SUMMARY GUIDE TO GNSS OUTAGES FOR OPERATORS

Leading to Navigation System Degradation

EXAMPLES OF JAMMING OR SPOOFING

- Incoherence in navigation position, such as GNSS/FMS position disagree warnings;
- Abnormal differences between Ground speed and True airspeed;
- Time shift;
- Problems with INS/IRS.

MOST AFFECTED FLIGHT INFORMATION REGIONS

- The Black Sea area:
- FIR Istanbul LTBB, FIR Ankara LTAA
- Eastern part of FIR Bucuresti LRBB, FIR Sofia LBSR
- FIR Tbilisi UGGG, FIR Yerevan UDDD, FIR Baku UBBA
- The south and eastern Mediterranean area, and the Middle East:
- FIR Nicosia LCCC, FIR Beirut OLBB, FIR Damascus OSTT, FIR Tel-Aviv LLLL, FIR Amman OJAC, north-eastern part of FIR Cairo HECC
- FIR Baghdad ORBB, north-western part of FIR Tehran OIIX
- Northern part of FIR Tripoli HLLL
- The Baltic Sea area (FIRs surrounding FIR Kaliningrad UMKK):
- Western part of FIR Vilnius EYVL, north-eastern part of FIR Warszawa EPWW, south-western part of FIR Riga EVRR
- Arctic area:
- Northern part of FIR Helsinki EFIN, northern part of FIR Polaris ENOR

EXAMPLES OF ISSUES THAT DEGRADATION OF GNSS SIGNAL COULD GENERATE

- **Temporary or non-recoverable failure or degradation of PNT information provided by GNSS possibly resulting in:**
- **Inconsistent flight guidance possibly resulting in route deviations, uncommanded turns, and potential airspace infringements;**
- **Loss or misleading surveillance system (e.g. corrupted Automatic Dependent Surveillance-Broadcast (ADS-B), TAWS (e.g., false PULL UP alert triggered by TAWS during cruising phase), wind shear, terrain and other surface functionalities);**
- **Loss or misleading time dependent systems (e.g. clock, fuel computation system, flight management system);**
- **Inconsistent, potentially misleading aircraft position, and ground or wind speed on the navigation display.**
- **Inability to use GNSS for navigation, including waypoint navigation;**
- **Inability to conduct or maintain GNSS based Area Navigation (RNAV) and/or required Navigation Performance (RNP) operations.**

OPERATOR RECOMMENDATIONS

- **Ensure that flight crews are aware of and trained on the importance of prompt reporting by means of a special air-report (AIREP) to air traffic services of any observed interruption, degradation or anomalous performance of GNSS equipment or related avionics (e.g. map shifts, suspected GNSS spoofing, position and duration of the GNSS interference);**
- **Evaluate different scenarios based on their operations in order to provide the flight crew with timely information to increase awareness of jamming and spoofing;**
- **Ensure that GNSS outage or spoofing topic is included in the flight crew ground recurrent training, highlighting the identified operational scenarios to recognize, react in a timely manner to different jamming and spoofing cases;**
- **Assess operational risks and limitations linked to the loss of on-board GNSS capability, including any on-board systems requiring inputs from a reliable GNSS signal;**
- **Ensure that operational limitations introduced by the dispatch of aircraft with inoperative radio navigation systems in accordance with the Minimum Equipment List, are considered before operating an aircraft in the affected areas;**
- **Ensure, in the flight planning and execution phase, the availability of alternative conventional arrival and approach procedures (e.g. an aerodrome in the affected area with only GNSS, including augmentation, approach procedures should not be considered as destination or alternate).**
- **If subject to FDM requirements and necessary data are available, use FDM programme to identify and assess GNSS spoofing events.**
- **Concerning spoofing: contact aircraft or equipment manufacturers for instructions on how to deal with spoofing cases of their products and apply them.**

JAMMING SPECIFIC RECOMMENDATIONS FOR CREW AND FLIGHT OPS PERSONNEL

- **Are aware of possible GNSS jamming ;**
- **Verify the aircraft position by means of conventional navigation aids when flights are operated in proximity to the affected areas;**
- **Check that the navigation aids critical to the operation for the intended route and approach are available;**
- **Remain prepared to revert to a non-GNSS arrival procedure where appropriate and inform air traffic services in such a case; and**
- **Report (AIREP) to air traffic services any observed irregularities.**

SPOOFING SPECIFIC RECOMMENDATIONS FOR CREW AND FLIGHT OPS PERSONNEL

- **Are aware of possible GNSS spoofing;**
- **Continuously monitor aircraft position using non-GNSS navaids and all available automatic navigation accuracy calculations, including the Estimated Position Uncertainty (EPU) figures.**
- **Monitor the GNSS time versus non-GNSS time sources.**
- **Closely monitor the ATC Frequencies in the vicinity of spoofing area.**
- **Apply the manufacturer's instructions for the aircraft type on dealing with suspected spoofing, non-exhaustive list of examples of possible instructions could be such as:**
  - **being ready to select HDG mode and manually adjust the flight course.**
  - **being ready to ask for verification vector from ATC as long as needed.**
  - **being ready to crosscheck with and switch to using alternate PNT such as IRS and/or available ground facilities (Multi-DME and VOR/DME).**
  - **being ready to exclude the GNSS signals within affected area.**
  - **being ready to disable automatic INS/IRS updating**
- **Report (AIREP) to air traffic services any observed irregularities.**