



SYSTEMS MANAGEMENT RECOMMENDED PRACTICE

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Requirements for a Terrestrial Based Positioning, Navigation, and Timing (PNT)
System to Improve Navigation Solutions and Ensure Critical Infrastructure Security

RATIONALE

The Global Navigation Satellite System (GNSS) receivers used to aid vehicle navigation (e.g., Unmanned Aerial Vehicles/Systems (UAV/UAS) and ground vehicles) and critical infrastructure security can be subject to signal disruption, such as urban canyons, jamming, or spoofing. A terrestrial based PNT system that is difficult to disrupt, jam, or spoof is needed to complement and serve as an alternative to GNSS.

FOREWORD

GNSS is the primary, and in many cases, the sole means of supporting many critical infrastructure segments worldwide. GNSS Positioning, Navigation, and Timing (PNT) services are vulnerable to interference: natural and man-made, intentional and unintentional, predictable and unpredictable; crude or sophisticated (i.e., jamming or spoofing), and local or widespread. Yet, of the 18 Critical Infrastructure Sectors identified by the US Department of Homeland Security, all rely to some extent on GNSS PNT services, and 15 of these sectors rely almost totally on GNSS for time and frequency services. Even those sectors that have maintained pre-GNSS alternatives (surveyors, aviation, maritime, etc.) would suffer significant economic impact if GNSS services became unavailable for a prolonged period (which varies by sector) to maintain safe, secure, and reliable operations. It is, therefore, imperative for users to identify the safety, security, efficiency, and economic benefits they derive from GNSS PNT services and determine the level of performance required from an alternative/backup system to mitigate impacts of losing reliable GNSS services over varying periods. It is also imperative that a robust and resilient alternative/complementary PNT system(s) and user equipment be developed and made operational to support current and emerging user sectors. Due to the vulnerability of satellite-based systems, it would be prudent to identify the performance requirements of terrestrial-based system(s) that would be resistant to jamming and spoofing, provide the accuracy, availability, integrity, continuity, and coverage required of all user sectors, and serve as a means to detect and safeguard against risks associated with GNSS interference [US-DOT]. Using multiple GNSS sources and anti-jam antennas may add some robustness, but is outside the scope of this document.

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1. SCOPE

This Recommended Practice defines the technical requirements for a terrestrial-based PNT system to improve vehicle (e.g., unmanned, aerial, ground, maritime) positioning/navigation solutions and ensure critical infrastructure security, complementing GNSS technologies.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

[SAE J2945/1] On-Board System Requirements for V2V Safety Communications

2.1.2 External Publications

[US-DOT] U.S. Department of Transportation: "GPS Dependencies in the Transportation Sector," https://ntl.bts.gov/lib/60000/60400/60433/DOT_VNTSC_NOAA_16_01.pdf

[3GPP 22.261] 3GPP Technical Specification 22.261: "Service requirements for next generation new services and markets"

[3GPP 36.305] 3GPP Technical Specification 36.305: "Stage 2 functional specification of User Equipment (UE) positioning in E-UTRAN"

[3GPP 37.857] 3GPP Technical Report 37.857: "Study on indoor positioning enhancements for UTRA and LTE"

[802.11] IEEE 802.11: "Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications"

[ATIS-0000027] ATIS-0500027: "Recommendations for Establishing Wide Scale Indoor Location Performance", May 2015

[ATIS-I-0000060] ATIS-I-0000060, "Unmanned Aerial Vehicle (UAV) Utilization of Cellular Services," 2017

[FCC3] "Third Report and Order," October 6, 1999, <https://www.fcc.gov/Bureaus/Wireless/Orders/1999/fcc99245.pdf>

[FCC4] "Fourth Report and Order," January 29, 2015, https://apps.fcc.gov/edocs_public/attachmatch/FCC-15-9A1.pdf

[FCC-CSRIC-III] CSRIC III Working Group 3: E9-1-1 Location Accuracy, "Indoor Location Test Bed Report." http://transition.fcc.gov/bureaus/pshs/advisory/csr3/CSRIC_III_WG3_Report_March_%202013_ILT_estBedReport.pdf

[GPS] "GPS Accuracy," December 5, 2017, National Coordination Office for Space-Based Positioning, Navigation, and Timing, <https://www.gps.gov/systems/gps/performance/accuracy>