Fortieth Meeting of the
Informal South Pacific ATS Coordinating Group
(ISPACG/40)

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Agenda Item 4: Information and Working Papers

GNSS interference: Building ATC Resilience.

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SUMMARY

This paper outlines Australia’s approach to GNSS interference contingency, combining the Backup Navigation Network (BNN) with operational ATC preparedness for GNSS interference. It summarises key operational impacts of GNSS interference and highlights the need for consistent identification, reporting and training to maintain safety and efficiency in a GNSS degraded environment.

1. INTRODUCTION

1.1 The Global Navigation Satellite System (GNSS) underpins modern air traffic management in Australia, enabling reduced separation standards, improved efficiency, and safe operations in oceanic and remote airspace. However, the increasing occurrence of GNSS interference events has highlighted vulnerabilities that manifest operationally within Air Traffic Control (ATC) and strategically within national navigation resilience planning.

1.2 Recognising that GNSS is not immune to disruption—whether through Intentional or unintentional interference or avionics failure—Australia conducted a comprehensive safety assessment and established a Backup Navigation Network (BNN) independent of GNSS. The BNN was designed to ensure aircraft can safely complete flight when GNSS is unavailable.

1.3 In parallel, Air Traffic Control units have experienced a rise in reported loss of GNSS capability on the aircraft. These events often result in the degradation or loss of surveillance, communication, and navigation capabilities, increasing controller workload and reducing situational awareness. While infrastructure resilience has been strategically addressed through the BNN, the operational impacts of GNSS interference require equal attention.

1.4 This paper brings together these two perspectives—navigation infrastructure resilience and operational ATC management—to provide a more complete picture of GNSS contingency readiness.

2. DISCUSSION

2.1 Australia's Backup Navigation Network

In February 2016, Australia mandated the use of the Global Navigation Satellite System (GNSS) as the primary means of Instrument Flight Rules (IFR) navigation in Australia. With the transition to GNSS as the primary means of Navigation, Australia undertook a comprehensive safety assessment and determined that a Backup Navigation Network (BNN), independent of GNSS was required to support the safe completion of flight, in the event GNSS is unavailable to a pilot

Rationale and Design Principles

The establishment of the BNN was driven by a safety assessment that considered:

- Loss of GNSS during different phases of flight
- Australia's unique operating environment, including large remote and oceanic areas
- Regulatory requirements for alternates and navigation capability
- Aircraft equipage across general aviation, regional, and RPT operations

The BNN ensures that, in the absence of GNSS, pilots retain access to conventional navigation aids to support safe flight completion rather than continued GNSS-dependent operations.

Composition of the BNN

The BNN consists primarily of:

- Non-Directional Beacons (NDB)
- Very High Frequency Omnidirectional Range (VOR)
- Distance Measuring Equipment (DME)

Navigation aids are generally located at or near aerodromes with associated instrument approaches. En-route-only aids were largely decommissioned. The result was a reduction from 394 navigation aids pre-BNN to approximately 209 as of April 2025, while maintaining required safety outcomes.

Validation of the BNN

The safety case for the BNN was validated through fault-tree analyses examining:

- Mid-Air Collision (MAC)
- Controlled Flight Into Terrain (CFIT)

Scenarios assessed included:

- GNSS with legacy navigation aid network
- GNSS with BNN
- GNSS-only environment

The analysis demonstrated a negligible difference in MAC and CFIT probabilities across scenarios, confirming that the BNN provides an acceptably safe contingency framework even with a significantly reduced ground-based network.

2.2 Operational Impacts of GNSS Interference on Air Traffic Control

Despite the robustness of the BNN, ATC units still experience immediate and substantial operational challenges when GNSS interference occurs

Increased Controller Workload

Loss of GNSS-dependent systems can lead to:

- Loss of ADS-B and ADS-C surveillance
- Inability to apply reduced separation standards
- Requirement for emergency separation or traffic avoidance advice

Controllers must revert to less precise procedural control, significantly increasing workload and complexity.

Reduced Situational Awareness

In oceanic and remote airspace, loss of GNSS degrades the accuracy and timeliness of position information. Traffic awareness becomes heavily reliant on:

- Pilot position reporting
- Accurate flight planning
- Correct and timely transfer of accurate Flight plan information between ATC units and ANSPs

Communication Challenges

The loss of CPDLC often necessitates reversion to HF radio. Establishing effective HF communication can be slow and dependent on pilot awareness, HF operator availability, and prevailing radio conditions, further compounding operational risk.

The role of training, education and checking

To ensure controllers are well prepared to manage GNSS interference events a structured approach to degraded modes training should be embedded within initial training, endorsements refresher training and incorporated into Competency check processes. Some considerations for the development of appropriate training and checking tools are:

Degraded modes scenarios (simulation): sudden loss of ADS-B/ADS-C; CPDLC failure with transition to HF; aircraft advising loss of RNP capability (RNP 10/4/2) and requesting re-route/level changes; multiple aircraft affected concurrently; mixed-equipage environment (some aircraft unaffected) and associated complexity; use of emergency separation/traffic information where required.

Education: common indicators that interference is the underlying cause (versus isolated avionics faults); expected pilot phraseology/capability statements; controller responsibilities for downstream coordination and information sharing; occurrence classification and reporting requirements to ensure GNSS interference is captured consistently.

Competency Checks: periodic assessment of degraded mode performance, including correct application of separation minima, timely transition to alternate communications, accurate flight plan maintenance, and appropriate use of contingency procedures; validation that controllers can manage workload, prioritise actions, and maintain an accurate traffic picture using procedural methods.

2.3 REPORTING AND INFORMATION GAPS

Operational experience indicates that GNSS interference is frequently under-reported or misclassified. Case reports from 2025–2026 show that events involving ADS-B, ADS-C, or RNP loss may only trigger robust responses if GNSS interference is explicitly identified and reported by flight crew and documented by ATC. Otherwise, occurrences may be recorded as generic equipment failures, masking the true scale of GNSS disruption.

This inconsistency limits:

- National and regional awareness of GNSS interference events
- Trend Analysis
- Informed decisions regarding future composition of infrastructure like the BNN and the effectiveness of GNSS resilience measures.

2.4 Integrating Infrastructure and Operations

The BNN provides the foundation for the safe completion of flight in a GNSS degraded environment. ATC procedures, education and training practices facilitates the immediate response and ongoing efficient management of GNSS interference.

To maximise resilience:

- Controllers must have strong awareness of BNN capabilities and limitations and be trained to respond to GNSS interference events.
- Pilots must understand when and how to declare GNSS interference, including accurate reporting of affected systems and resultant navigation and communication degradation.
- ATC units must consistently identify and report GNSS interference events
- Information must be shared effectively across ANSPs and FIR boundaries

2.5 Future Considerations

Ongoing review of contingency infrastructure such as the BNN as well ATC training should continue to be informed by:

- Increasing global GNSS interference and spoofing activity
- Regional operational occurrence reports and ATC feedback
- Evolution of aircraft equipage and navigation capabilities
- Changes to PBN regulatory requirements

It is integral that Air Traffic Control training and procedures evolve in parallel with infrastructure planning and technology advancements to ensure operational readiness aligns with strategic planning.

2.6 Conclusion

Australia's Backup Navigation Network has been shown to provide a robust and acceptably safe contingency for GNSS unavailability. However, recent operational experience demonstrates that GNSS interference presents immediate challenges for Air Traffic Control that cannot be addressed by infrastructure alone. Consistent training and education of Air Traffic Controllers is necessary in ensuring an efficient response to degraded navigation and communication capabilities.

An integrated approach—linking navigation infrastructure, effective ATC procedures, comprehensive training, and consistent reporting—is essential to maintaining safety and efficiency in a GNSS-degraded environment. Strengthening this integration will ensure Australia remains well positioned to manage both short-term GNSS disruptions and longer-term resilience challenges.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

- Note Australia’s approach to GNSS contingency planning
- Recognise the operational impacts of GNSS interference on ATC
- Encourage consistent reporting and information sharing across ANSPs and Stakeholders

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