1200 G Street, NW
Suite 500
Washington, DC 20005

P: +1 202-628-6380
W: www.atis.org

July 13, 2020

Via Email (pnt-eo@list.nist.gov)
United States Department of Commerce
National Institute of Standards and Technology
Profile of Responsible Use of Positioning, Navigation, and Timing Services

Re: Docket Number 200429–0124

To the National Institute of Standards and Technology:

The Alliance for Telecommunications Industry Solutions (ATIS) SYNC Committee (SYNC) is writing to offer comments in response to the National Institute of Standards and Technology (NIST) *Request for Information* (*RFI*) seeking input about public and private sector use of positioning, navigation, and timing (PNT) services, and standards, practices, and technologies used to manage cybersecurity risks, to systems, networks, and assets dependent on PNT services.

ATIS is a global standards development and technical planning organization that creates and promotes worldwide standards for information, entertainment, and communications technologies. Nearly 600 industry subject matter experts work collaboratively in ATIS' open industry committees, such as SYNC. ATIS SYNC develops and recommends standards and prepares technical reports related to telecommunications network synchronization interfaces.

In the *RFI*, NIST seeks input on a number of topics related to its development of a PNT profile, including potential impacts to public or private sector operations if PNT services are disrupted. ATIS SYNC believes that this should include an evaluation of the impacts to all 18 critical infrastructure sectors identified by DHS CISA.[1]

Global Navigation Satellite Systems (GNSS) security and vulnerability and its impact on network timing is an important topic for ATIS SYNC. The ATIS SYNC technical report on *GPS Vulnerability* explores this issue in depth.[2] ATIS SYNC believes it provides valuable information for identifying threats and addressing recommendations for assured PNT. Two sections of the report may be particularly relevant to the RFI:

(1) Section 7 of that report describes GPS vulnerability mitigation and alternatives to GPS timing that are generally applicable to critical infrastructure sectors; and
(2) Section 8 of that report provides recommendations to assist in defining PNT profiles relevant to the telecommunications industry.

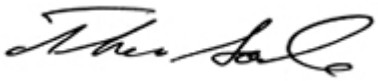
---

[1] https://www.cisa.gov/critical-infrastructure-sectors
[2] *GPS Vulnerability* (ATIS-0900005) is publicly available at no charge from: https://access.atis.org/apps/group_public/download.php/36304/ATIS-0900005.pdf.

ATIS' December 2016 presentation to the PNT Advisory Board (attached hereto) provides a useful overview of the technical report emphasizing precision timing receivers as well as ATIS SYNC's views on PNT vulnerabilities and mitigations for the telecommunications industry.

If there any questions, please contact the undersigned.

Sincerely,



Thomas E. Goode
ATIS General Counsel

cc: Lee Cosart, SYNC Chair, lee.cosart@microchip.com
Michael Calabro, SYNC Vice Chair, calabro_michael@bah.com
Steve Barclay, ATIS Senior Director, Global Standards Development, sbarclay@atis.org
Jackie Wohlgemuth, ATIS Senior Manager, Global Standards Development, jwohlgemuth@atis.org

GPS Vulnerability Report

Prepared by

Alliance of Telecommunications Industry Solutions

Copper/Optical Access, Synchronization and Transport Committee

Synchronization Working Group

December 7th 2016

Table of Contents

The Alliance for Telecommunication Industry Solutions

- ATIS is accredited by the American National Standards Institute (ANSI). The organization is the North American Organizational Partner for the 3rd Generation Partnership Project (3GPP), a founding Partner of the oneM2M global initiative, a member of and major U.S. contributor to the International Telecommunication Union (ITU), as well as a member of the Inter-American Telecommunication Commission (CITEL).
- ATIS COAST SYNC develops and recommends standards and prepares technical reports related to telecommunications network technology pertaining to network synchronization interfaces. The interfaces are between North American Telecommunications Networks, some of which are associated with other Telecommunications Networks. SYNC focuses on those functions and characteristics necessary to define and establish synchronization between networks and also on areas concerned with network phase/time characteristics that require theoretical, analytical and empirical investigations to ensure that standards and reports meet the highest norms of technical integrity and completeness. SYNC also prepares recommendations on related subject matter under consideration in various North American and international standards organizations.
- GPS Vulnerability has been identified as an ATIS COAST SYNC priority.

Precision Timing Technologies are Critical to the Operation of US Telecommunications Infrastructure

- North American telecommunications networks are critically dependent on GPS-derived timing using stationary antennas with long lifecycles. **GPS facilitates the precise synchronization of networks** operated by different network providers and provides a means of meeting national and international telecom network synchronization standards.
- **Synchronization is necessary for network operation and scalability**, including many functions of wireless technologies and the realization of network performance objectives. **GPS-based network synchronization** is critically important for location-based services, and is necessary in many North American networks to meet FCC-mandated E911 emergency location services requirements.

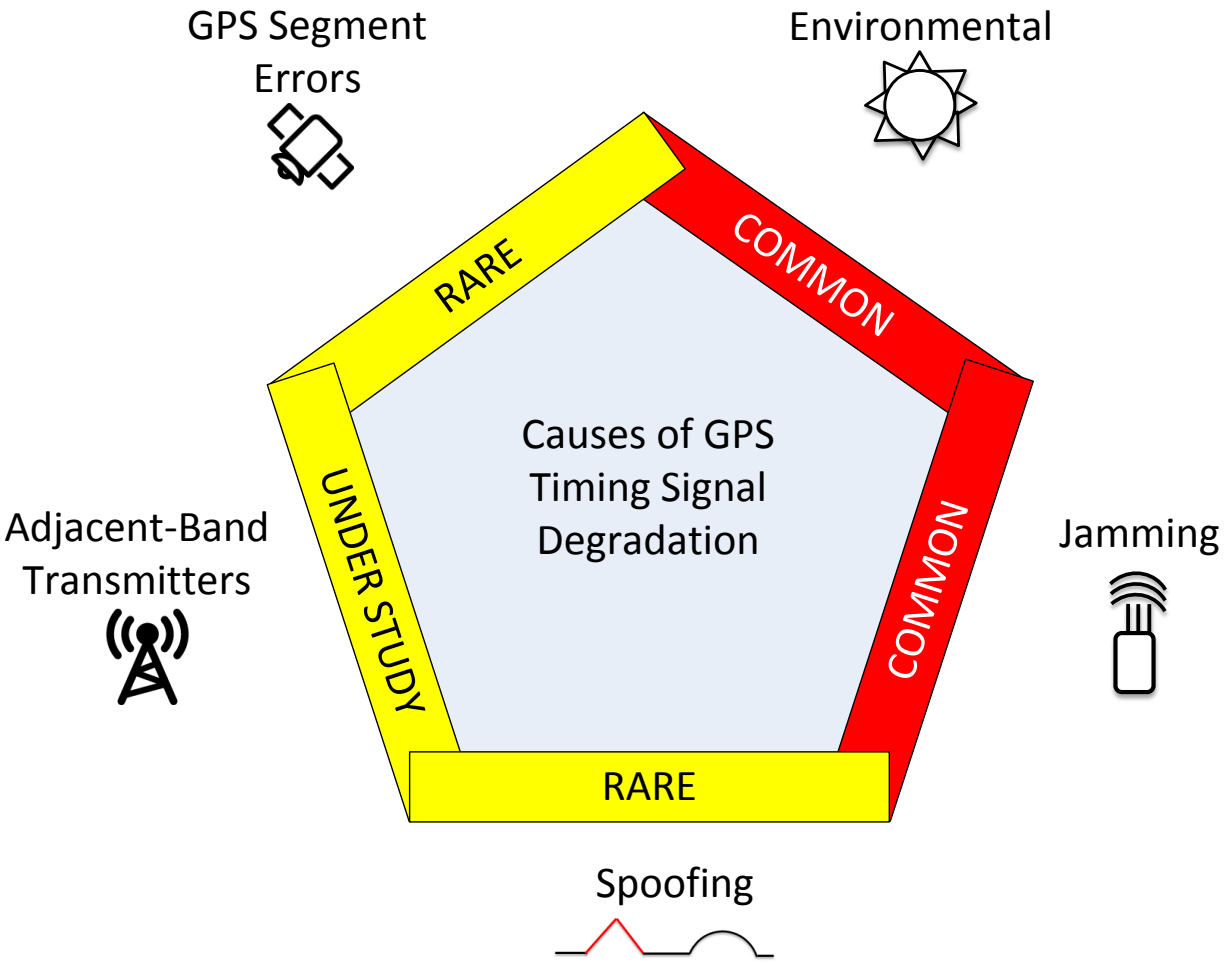
This report provides a North American Telecom perspective on the impact of GPS vulnerabilities to telecom networks, and provides a series of comments and recommendations for consideration by the larger timing community.

Telecom Timing Requirements

Application/ Technology	Accuracy	Specification
Billing and alarms	100 ms	
IP network delay monitoring	100 µs to 1 ms	NOTE – No standard requirement yet - operator dependent.
W-CDMA (Home NodeB)	µs level accuracy	[b-3GPP TR 25.866] section 8
LTE-A	µs level accuracy	[b-TR 3GPP TS 36.814]
WCDMA MBSFN	12.8 µs	[b-3GPP TS 25.346] sections 7.1A and 7.1B.2.1
LTE-TDD (wide-area)	10 µs	[b-3GPP TS 36.133]) section 7.4.2
LTE-TDD to CDMA	10 µs	[b-TS 3GPP TS 36.133] section 7.5.2.1
CDMA2000	3 µs	[b-3GPP2 C.S0002] section 1.3; [b-3GPP2 C.S0010] section 4.2.1.1
TD-SCDMA	3 µs	[b-3GPP TS 25.123] section 7.2
LTE-TDD (home-area)	3 µs	[b-3GPP TS 36.133] section 7.4.2; [b-3GPP TR 36.922] section 6.4.1.2
WCDMA-TDD	2.5 µs	[b-3GPP TS 25.402] sections 6.1.2 and 6.1.2.1
WiMAX (downlink)	1.428 µs	[b-IEEE 802.16] table 6-160, section 8.4.13.4
WiMAX (base station)	1 µs	[b-WMF T23-001], section 4.2.2
LTE MBSFN	1 µs	Under study
PRTC	100 ns	[ITU-T G.8272] (Primary Reference Time Clock)
ePRTC	30 ns	[ITU-T G.8272.1] (Enhanced Primary Reference Time Clock)

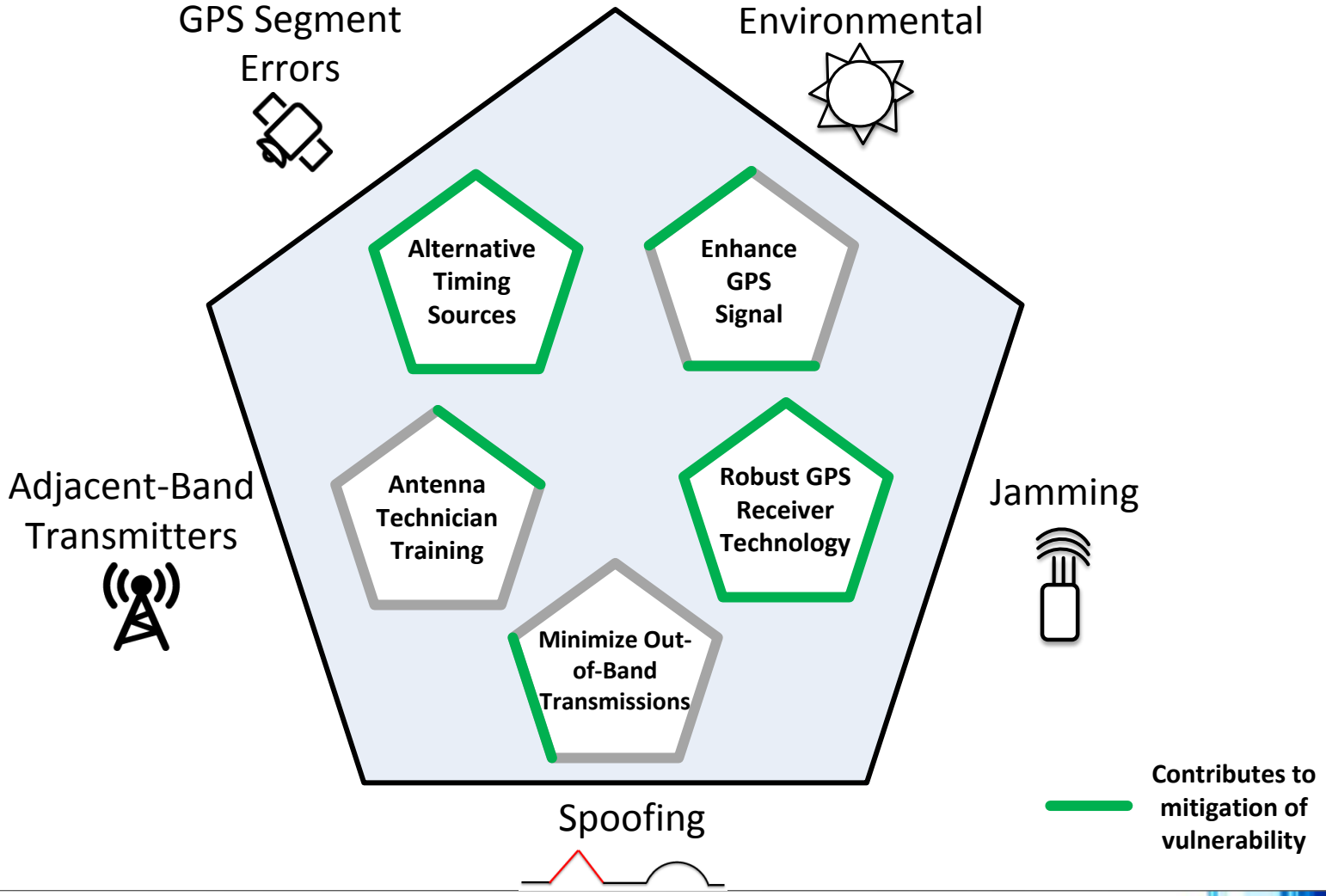
New Telecom Technologies Require Secure High-Performance Timing Sources.

Known GPS Vulnerabilities to Telecom



Identified Candidate Mitigation Strategies

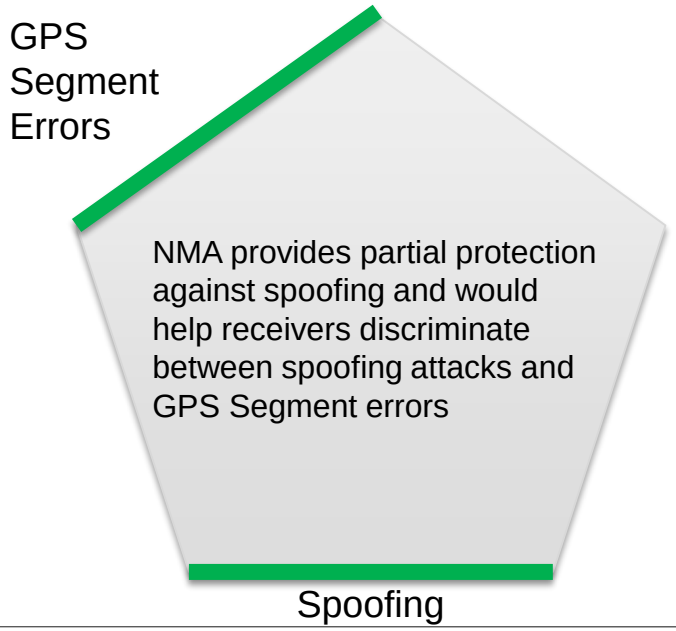
Each has significant challenges associated with implementation



ATIS COAST SYNC asks for Further Study of GPS Navigation Message Authentication

COAST SYNC Recommendations

- COAST SYNC recommends that the US government agencies responsible for GPS consider adding signal-side security features, such as the Navigation Message Authentication (NMA) that the Galileo system has incorporated in their design, to the L2C, and L5 Modernized Civil Signals to enable a possible mitigation strategy against spoofing attacks on civil GPS signals. Signal-side protections such as NMA may be adopted in future GPS receivers used by GPS-dependent critical infrastructure. The Sector Coordinating Council representing the civil signal user community should poll users of civil signals for their level of interest in NMA on the modernized civil signals.



Licensed Adjacent Band Transmitters

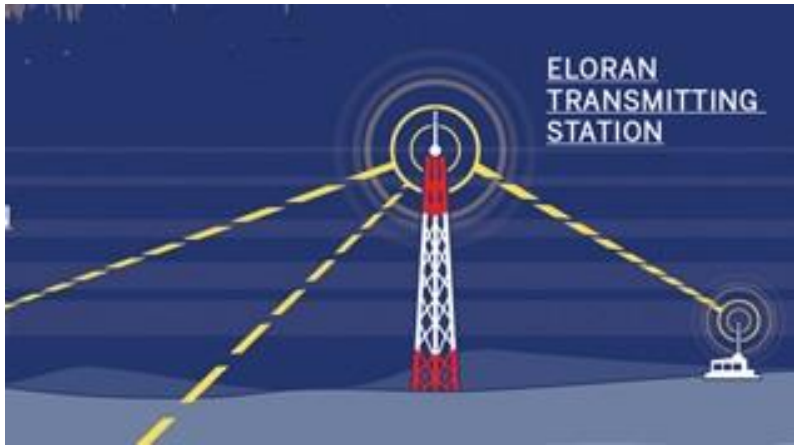
COAST SYNC Recommendations

- The telecommunications industry supports the efforts of the Federal Communications Commission to maximize the bandwidth available for wireless services, but it cannot support these efforts at the expense of degrading existing network operations.
- Given the critical nature of communications networks and the support that these networks provide for other critical infrastructure services, **ATIS COAST SYNC believes that it is crucial to consider how signals in adjacent bands may impact this sector** and recommends that test plans for this complex testing be reviewed by neutral parties before any agency makes a decision to change the use of bands adjacent to GPS signals, to avoid any impact to voice and data services on existing and future networks.

Alternative PNT Systems should be developed and implemented in the United States

COAST SYNC Recommendations

- An eLoran system (or equivalent) should be developed and implemented in the U.S. to provide a near-term alternative to GPS for the telecom system and other critical infrastructure.
- Properties that make eLoran desirable
  - Capable of providing UTC-traceable time to < 100 ns
  - Extremely robust against intentional and unintentional RF interference
  - Extremely robust against signal spoofing due to required power levels
  - Robust against environmental factors that GPS receivers are susceptible to
  - Mature and proven technology
  - Indoor reception



Multi-GNSS may be critical to enable resilient telecom infrastructure

COAST SYNC Recommendations

- COAST SYNC supported and encouraged the FCC Communications, Security, and Interoperability Council Working Group 4B to recommend simplification of use of foreign GNSS as alternative timing sources for licensed transmitters.

Dialogue in the Timing Community

COAST SYNC Recommendations

- The US government agencies responsible for NIST and USNO should continue to empower scientists and engineers, particularly with timing expertise, to work cooperatively with COAST SYNC on GPS vulnerability and back up issues. This would provide opportunities for the agency scientists and engineers to share their technical views and jointly develop solutions that industry can use.
- All work in ATIS standards committees, including COAST SYNC, is contribution driven. COAST SYNC requests the Communications Sector Coordinating Council to encourage carrier and equipment supplier participation in ATIS COAST-SYNC.
- If agency representatives are available, COAST SYNC would participate in a periodic dialog to share information with the US government agencies on issues related to GPS vulnerability mitigation and GPS augmentation.

ATIS COAST SYNC Encourages Open Testing of Precision Timing GPS receivers

COAST SYNC Recommendations

- ATIS COAST SYNC encourages open GPS Vulnerability testing where the precision timing GPS receiver type is represented.
- Any impact of an adjacent band transmission on this specific type of GPS receiver should be measured for timing accuracy versus both industry specifications (e.g. for LTE wireless networks) and other requirements (e.g. E911 positioning requirements).
- Measurement of C/N_0 alone does not sufficiently characterize timing degradation that may be introduced by adjacent band transmissions and their mitigation techniques on timing receivers.
- Raw test results and post-processed data should be made available.
- Test plans should be available for review and comment by the general interested public.
- The statistical and deterministic uncertainty of measurements should be established.

Unique Issues Associated with Testing Precision Timing Receivers for Adjacent Band Interference

COAST SYNC Recommendations

- The major difference for testing between a timing receiver and a navigation receiver is that the stability of the delay through the antenna and receiver is critical for a precision timing receiver.
- Timing requirements for telecom are becoming increasingly stringent. Granting a license to transmit in a band adjacent to GPS should consider the impact on emerging timing requirements.
  - For example, testing of the change in the delay with temperature should be done for any antenna/receiver system, over an appropriate temperature range.
  - Though using a sharp cutoff in a pass band may allow a navigation receiver to function in the presence of an adjacent band signal, such a filter may, if not properly designed, add unacceptable delay instability over time or temperature for a precision timing receiver, particularly for new and newly developing requirements.

Conclusions

- The ATIS COAST SYNC committee represents the timing issues of the North American telecom networks.
- North American telecommunications networks are critically dependent on GPS-derived timing using stationary antennas. Future networks will likely require even tighter timing constraints.
- Alternatives to GPS timing for telecom all have significant limitations.
- While the telecommunications industry supports efforts to maximize the bandwidth available for wireless services, it cannot support these efforts at the expense of degrading existing network operations. Hence any proposed adjacent band signal must be tested to ensure it does not degrade network functions.

Contact Information

Complete COAST SYNC findings and recommendations will be made available in a final GPS Vulnerability report to be released Q1 2017. Additional questions may be directed to Lee Cosart or Jackie Wohlgemuth.

Lee Cosart

ATIS COAST SYNC Chair

lee.cosart@microsemi.com

Jackie Wohlgemuth

ATIS Manager, Global Standards Development

jvoss@atis.org