



Safety Information Bulletin

CAAS SIB No.	2022-01 R4
Issued	22 October 2026
Subject	Global Navigation Satellite System (GNSS) Outage and Alterations Leading to Communication, Navigation and Surveillance Degradation
Ref. Publication(s)	EASA SIB 2022-02R4 dated 3 July 2026, Global Navigation Satellite System Outage and Alterations Leading to Communication / Navigation / Surveillance Degradation
Purpose	This SIB advises AOC holders of possible GNSS outages or disturbances in geographical areas affected by, or located near conflict zones. GNSS disruptions have been reported in Eastern Europe, the southern and eastern Mediterranean, the Black Sea, the Middle East, the Baltic Sea, the Arctic regions, the Yangon FIR and along the India-Pakistan FIR boundaries, affecting airports located near these frontiers. This SIB has been revised to provide updated guidance on pilot-ATC interim phraseology, EFB-based GNSS RFI awareness tools, operational risk assessment, flight crew training, and reporting of GNSS jamming and spoofing occurrences.
Applicability	All Singapore AOC holders operating to destinations in, or overflying airspace within, the geographical areas identified above and any other area where GNSS jamming or spoofing has been identified.
Cancellation	This SIB supersedes the previous SIB dated 11 January 2024 on this subject.
Description	Since February 2022, reported GNSS jamming and spoofing events have increased. In addition, data analysed by EASA from the Network of Analysts and open sources indicates that these events

have also become more sophisticated and may have greater operational impact.

Jamming is intentional radio frequency interference (RFI) affecting GNSS signals. This interference prevents receivers from locking onto satellite signals, resulting in degradation or loss of GNSS service for users in the affected area.

Spoofing involves the transmission of counterfeit satellite signals intended to deceive GNSS receivers, which may result in incorrect position, navigation, and timing (PNT) information being displayed or used by aircraft systems.

Flight deck indications may not clearly distinguish whether the aircraft is experiencing jamming or spoofing. Jamming effects are typically more immediate and noticeable when GNSS-dependent systems fail or degrade. Spoofing may be more difficult to detect, as affected systems may continue to provide misleading position, navigation, or timing information without an immediate or obvious alert. For this reason, spoofing may present a higher operational risk if it is not promptly recognised and managed.

The effects of GNSS jamming or spoofing have been observed by crews in various phases of flight. In some cases, operators have re-routed or diverted flights to maintain operational safety. Such events may also result in deviations from ATC clearances or instructions. The operational impact will depend on factors such as the size of the affected area, the duration of the interference, traffic density, phase of flight, and the extent to which aircraft systems rely on GNSS inputs.

The following non-exhaustive list provides examples of flight deck effects that may arise from GNSS signal degradation, including degradation affecting systems supported by Satellite-Based Augmentation Systems (SBAS) or Ground-Based Augmentation Systems (GBAS):

- Temporary or non-recoverable failure or degradation of position, navigation, and timing (PNT) information provided by GNSS, possibly resulting in:
 - Loss of, or misleading information from:
 - Terrain Awareness and Warning Systems (TAWS) (e.g. spurious PULL UP alerts triggered by predictive TAWS during the cruise, descent, approach, or landing phase that in some cases may result in high vertical-rate uncoordinated climbs. TAWS PULL UP alerts take priority over traffic alerts);

- surveillance functions (e.g. corrupted Automatic Dependent Surveillance-Broadcast (ADS-B)).
- Information on Synthetic Vision Systems (SVS), weather uplink functions, predictive wind shear, and other surface functionalities; inconsistent flight guidance possibly resulting in route divergence, uncommanded turns, and deviations from ATC clearances or instructions received, which could potentially lead to airspace infringements, loss of traffic separation, insufficient terrain/obstacle clearance, etc.;
- Inconsistent or potentially misleading aircraft position, GNSS altitude, and calculated ground or wind speed on the navigation display or on the Electronic Flight Bag (EFB);
- Inconsistent, or potentially misleading aircraft position or GNSS altitude, later in the flight after exiting the affected area, such as during the approach;
- Loss of or misleading time- or date-dependent systems such as the clock, fuel computation system, flight management system, or Controller Pilot Data Link Communication (CPDLC) messages being discarded.
- Inability to use GNSS for navigation, including waypoint navigation;
- Inability to use GNSS for navigation after exiting the affected area or for the remainder of the flight;
- Inability to maintain GNSS-based Area Navigation (RNAV) and/or Required Navigation Performance (RNP) operations.

The combination of two or more of these issues may adversely affect flight safety. Repeated or widespread GNSS disruptions may also increase crew workload and the likelihood of error.

Recommendation

These measures are to be considered for the affected flight information regions identified above, and for any other area where GNSS jamming or spoofing is identified.

1. AOC holders should **consider** the following measures:

- a) Ensure that flight crew are aware of, trained for, and prepared to recognise and respond appropriately to GNSS interference during flight;
- b) Ensure that flight crew are aware of the need to promptly report by special air-report (AIREP) to air traffic services any observed interruption, degradation, or anomalous performance of GNSS equipment or related avionics such as map shifts, suspected GNSS spoofing, lost or misleading position, time anomalies, and their duration;
- c) Evaluate different scenarios based on the type of operations, to provide flight crew with timely information to increase awareness of GNSS jamming and spoofing;
- d) Ensure that GNSS jamming or spoofing is included in the flight crew recurrent ground training and the training of other relevant operations personnel, especially when operating in the identified areas, highlighting the identified operational scenarios so that personnel can recognise and respond in a timely manner to different jamming and spoofing scenarios;
- e) Assess operational risks and limitations linked to the loss of on-board GNSS capability, including the impact on on-board systems that require inputs from a reliable GNSS signal, such as TAWS;
- f) Maintain contact with aircraft or equipment manufacturers for guidance on operations and maintenance when exposed to GNSS jamming or spoofing, and incorporate the applicable recommendations into the operator's standard operating and maintenance procedures;
- g) Ensure, before commencing a flight into an area known to be affected by GNSS interference, that any system intended to provide backup to GNSS is operative in accordance with the Minimum Equipment List (MEL), except that one flight may be conducted, if necessary, to a station where repairs can be carried out;
- h) Ensure, whenever possible (e.g., airspace that is not oceanic or remote), that flight planning for flights into affected areas includes the availability of alternative non-GNSS based procedures for the whole flight, regardless of the type of operation. This should be complemented by information on the ability to receive radar vectoring in the airspaces to be transited;
- i) Consider longer approach legs arising from contingency procedures, as well as possible extended holding trajectories

in congested areas, when developing fuel planning, in-flight replanning, and in-flight fuel management policies.

- j) If subject to Flight Data Monitoring (FDM) requirements and the necessary data are available, use the FDM programme to identify and assess possible GNSS jamming and spoofing events;
 - k) Ensure that pilots recognise the recommended interim phraseology presented in the Appendix to this SIB, and use it to respond clearly and consistently to communications related to GNSS jamming or spoofing;
 - l) Consider the use of EFB applications that support the depiction of GNSS RFI-affected areas on the flight deck.
2. AOC holders should ensure that flight crew and relevant flight operations personnel:
- a) are aware of the possibility of GNSS jamming or spoofing;
 - b) verify and monitor the aircraft position using non-GNSS sources, including conventional navigation aids and available aircraft system indications, when operating in or near affected areas;
 - c) verify that the navigation aids required for the intended route, arrival, approach, and alternate procedures are available;
 - d) remain prepared to revert to a non-GNSS procedure where appropriate;
 - e) monitor GNSS time against non-GNSS time sources;
 - f) monitor navigation accuracy including Estimated Position Uncertainty (EPU), Actual Navigation Performance (ANP) against Required Navigation Performance (RNP), or equivalent aircraft system indications;
 - g) closely monitor ATC frequencies in areas where GNSS interference is suspected or reported, and request ATC assistance where required;
 - h) apply the manufacturer's instructions and guidance for the aircraft type on detecting and managing suspected GNSS jamming or spoofing;
 - i) report any observed or suspected GNSS interference to air traffic services by AIREP, particularly where the event is

unexpected, safety may be affected, or ATC assistance is required;

- j) use the recommended interim phraseology presented in the Appendix to this SIB to support clear and consistent communications related to GNSS jamming or spoofing events.
3. AOC holders must promptly report to CAAS if any of the following events occur:
- a) An aircraft experiences unrecoverable loss of any system function due to GNSS interference.
 - b) An aircraft experiences a GNSS spoofing event, where false GNSS signals result in the aircraft's calculated position differing from its actual position.
 - c) An aircraft experiences GNSS interference in any location where safety, navigation performance, system functionality, or ATC compliance is affected.
 - d) The actual navigation performance of an aircraft does not meet the required navigation performance of the given airspace or procedure as a result of GNSS interference.
 - e) Spurious triggering or degradation of aircraft warning or surveillance systems occurs as a result of GNSS interference, including but not limited to Ground Proximity Warning Systems (GPWS), Traffic Collision Avoidance Systems (TCAS), and windshear prediction or detection systems.
 - f) Any deviation from or inability to comply with the assigned Air Traffic Control (ATC) clearance as a result of GNSS interference.

Reports must include full details of the event, including the time, date, FIR, locations at which the occurrence started and ended, and a detailed narrative of the GNSS interference. Operating crew should also promptly report any observed interruption, degradation, or anomalous GNSS performance, including jamming or spoofing, to ATC, regardless of location or impact on system performance.

Contact(s)

For further information, contact the respective CAAS principal operations inspectors.

Appendix: Interim R/T Phraseology for Communication between Pilots and ATS

Adapted from EASA SIB 2022-02R4_1

Circumstances	Phraseology	Transmission
Note: ‘*’ denotes pilot transmission		
GNSS service status		
... use REPORTED when information is received from aircraft operating in the respective area	a) GNSS [REPORTED] UNRELIABLE (or GNSS MAY NOT BE AVAILABLE) [DUE TO (reason, e.g. INTERFERENCE, or JAMMING, or SPOOFING)]; 1) IN THE VICINITY OF (location) (radius) [BETWEEN (levels)]; or 2) IN THE AREA OF (description) (or IN (name) FIR) [BETWEEN (levels)];	ATC / FIS
... when planned activities or interferences affect GNSS availability for specific operations for a duration of time	b) GNSS (or SBAS, or GBAS) UNAVAILABLE FOR (specify operation) [FROM (time) TO (time) (or UNTIL FURTHER NOTICE)];	ATC / FIS
... the reason depends on the information available to the pilot	*c) GNSS UNAVAILABLE (or UNRELIABLE) [DUE TO (reason, e.g. LOSS OF RAIM or RAIM ALERT, or INTERFERENCE or JAMMING or SPOOFING)]; *d) GBAS (or SBAS) UNAVAILABLE; e) CONFIRM GNSS NAVIGATION; *f) AFFIRM GNSS NAVIGATION.	Pilot / ATC
RNAV		
...RNAV arrival or departure procedure cannot be accepted by the pilot	*a) UNABLE (designator) DEPARTURE [or ARRIVAL] DUE RNAV TYPE;	Pilot
...pilot is unable to comply with an assigned terminal area procedure	*b) UNABLE (designator) DEPARTURE [or ARRIVAL] (reasons e.g. INTERFERENCE, or JAMMING, or SPOOFING);	Pilot

...ATC unable to assign an RNAV arrival or departure procedure requested by the pilot due to the type of on-board RNAV equipment	c) UNABLE TO ISSUE (designator) DEPARTURE [or ARRIVAL] DUE RNAV TYPE;	ATC
...ATC unable to assign an arrival or departure procedure requested by the pilot	d) UNABLE TO ISSUE (designator) DEPARTURE [or ARRIVAL] (reasons e.g. INTERFERENCE, or JAMMING, or SPOOFING);	ATC
...confirmation whether a specific RNAV arrival or departure procedure can be accepted	e) ADVISE IF ABLE (designator) DEPARTURE [or ARRIVAL];	ATC
...informing ATC of RNAV degradation or failure	*f) UNABLE RNAV DUE EQUIPMENT;	Pilot
...informing ATC of no RNAV capability	*g) NEGATIVE RNAV;	Pilot
Terrain alert		
...after a flight crew starts to deviate from any ATC clearance or instruction to initiate climb in response to a terrain alert warning	*a) (aircraft call sign) TERRAIN ALERT, (suggested pilot action, if possible). Note: — possible action — PULL UP due to GNSS INTERFERENCE, JAMMING, or SPOOFING. *b) PULL UP, PASSING (level)[intentions]; c) ATTENTION ALL AIRCRAFT IN VICINITY OF (or AT) (significant point or location), TERRAIN ALERT CLIMB [IN PROGRESS] FROM (level) or PASSING (level) (followed as necessary by specific instructions, clearances, traffic information, etc).	Pilot / ATC
Time anomalies		
...when due to GNSS INTERFERENCE flight crew experiences time anomalies	*a) REQUEST TIME CHECK;	Pilot
	b) TIME (time in minutes and seconds, followed by the word NOW);	ATC / FIS