RFI Title: Request for Information - Profile of Responsible Use of Positioning, Navigation, and Timing Services

Robert Bosch LLC

PNT RFI Response

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Confidentiality Statement: Not Applicable

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Bosch Overview

Having established a regional presence in 1906 in North America, the Bosch Group employs 34,600 associates in more than 100 locations, as of December 31, 2019. In 2019, Bosch generated consolidated sales of $14.4 billion in the U.S., Canada and Mexico. For more information, visit www.bosch.us.

The Bosch Group is a leading global supplier of technology and services. It employs roughly 400,000 associates worldwide (as of December 31, 2019). The company generated sales of 77.7 billion euros in 2019. Its operations are divided into four business sectors: Mobility Solutions, Industrial Technology, Consumer Goods, and Energy and Building Technology. As a leading IoT provider, Bosch offers innovative solutions for smart homes, Industry 4.0, and connected mobility. Bosch is pursuing a vision of mobility that is sustainable, safe, and exciting. It uses its expertise in sensor technology, software, and services, as well as its own IoT cloud, to offer its customers connected, cross-domain solutions from a single source. The Bosch Group's strategic objective is to facilitate connected living with products and solutions that either contain artificial intelligence (AI) or have been developed or manufactured with its help. Bosch improves quality of life worldwide with products and services that are innovative and spark enthusiasm. In short, Bosch creates technology that is "Invented for life." The Bosch Group comprises Robert Bosch GmbH and its roughly 440 subsidiary and regional companies in 60 countries. Including sales and service partners, Bosch's global manufacturing, engineering, and sales network covers nearly every country in the world. The basis for the company's future growth is its innovative strength. Bosch employs some 72,600 associates in research and development at 126 locations across the globe, as well as roughly 30,000 software engineers.

Additional information is available online at www.bosch.com, www.iot.bosch.com, www.bosch-press.com, www.twitter.com/BoschPress.

RFI Response

Current usage Functions

1.1.) Which Bosch products are using Global Positioning Systems (GPS) today?

- *Vehicle Motion Positioning Sensor (VMPS)*
- *Infotainment automotive display – navigation*
- *Infotainment watercraft display – speed, heading, altitude*
- *Event Data Recorder (EDR) – crash data*

1.2.) What are current plausibility checks?

- *VMPS uses plausibility checks with inertial data to check the GPS*
- *VMPS uses inertial data to supplement GPS – when a car drives through a tunnel*
- *VMPS compares GPS and Galileo to enhance accuracy and security*
- *VMPS enhances GPS with terrestrial accuracy services*

1.4.) Background from Chassis Controls group

Instead of "position data" experts talk about satellite ephemeris data. Satellites do not provide a location, but information from which it is possible to calculate position.

Additional Measures

- *GPS system should also provide a trust level for the information*
  - *Are other incidents recognized by the system itself in the direction of data integrity?*
  - *Alarms for detected problems – broadcast only, no feedback*
  - *Since the system don't provide it at the moment, third party service providers supplement this today*
- *Protect updates against manipulation*
  - *Satellite SW, global reference network SW updates should be also protected against possible manipulation (Secure Flashing + RTMD)*
  - *Encrypt over the air the firmware updates*
  - *Bosch experts are not familiar with current satellite firmware update strategy*
  - *Not knowing that these security measures are in place reduce the trust level for the information,*
- *Authenticate correction upload data*
  - *Global reference network corrects satellite information*
  - *Corrected data uploaded to satellite every time it passes over reference station*
  - *Corrected data provided from satellite to GPS receivers*
- *Anomaly detection in satellites and reference network stations*

1.5.) What would Enhancing Security Enable?

- *Authenticity of position data*
  - *Can we be sure that the data is coming from a satellite and not being spoofed?*
  - *Vehicle location after short-term lease expiration (i.e. car share, rental, etc.)*
  - *Geofencing restrictions – ensuring the vehicle does not operate outside safe region*
  - *Plausibility of vehicle speed. (correlation of on vehicles sensors with GPS data)*
- *Authenticity of navigation data*
  - *Where is the vehicle on the map? Without authenticity of exact vehicle location a vehicles routing could be abused.*
  - *Prevent manipulation of route profile and spoofing of destination*
  - *Electronic horizon*
- *Authenticity of timing data*
  - *Alignment with terrestrial correction service data (i.e. 100ms for time expiration of valid signal). Ensures that one or both signals (GPS and terrestrial) are not being spoofed. This would enable a shorter key length for normal, fast, messages to improve processing time.*
  - *Authoritative time signal (i.e. hour(s) broadcast rate) to prevent use of expired certificate. A longer key length, longer compute time, could be used*

to add higher level of security and trust. This signal would not be necessarily required for navigation but could be used for software updates and other higher risk operations.

- *Vehicle clock (not safety critical)*

- *Robustness*
  - *Increased robustness against DoS jamming*
  - *Increased robustness against DoS network shutdown*