SYSTEM ENGINEERING
SOFTWARE DEVELOPMENT
PROCESS & RAMS CONSULTING
VALIDATION & VERIFICATION
EMBEDDED SOFTWARE

G-PASSION
Galileo Public Authenticated Server-based Snapshot positIONing

THE 2ND NAVISP INDUSTRY DAYS

NAVISP Element 2 - ESA AO/1-8927/17/NL/MM

23rd January 2020 – ESTEC

Speakers: **Filippo Giuliani**

Project references

Subject: NAVISP Element 2, CALL FOR PROPOSAL

Ref: ESA AO/1-8927/17/NL/MM

Project Title: Galileo Public Authenticated Server-based Snapshot positIONing (G-PASSION)

Project start: Kick-Off meeting (dated 16th February 2018)

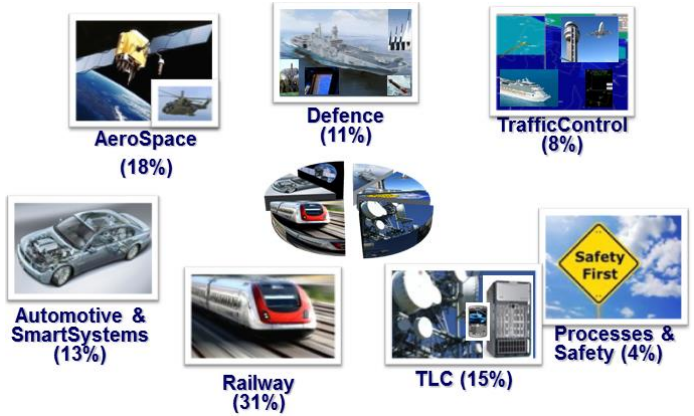
G-PASSION project is an innovative and competitive system in the Satellite Navigation and in the wider Positioning Navigation and Timing (PNT) domains.

Company Presentation: INTECS Solutions

INTECS is an **Italian** company which since **1974** offers the most innovative technologies for the **software and hardware** development for **safety-critical** and **mission-critical electronic systems**.

INTECS offers services, solutions and products for the design and development of applications, tools, software and hardware components in the **Aerospace, Defence, Railway, Automotive, Telecommunication** and **Smart Systems market**.

INTECS cooperate with the main European and Italian Industries, Organizations, Universities and Research Centres.



Objectives

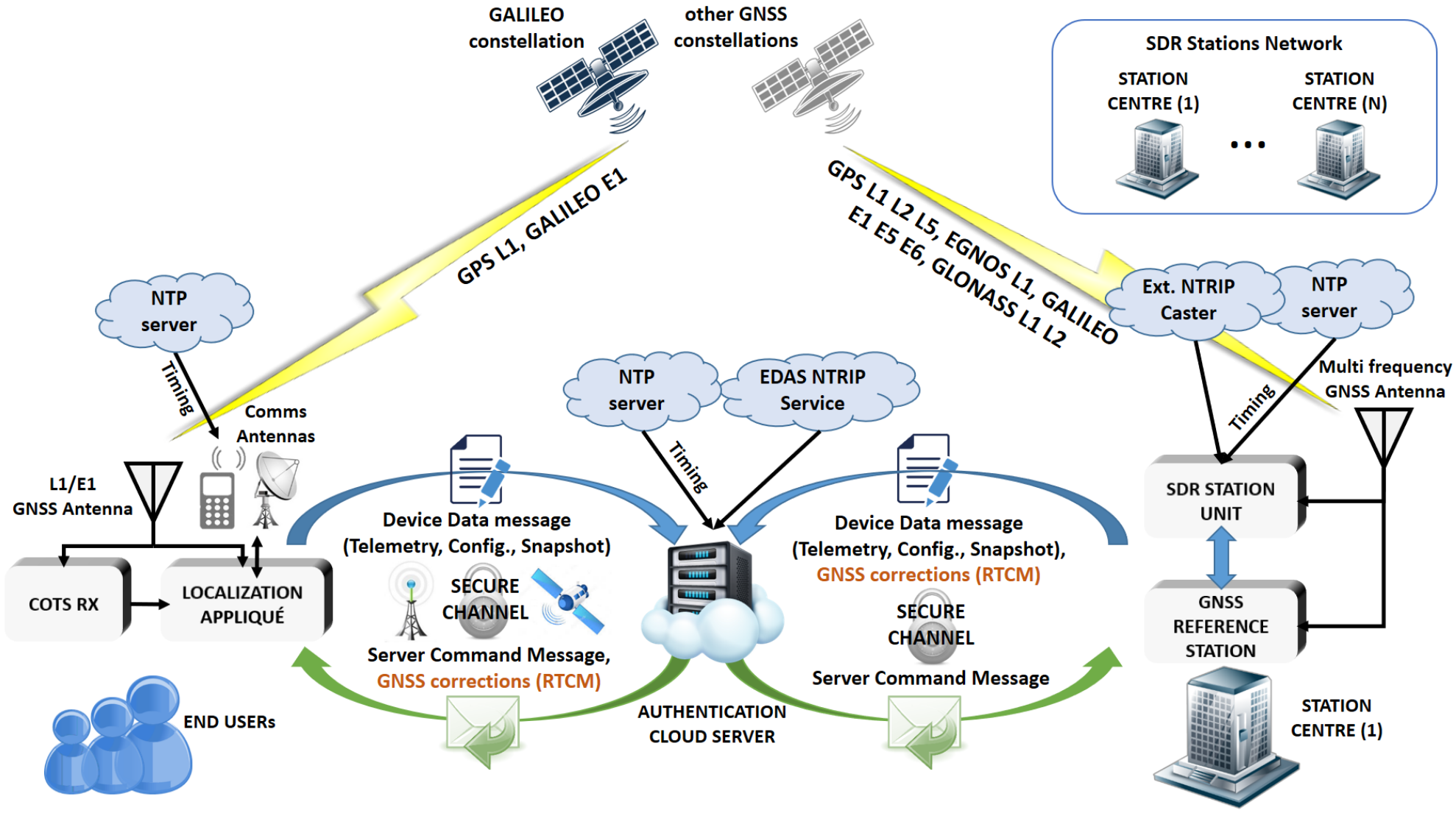
G-PASSION is a GNSS signal authentication service exploiting the full spectrum of the Galileo E1 signal **at physical signal level**, thus without demodulating

The system exploit the cross-correlation on Galileo E1A channel of signal snapshots, recorded at user and at a reference positions

Key Features

- **Cost-effective** authenticated position system **deployment**
- Approach based on digital **techniques** performed **on physical level** of the Galileo E1 signal
- **Cross-Correlation** based algorithm for **watermark identification**
- Verification and **authentication of all GNSS** (GPS, GLONASS, BEIDOU, GALILEO, SBAS) **PVT solutions**
- **Innovation**: disruptive technology compared to approaches of only-PRS receivers, PRS server-based authentication position systems with keys hosted in the secure server or other signal authentication schemes
- **Re-configurability and Upgradability**: SDR & Cloud approach
- **Scalability**: star-topology, a single Authentication Server is able to manage PVT authentication requests from different user terminals
- **Low impact on pre-existing systems**: LA & AU are in charge of communicate with existing systems by supporting a wide variety of interfaces (e.g. LAN, Bluetooth, USB) and protocols (RTCM or proprietary)
- **Traceability**: for finance applications, knowledge of the traceability of the time signal to UTC is essential to ensure regulatory compliance at the time-stamp (MiFID II Directive took effect from the 3rd of January 2018)

System overview



System devices

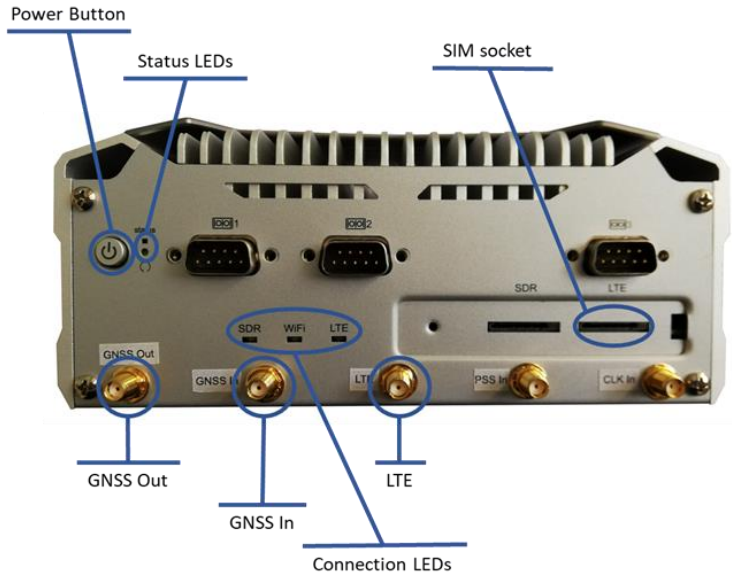
A **single device** for both user and reference station

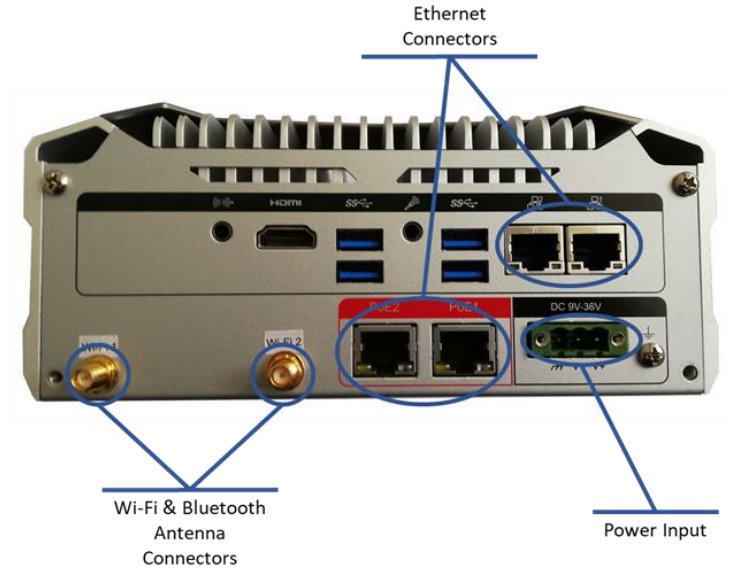
Custom **fanless industrial** PC:

- Intel i5-7300U
- 8 GB RAM DDR4-2400
- Ubuntu OS

Embedded modules:

- Fairwaves XTRX Software-Defined Radio
- LTE module
- Wi-Fi/Bluetooth module
- GNSS module





Use Cases overview (1/2)

- **G-PASSION** looks at **non-institutional professional market sectors** requiring an authenticated, robust, resilient and traceable PVT solution.
- Today, authentication is only provided by Galileo Public Regulated Service (PRS), which is just for government-authorized users. Though, a significant part of non-institutional professional GNSS users would require and benefit of similar capabilities.
- Our analysis has focused mainly on three market sectors: **maritime, road, timing & synchronization**.

MARITIME

ROAD

TIMING & SYNCHRONIZATION

Use Cases overview (2/2)

	Maritime	Road		Timing & Synch	
USE CASE	**Vessel Monitoring Systems** for Illegal, Unreported and Unregulated (IUU) Fishing	**Liability-critical systems**: - Road User Charging - Usage-Based Insurance	**Regulated applications**: - Smart Tachograph	**Energy**: - Phasor Measurement Units	**Financial Transaction**
GNSS REQUIREMENTS	• Availability • Authentication	• Accuracy • Authentication • Integrity • Robustness	• Authentication • Integrity • Robustness • TTFF	• Authentication • Robustness • Resiliency	• Authentication • Availability • Resiliency • Traceability

Sources: GNSS Market Report, GSA, 2017, Market Strategy Update in Maritime Segment, GSA, 2017

GNSS attacks and vulnerabilities

Interferences (unintentional): Other services signals interfering with GNSS (out-of-band, in-band, adjacent band)

Jamming: Intentional transmission of noise signal or other waveforms in GNSS bands, causing loss-of-lock

Meaconing: Retransmission of a recorded GNSS signal, also with a maliciously computed delay

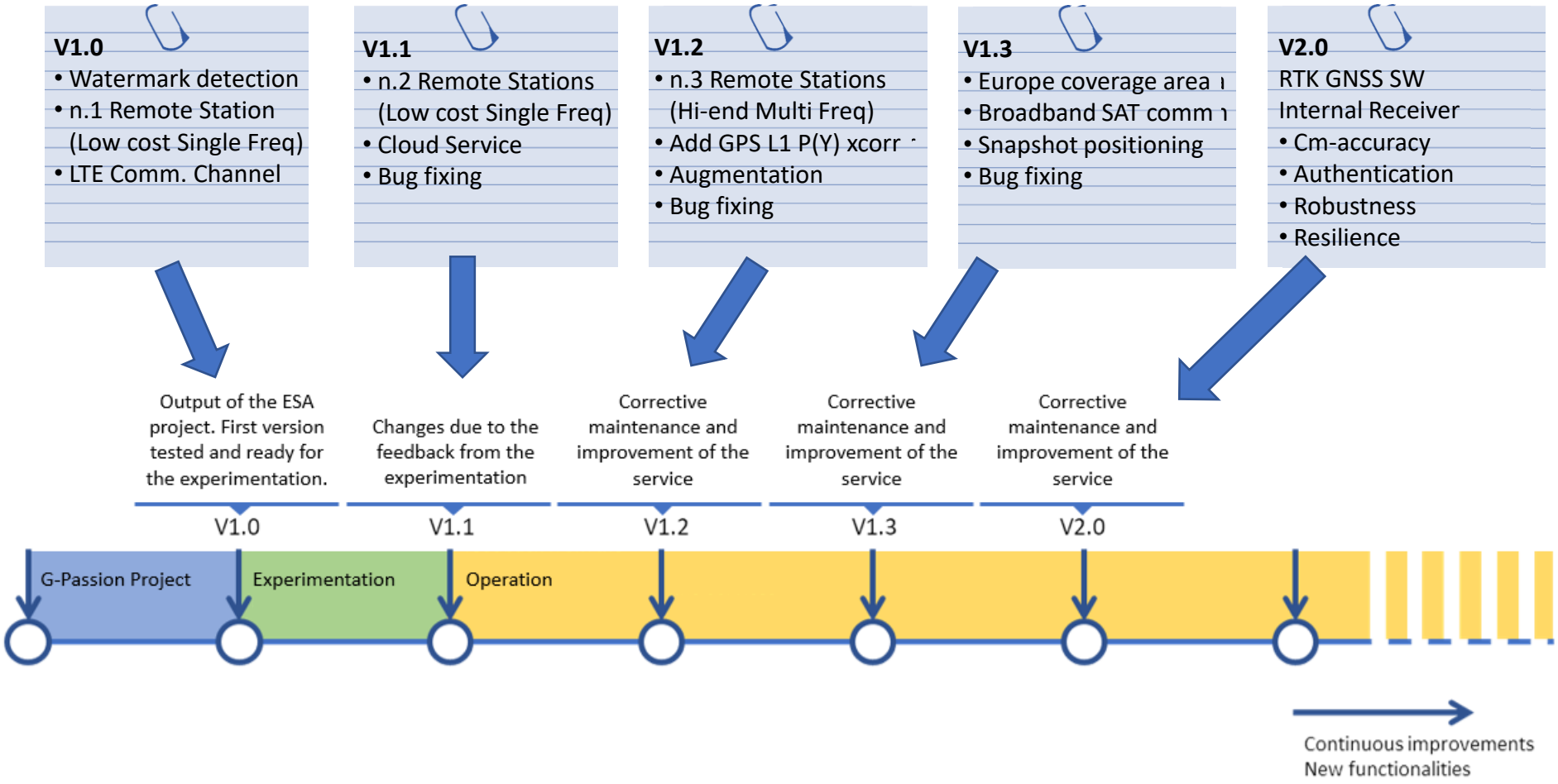
Spoofing: Transmission of fully synthetic GNSS signals misleading the GNSS receiver PVT computation

GNSS spoofing countermeasures

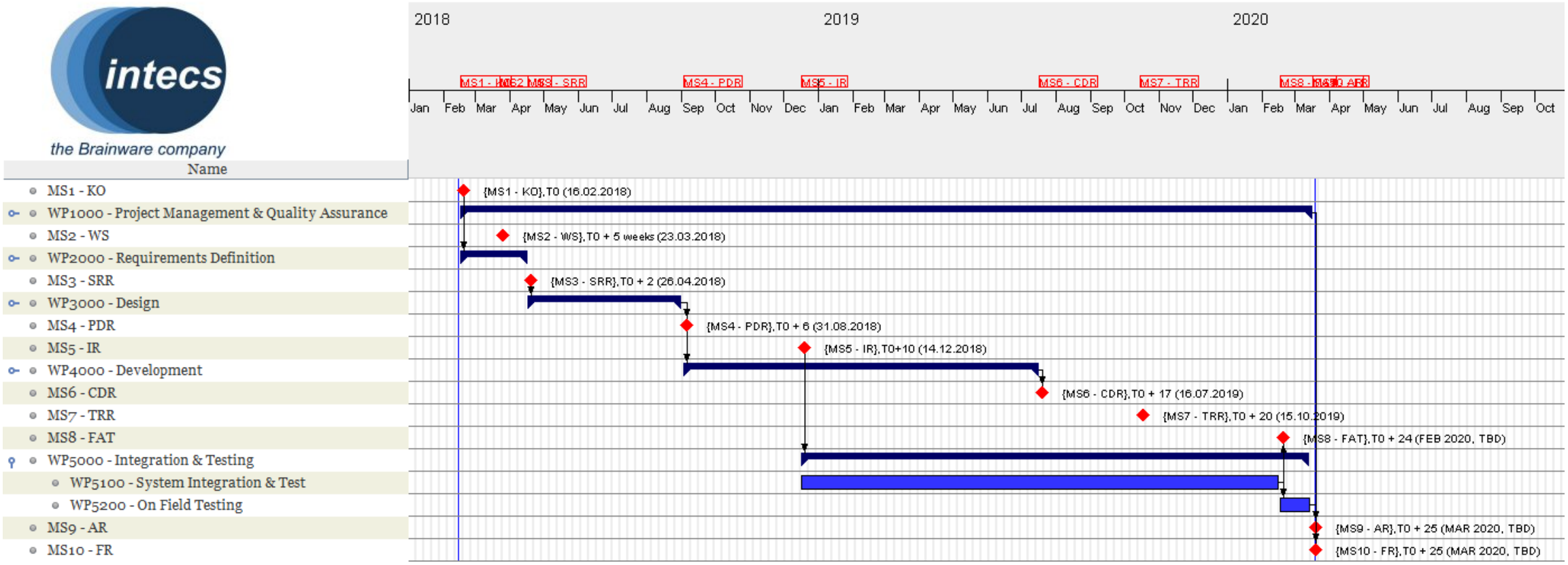
Technique	Cost	Effective	Pratical
Signal Processing	-	-	-
RAIM	Low	Low	High
SNR	Low	Low	High
Abs. Power	Low	Medium	High
Doppler shift test	Low	High	High
Correlation peak	High	Low	Low
Clock bias	Medium	Low	Low
Encryption	-	-	-
SCE	High	High	High
NMA	Medium	Medium	Medium
NME	High	Medium	Low
TESLA	High	Low	Low
Correlation	-	-	-
Other GNSS	Medium	High	Low
Non-GNSS	High	Low	Low
Antenna based	-	-	-
AOA	Medium	Very High	High
Moving	Medium	Medium	Low
Two different	Medium	Low	Low
Transmit null	High	Low	Low

Source: Survey and Analysis of the GNSS Spoofing Threat and Countermeasures, Desmond Schmidt, (2016)

Product roadmap and future plans

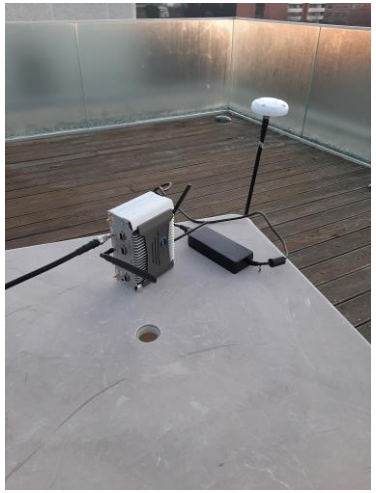


Project GANTT

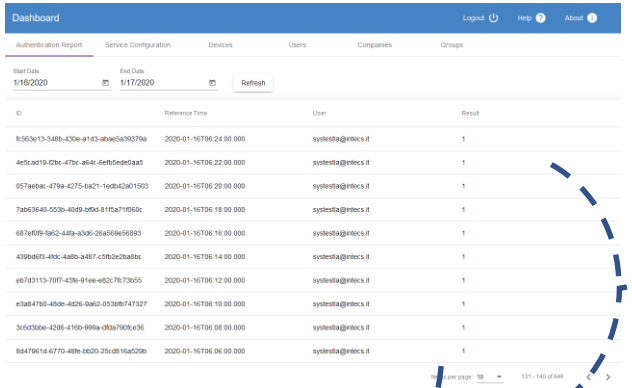


Project Status (1/2)

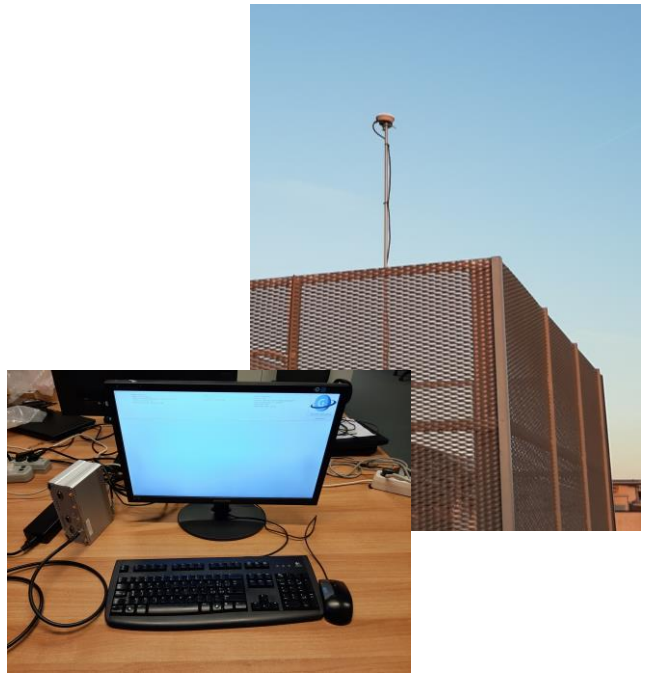
USER SEGMENT



AUTHENTICATION CLOUD SERVER



REFERENCE STATION



Project Status (2/2)

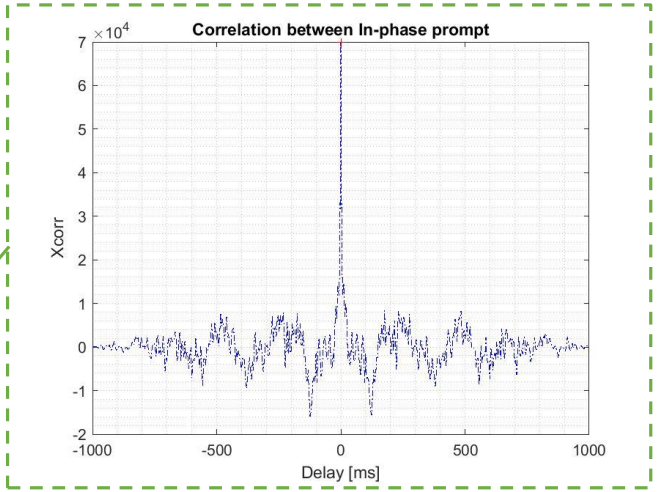
Dashboard

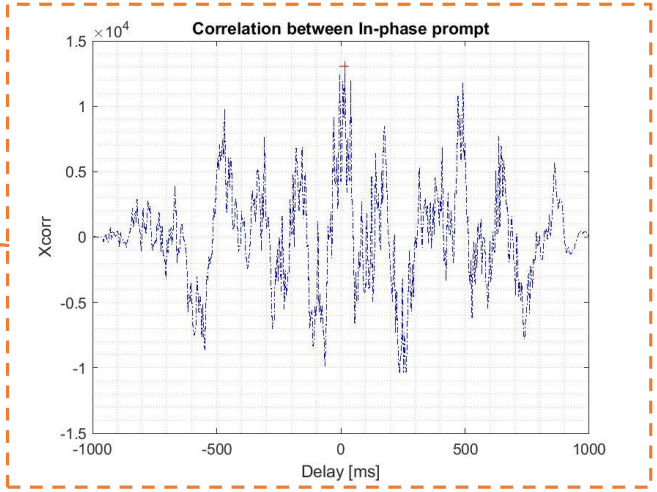
Logout Help About

Authentication Report | Service Configuration | Devices | Users | Companies | Groups

Start Date 1/17/2020 End Date 1/18/2020 Refresh

ID	Reference Time	User	Result
5f3a9108-1b6b-4648-9f32-2dc8ceb4b85a	2020-01-17T16:12:00.000	systestla@intecs.it	Authenticated
6346d71f-b580-402d-9f7a-eb4e52a5b803	2020-01-17T16:10:00.000	systestla@intecs.it	Authenticated
d41fd067-3f2a-4b21-afe7-e8afab6bfd47	2020-01-17T16:08:00.000	systestla@intecs.it	Authenticated
d13be88a-8b13-4075-b06c-730da66cdc1a	2020-01-17T16:06:00.000	systestla@intecs.it	Authenticated
96e04fb1-0b3e-4da0-b56c-438fcae871a2	2020-01-17T16:04:00.000	systestla@intecs.it	Authenticated
51699ee5-61b4-43d3-82e8-cdf969eb9dc3	2020-01-17T16:02:00.000	systestla@intecs.it	Authenticated
a2d2f329-9ee7-4d9d-bc5c-4ed832a5210e	2020-01-17T15:46:00.000	systestla@intecs.it	Not Authenticated
93adf0bc-f8ac-42a3-a9ab-1d3816a5f8e8	2020-01-17T13:32:00.000	systestla@intecs.it	Not Authenticated
51d970f9-0745-4b1a-8813-94b030e9b4b2	2020-01-17T10:04:00.000	systestla@intecs.it	Authenticated





Benefits from NAVISP

Technical expertise in the GNSS domain

Product engineering experience

End user know-how in terms of **user requirements**

European visibility with workshop and business days

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Thank you for your attention

Filippo Giuliani - filippo.giuliani@intecs.it