Galileo: The European GNSS enhances location performance for IoT

IoT Week 2019

Omar Valdés Market Development Officer at European GNSS Agency

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Several technologies can provide positioning capabilities relevant to locate “things”

**Main absolute positioning technologies and accuracy**

<table>
<thead>
<tr>
<th></th>
<th>Indoor</th>
<th>Outdoor</th>
<th>Accuracy</th>
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<tbody>
<tr>
<td><strong>Network based</strong></td>
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<tr>
<td>Cell-ID</td>
<td></td>
<td></td>
<td>200-5000m</td>
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<tr>
<td>Cell Tower Triangulation</td>
<td></td>
<td></td>
<td>50-1000m</td>
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<tr>
<td><strong>Handset based</strong></td>
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<td>1 - 50m</td>
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<td>GNSS</td>
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<tr>
<td>A-GNSS</td>
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<tr>
<td><strong>Hybrid</strong></td>
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<tr>
<td>Wi-Fi</td>
<td></td>
<td></td>
<td>3-10m /20-50m</td>
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<tr>
<td><strong>Infrastructure based</strong></td>
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<tr>
<td>Bluetooth</td>
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<td></td>
<td>3-10m</td>
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<tr>
<td>UWB</td>
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<td>20 cm-10 m</td>
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<tr>
<td>RFID</td>
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<td>&lt;3m</td>
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</table>

- **Network based**: (Cell-ID, E-OTD, TDOA etc.) using the telecommunication networks
- **Handset based**: (GNSS) the handset itself is the primary means of positioning the user. The A-GNSS corresponds to a hybrid technology based on the GNSS but using the cellular network
- **Infrastructure based**: (Bluetooth, UWB, Wi-Fi or RFID) the position is computed by evaluating of the distance between the device and transmitters (for example a Bluetooth beacon or a Wi-Fi router)
Internet of Things is developing alongside 4 building blocks where sensing is the enabler.
Current GNSS is not enough... emerging applications are more and more demanding in terms of performance

- Augmented reality
- Self-driving cars
- Drones
- Smart cities
- Automation on the farm
- Antifraud applications
Improving GNSS-based location (1/2)

Multi-constellation for more availability of the signals

Multi-constellation is already widely used in many applications but is **not yet a standard in IoT**

Usual combination of GPS and Glonass is now expanded with Galileo and Beidou

R&D progress enabled multiple constellations to work together **without much impact on the power consumption**
First dual frequency chipsets now available for the mass market

Available today:

Announced prototypes:

Multi-frequency for better accuracy of the position

Supported frequencies by GNSS receivers:

2 shows percentage of receivers capable of tracking 1, 2, 3 or all the 4 frequencies
E5/L5: The second frequency of choice

- Wide band signal providing increased **accuracy**
- Exceptional resistance to **multipath**
- In combination with E1 providing **iono-free** solution
- All constellations support this frequency, the number of available signals will grow rapidly
- E1/E5 combination is recognized in **all segments**, professional, automotive and also mass market
Galileo can contribute with innovative features to IoT

- **Authentication**
  - **Data level:** Navigation Message Authentication
    
    Integrated in the E1-B band for OS. Aimed at consumer users and offered for free. Already prototyped and under testing
  
  - **Range level:** Signal Authentication
    
    Based on the E6-C Spreading Code Encryption to protect against more sophisticated attacks
“Navigation Message Authentication” is the ability of the system to guarantee to the users that they are utilising legitimate navigation data that has not been modified and comes from the Galileo satellites and not from any other source (spoofing).

Galileo OS Navigation Message Authentication

- Clear differentiator w.r.t. other GNSS available to the civil community
- Fully backward compatible
- Disseminated on the first Galileo frequency (E1B)
- Contributes to mitigate GNSS vulnerabilities
- No need to store secret keys in the Rx, just public key
- Follows crypto standards and recommendations to be secure over the next decades
Galileo OS-NMA can add value to multiple markets

The use of OSNMA is expected to **reduce the associated spoofing risk** in many applications categories:

- **Road** (AD, PAYD, RUC)
- **Commercial Marine**
- **Logistics** (proof of delivery)
- **Mobile payments**
- **Internet of Things**
- **UAV**
- **Augmented Reality**
- **Timing & Synchronisation**

*Not exhaustive list.....*
Galileo High Accuracy Service on E6 to be offered for FREE

- User positioning accuracy with **decimeter level error** (≈20cm)
- **No need of additional** ground communication channel (448 bps allocated on Galileo E6B)
- **No need of proximity to base stations** to access corrections (**as opposite to RTK**)
- **Triple frequency** to further **increase accuracy** and **reduce PPP convergence time**
- **Improved line-of-sight and better coverage** at high latitudes

* It will require compatible receivers E1/E5/E6
Short answer: Yes!

- Galileo operational since 2016
- 26 satellites already launched
- 22 satellites are usable
- 12 more satellites procured

Can we use Galileo right now?

www.gsc-europa.eu
First dual frequency phone was launched in 2018

Xiaomi Mi8
Powered by Broadcom 4775
Dual frequency E1/L1 and E5/L5
Example of implementation of a dual frequency positioning module for autonomous driving

GSA funded project ESCAPE that develops a highly automated positioning engine
Galileo-enabled devices are already available
A perspective of IoT from the GNSS point of view

**HIGH END**
Lower power consumption and cost constraints (fleet management, drones, smartphones)

**MID RANGE**
Medium power consumption and cost constraints (asset tracking, wearables, bike sharing, smart lightning)

**LOW END**
High power consumption and cost constraints (low value asset management and tracking)

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**TODAY**
- Multi-constellation
- GPS – only
- No GNSS

**TOMORROW**
- Multi-frequency
- Multi-constellation
- Innovative concepts (e.g. cloud processing)
Summary of Galileo differentiators for IoT applications

Need for NMA authentication emerged from users to enhance Galileo value proposition wrt:
- Enabling **commercially sensitive applications**
  - Enhancing **big data** collection
  
  **Main applications:** Fraud management, billing, payment by location…

Galileo better mitigates **multipath effects** through dual frequency E1/E5

**Main applications:** navigation, tracking, augmented reality…

- **Galileo High Accuracy Service**
  - Development of new value-added services
  - Enhancement of offered ones

- **Galileo NMA Authentication**

- **Multipath Resistant**

Free provision service based on PPP transmission in E6B and via internet link

Future differentiator of Galileo for **semi-professional applications**
Linking space to user needs

How to get in touch:

- GSA Newsletter
- GSA Twitter - @EU_GNSS
- EGNOS Twitter - @EGNOSPonal
- GNSS Facebook page
- GNSS YouTube Channel
- European GNSS Agency LinkedIn Page
- GNSS Market, Research & Development
- GNSS Slideshare Page (presentations)

www.GSA.europa.eu