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PROPOSAL FOR DEVELOPING A GUIDELINE FOR Exchanging GNSS Interference Data for Navigational Safety

# Summary

This paper presents the conceptual need for a standardized method to exchange Global Navigation Satellite System (GNSS) interference data between shore and ship and vice versa. The aim is to enhance maritime safety by facilitating reporting and dissemination of GNSS interference events that may impact navigation. The proposed solution suggests the use of an S-200 series message structure, leveraging existing standards to ensure interoperability and efficiency.

## Purpose of the document

The document seeks to:

* Highlight the need for a structured approach to sharing GNSS interference data for improved navigational safety.
* Propose the adoption of the S-200 series as the standard messaging format for such data exchanges.
* Encourage the IALA DTEC Committee to assess feasibility and initiate the development of relevant specification.

## Related documents

* IALA G1180 on resilient position, navigation, and timing (PNT) provides information about GNSS interference
* IMO Resolution A.915(22) on GNSS vulnerabilities
* IALA G1158 VDES R-Mode
* IALA G1128 on the S-200 product specification framework
* ITU-R Recommendation SM.2181 on radio interference reporting
* IALA G1106 producing an IALA S-200 series product specification

# Background

The increasing reliance on GNSS for safe maritime navigation makes it crucial to detect and mitigate GNSS interferences. Various sources such as intentional inference, unintentional interference, and space weather events can compromise GNSS performance, leading to degraded position, navigation, and timing (PNT) accuracy. Currently, there is no standardized mechanism for ships to receive GNSS interference alerts from shore nor a system for ships to report detected interference back to shore authorities in a structured manner.

# Discussion

## Challenges of GNSS Interference in Maritime Navigation

Disruptions in GNSS signals can pose significant safety risks, especially in restricted waters, ports, and critical navigation zones. The lack of a coordinated reporting and notification system limits the ability to take timely mitigation actions, increasing the potential for navigational hazards. Furthermore, existing navigation systems do not uniformly integrate interference alerts, leading to fragmented awareness and inconsistent responses among maritime stakeholders.

## Need for a Standardized GNSS Interference Messaging Framework

To enhance situational awareness and response effectiveness, a standardized message structure based on the S-200 series would facilitate efficient data exchange between maritime stakeholders. Leveraging the S-200 framework ensures alignment with existing e-Navigation standards and guarantees interoperability with future digital maritime services. A structured format would enable efficient storage, processing, and dissemination of GNSS interference information across different maritime systems, ensuring a more coordinated approach to addressing navigation disruptions.

As a countermeasure, alternative PNT solutions could be more heavily emphasised in determining the ship's location on board. For example, the VDES R-mode is part of the VDES communication system. Shore stations could use more resources, such as more time slots for ranging sequences, to improve the performance and reliability of VDES R-mode onboard in specific interference areas. The request could be made on demand as a result of the reported interference.

## Implementation Considerations

The S-200 framework provides a suitable baseline for defining the necessary data model and messaging protocol, ensuring consistency and accuracy in GNSS interference reporting.

The proposed messaging framework should seamlessly integrate with S-100 compatible vessel traffic service (VTS) platforms, electronic chart display and information systems (ECDIS), and integrated bridge systems (IBS) to maximize its effectiveness.

Successful implementation requires collaboration with key international bodies such as the International Maritime Organization (IMO), International Electrotechnical Commission (IEC), International Hydrographic Organization (IHO), and International Telecommunication Union (ITU), alongside active engagement with the maritime industry. Broad stakeholder participation will be essential to ensuring widespread adoption and practical deployment of the GNSS interference messaging system.

# References

As reference, in aviation, GNSS interference detection and reporting are integrated into the Automatic Dependent Surveillance–Broadcast (ADS-B) system. Aircraft continuously broadcast their position and navigation data, relying on GNSS signals. When interference occurs, onboard systems such as Receiver Autonomous Integrity Monitoring (RAIM) detect anomalies, and some avionics can encode GNSS degradation within ADS-B messages.

Ground-based ADS-B stations aggregate aircraft data, allowing air traffic management (ATM) to identify interference zones by correlating reports from multiple aircraft. Confirmed disruptions are communicated through Notices to Airmen (NOTAMs) and aeronautical information services to ensure pilots are aware of affected areas.

This structured reporting process provides a model for maritime GNSS interference management. A similar automated ship-to-shore reporting framework could enhance situational awareness, improve mitigation efforts, and ensure safer navigation in GNSS-dependent maritime zone

# Action requested of the Committee

The Committee is requested to take note and action as appropriate

* Review the conceptual need for GNSS interference data exchange as outlined in this paper.
* Assess the suitability of the S-200 series as a standardized format for GNSS interference reporting.
* Consider forming a task group to develop specifications for structured GNSS interference reports, either within the relevant DTEC committee working group or another appropriate IALA committee.
* Liasson with DTEC WG3 to revise IALA G1158 to consider the flexibility of resources for VDES R-mode depending on demand based on the interference level in the given area.
* Recommend further collaboration with relevant international organizations to ensure global alignment.