White Paper

Trimble RTX-NMA™ | Overview and Background GNSS Anti-Spoofing

Author: Nico Jaeger
Trimble Applanix
https://applanix.trimble.com/

Trimble

Trimble RTX-NMA™ | Overview and Background GNSS Anti-Spoofing

Trimble RTX-NMA™ Overview

GNSS navigation messages are essential for positioning, but the ephemeris data they contain can have errors. Because legacy navigation messages lack encryption and authentication, they are vulnerable to spoofing attacks where fake navigation messages are injected. Furthermore, while the commonly used GPS legacy navigation message uses parity bits for transmission error detection, it can still miss errors. To protect users from both spoofing attacks and faulty navigation messages, Trimble developed a Navigation Message Authentication (RTX-NMA) system using the Trimble RTX reference station network to secure legacy navigation messages.

Real-Time Mitigation Concept

Trimble RTX-NMA utilizes a global tracking network to continuously observe GNSS satellites and validate their broadcast ephemeris data. The core of this system is the Broadcast Ephemeris Validation module within the RTX correction server software, which validates and authenticates messages to reject data that does not originate from authentic GNSS satellites.

The system assesses signal-in-space integrity by evaluating observation residuals from GNSS reference stations with precisely known position. By performing this residual analysis, the system identifies faulty satellites and generates specific "do not use" flags for them. For verified navigation messages, authentication data is produced.

This authentication data, along with quality and integrity information, is transmitted to users via the RTX correction data streams, including the RTX L-band signals broadcast by geo-stationary communication satellites. The RTX correction streams contain authentication tags specifically for GPS (L1 C/A Nav) and BeiDou-3 satellites. Thus, RTX-NMA complements Galileo OSNMA, comprehensively protecting the user PVT

© 2026, Trimble Inc. All rights reserved. Trimble and the Globe & Triangle logo are trademarks of Trimble Inc., registered in the United States and in other countries. All other trademarks are the property of their respective owners.

(Position, Velocity, Time) solution from faulty and fake navigation messages across constellations.

Protection in POSPac Complete Post-Processing

RTX-NMA technology provides robust data verification across both real-time operations and post-processing workflows. While real-time applications authenticate live satellite signals, post-processing directly leverages the same underlying RTX-NMA mechanism by using verified external ephemeris data rather than relying solely on raw rover logs.

By incorporating RTX-NMA protection into POSPac Complete, the post-processing engine prioritizes Trimble broadcast ephemeris or ephemeris embedded in the RTX correction stream. Both sources are validated by the RTX Server's Ephemeris Validation Module before use. Applying this real-time technique within post-processing effectively shields the generated trajectory from spoofing vulnerabilities and message errors.

Summary

Relying on legacy GNSS navigation messages leaves positioning systems exposed to spoofing and false data injection. Trimble RTX-NMA mitigates this in real-time by using a global tracking network and observation residual analysis to identify faulty ephemeris and generate authentication data for legitimate navigation messages. By transmitting this data via RTX streams, users can verify message integrity and reject spoofed ephemeris. In post-processing, this is achieved by directly downloading Trimble’s pre-vetted, verified ephemeris data. This automatically overwrites potentially corrupted broadcast messages recorded by the rover receiver. Consequently, the IN-Fusion+ engine delivers a precise, fully audited SBET with total data integrity from the very first epoch.

© 2026, Trimble Inc. All rights reserved. Trimble and the Globe & Triangle logo are trademarks of Trimble Inc., registered in the United States and in other countries. All other trademarks are the property of their respective owners.