the aircraft manually during the erroneous activation of the autopilot flare maneuver at these altitudes, there would have been a high probability of the loss of the aircraft due to having insufficient altitude to recover from the resulting stall. As this example was caused by jamming devices, targeting aircraft, it is nevertheless very possible that similar effects could be observed, when failures occur caused by 5G interference. Ultimately the onboard equipment reacts the same, no matter what the source of the interference is.

Conclusion:

Radar altimeters are deployed on tens of thousands of commercial and general aviation aircraft as well as helicopters worldwide. The radar altimeter is one of the most critical components to an aircraft's operations; and the only sensor onboard an aircraft providing a direct measurement of the aircraft's clearance over the terrain or other obstacles. This information is the most critical information in many automated landing and collision avoidance systems. Undetected failure of this sensor can therefore lead to catastrophic results; and false alarms have the potential to undermine trust in the avionics systems.