1200 G Street, NW
Suite 500
Washington, DC 20005

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

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Via Email
Helen Jackson (helen.jackson@hq.dhs.gov)
NSTAC Designated Federal Official
Department of Homeland Security
NPPD/CS&C/SECIR Division

RE: COAST Synchronization Committee Recommendation regarding Proposed Solutions to Mitigate GPS Vulnerability to Jamming and Spoofing

Dear Ms. Jackson:

This letter is a follow-up to the Alliance for Telecommunications Industry Solutions' (ATIS) letter of March 11, 2014, and provides an update on the work of ATIS' Copper/Optical Access, Synchronization and Transport (COAST) Committee to address the vulnerability of GPS to jamming and spoofing.

ATIS is pleased to report that the COAST Synchronization Committee (COAST SYNC) has a project to study GPS vulnerability to jamming and spoofing, mitigation of jamming and spoofing, and proposed solutions to back up GPS as a timing source for the telecommunications sector. In addition, COAST SYNC is now collaborating with the Communications Sector Coordinating Council (CSCC) on GPS vulnerability issues.

There are four proposed solutions for mitigation of GPS vulnerability to jamming and spoofing under discussion at COAST SYNC:

1) Navigational Message Authentication on L2C;
2) Sync over fiber;
3) eLORAN; and
4) Sync distribution via other RF spectrum.

These solutions are described in Appendix A. COAST SYNC notes that its evaluation of these solutions is limited to technical issues and specifically excludes any evaluation of associated costs.

In all cases, the source for time and phase references in the United States would continue to be the National Institute of Standards and Technology (NIST) and the United States Naval Observatory (USNO). COAST SYNC does not recommend use of non-U.S. based Global Navigation Satellite System (GNSS) as a back up to GPS for core telecom network timing and synchronization. Signals from non-U.S. based GNSS may be vulnerable to jamming and spoofing as is GPS, and there are concerns about accuracy, availability, and security. The current recommendations from COAST SYNC are discussed in detail in Appendix A below.

If you would like additional information or if you have any questions, please do not hesitate to contact the undersigned.

Sincerely,

Thomas Goode
ATIS General Counsel

cc: Kathryn Condello, CSCC Chair, kathryn.condello@centurylink.com
Brooks Fitzsimmons, CSCC Vice Chair, brooks.fitzsimmons@att.com
Ken Biholar, ATIS COAST Chair, ken.biholar@alcatel-lucent.com
William Szeto, ATIS COAST Vice Chair, william.szeto@xtera.com
Lee Cosart, ATIS COAST SYNC Chair, lee.cosart@microsemi.com
David Overdorf, ATIS COAST SYNC Vice Chair, do3863@att.com
Steve Barclay, ATIS Director, Global Standards Development, sbarclay@atis.org
Jackie Voss, ATIS Manager, Global Standards Development, jvoss@atis.org
Emily Hoefer, ATIS Committee Administrator, ehoefer@atis.org

Appendix A

This appendix describes the four proposals for mitigation of GPS Vulnerability: (1) Navigational Message Authentication on L2C; (2) Sync over fiber; (3) eLORAN; (4) Sync distribution via RF spectrum.

1. Navigational Message Authentication (NMA) on L2C

This proposal would add Navigational Message Authentication (NMA) to GPS L2C signals as a means to mitigate spoofing attacks on GPS devices using L2C. COAST SYNC has spent a considerable amount of time discussing the merits of NMA, and points out that the telecom sector is presently using only L1 GPS receivers for timing and synchronization. Telecom sector use of NMA on L2C would require the deployment of additional receivers, or replacement of existing L1 receivers with a dual mode version supporting both L1 and L2C operation. COAST SYNC further notes that NMA does not provide any mitigation of a jamming attack, nor does it address the issue of poor penetration of GPS signals into buildings. While NMA on L2C would not be immediately usable by current telecom receivers, the long-term application of NMA on GPS civilian signals may become an important defense against a spoofing attack.

2. Sync over fiber

Private sector companies and NIST are conducting a proof of concept trial of transporting very high precision time and phase synchronization over fiber using IEEE-1588v2 Precision Time Protocol (PTP). COAST SYNC finds the results to date of this trial encouraging, but additional study and work are needed to determine if this method will be viable. PTP packetizes time and phase information, for delivery over a packet based network such as Ethernet which is in turn transported over fiber. PTP is susceptible to impairments due to packet delay variation and asymmetry in the forward versus reverse transmission paths. Further, there is a need to determine if PTP can be used to transport very high precision time and phase sync over the vast distances required to cover the continental United States.

COAST SYNC notes that there is a second proposal for sync over fiber that may develop in the future. ITU-T standard J.211 describes a two way protocol transported over the physical layer that includes a mechanism to correct for transport delay and asymmetry. It is not packet based and thus is not impaired by delay variation. COAST SYNC has been advised that this technology could be adapted to fiber transport using telecom industry standard Wave Division Multiplexing (WDM) technology.

3. eLORAN

In October 2014, COAST SYNC reviewed presentations on a joint government and private sector proposal that addresses the development of a new eLORAN type system in the U.S. for delivering very high precision time and phase sync. This type of signal is very long wavelength, very high powered, would be very difficult to jam, and penetrates buildings well. COAST SYNC has been informed that eLORAN could begin limited operations in the U.S. in about one year, and could be fully operational nationwide within several years. It is worth noting that some European nations are presently using eLORAN as a back up to GPS for position, navigation, and timing.

4. Sync distribution via other RF spectrum

COAST SYNC notes that it is technologically feasible to develop a very high precision timing reference similar to WWVB that would operate in RF-spectrum. Such a solution has been discussed in

COAST SYNC. Sub-1 GHz RF spectrum signals penetrate buildings very well, and a timing source in that spectrum could be a viable back up to GPS for timing references. This proposal would requiredevelopment to determine how best to provide the accuracies required for telecom needs. Another RF spectrum solution that could be considered is the use of terrestrial beacons.

Notes

NMA on L2C (proposal 1) would provide mitigation against spoofing of the L2C signal only.

Sync over fiber, eLORAN, and sync distribution via RF spectrum (proposals 2, 3, and 4, respectively) are methods for transporting time and phase synchronization that are technologically diverse from GPS; these solutions could continue to operate to deliver time and phase sync even if there were a total failure of the GPS system.

COAST-SYNC Recommendations

1. COAST SYNC recommends implementation of NMA on L2C as one form of mitigation against spoofing attacks on GPS. The Sector Coordinating Council representing the L2C user community should poll L2C users for their level of interest in NMA on L2C.
2. The U.S. government agencies responsible for GPS should consider adding NMA to all civilian signals if feasible, to be used in future versions of civilian receivers.
3. The eLORAN system should be developed and implemented in the U.S. to provide an alternate timing backup to GPS for the telecom system and other critical infrastructure.
   Other RF timing systems should be studied, such as further developing WWVB, potentially sending time from the NOAA weather satellites, or others, for example, terrestrial beacons.
4. The U.S. government agencies responsible for NIST and USNO should continue to empower scientists and engineers 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. As a minimum there should be an ongoing periodic dialog to share information.
5. 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 COAST SYNC, to share their ideas via contributions and to progress the evaluation of the proposals listed.