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Topic A: Interference in global navigation satellite systems Background Information

Since the launch of Sputnik 1, the start of the Space Race between the USA and the USSR, and the implementation of satellite-based geo-positioning systems in 1960, world's countries have been showing interest in implementing more technology and satellites, doubling its number since 2018 to the date. Due to this, countries' satellites have been organized in the Global Navigation Satellite System (GNSS), which is a constellation of satellites providing signals from outer space that transmit positioning and timing data to the organization receivers, and has been recognized by the International Civil Aviation Organization (ICAO). This constellation includes some programs such as the US Global Positioning System (GPS), the Russian GLONASS, the European Galileo and the Chinese BeiDou.

Aviation operations increasingly rely on the GNSS to improve navigation performance and to support air traffic control surveillance functions, unfortunately, in the last few years, an issue has emerged, aircrafts are reporting difficulties and failures with the GNSS positioning and tracking systems. But, which are these difficulties and how are they made?

We start with the most common one, the High-power radio interference. This is one of the simplest forms of interference and is mostly intentional. In some cases, the interferences were reported to cover over 300 nautical miles from the assumed source.

These interference transmitted near GNSS frequencies can overwhelm relatively weaker GNSS signals. This harmful interference increases noise level at the GNSS frequencies, decreasing the desired signal-to-noise ratio perceived by the aircraft receiver. Once the desired signal-to-noise ratio decreases to an unacceptable level, the receiver will start losing

its capability to decode GNSS satellite signals and can eventually lose its functionality in providing aircraft position information.¹

Military GPS radio frequency interference (RFI) in conflict zones.

GPS RFI can also cause loss of the GPS signal in flight if too close to areas of military conflict. It can be the case that military RFI activity is not known in advance or communicated leading to loss of GPS signal without prior notice. There are reported cases of interference to aircraft GNSS in areas with military activities. Airlines intending to transit through such areas are strongly advised to assess risks and operational limitations that may occur during loss of on-board GNSS and the required navigation performance capability.²

Personal Privacy Devices (PPD)

Some of the reported disturbances were caused by portable PPD that jam a GPS signal in the immediate area to avoid tracking. Operational disruptions at airports due to a loss of the GPS signal in the area around the airports have been caused when these devices were activated in the vicinity of an airport.

Protection of sensitive sites.

Certain sensitive sites may be protected using GNSS RFI for security reasons, such as correctional facilities or sites where dignitaries or political figures are living or visiting. And because of this RFI, aircrafts operating in the vicinity of these sites may be affected by interference with the GPS signal.³

¹ *Harmful interference to the Global Navigation Satellite System and its impacts on flight and air traffic management operations.* (2019, April 29)

² *GNSS Interference.* (2022, September 15).

³ *GNSS Interference.* (2022, September 15).

GPS repeater.

Used to make a GPS signal available inside a hangar during aircraft maintenance. GPS repeater signals have caused interference with actual GPS signals in some reported events, causing reception issues on aircraft located close to the hangar, causing severe issues for landings and arrivals.

All these problems induce dangerous and severe complications on-board of the aircrafts, such as the loss of GNSS position and timing, enabling the aircraft systems to maintain a position computation capability, loss of certain navigation and surveillance functions or operational capabilities and downgraded aircraft position computation. This endangers the safety and operation of aviation, also risking the lives of thousands of people a day.

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