GEARS
GalilEo Authenticated Robust timing System

Reliable GNSS Timing Source for Critical Networks: enhanced solution
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WHY A NEW TIMING RECEIVER

- Providing a Galileo-based timing receiver for Critical Infrastructures (CI) and targeted markets :
  - Telecom
  - Energy
  - Finance
- Subsidised by the European GSA (Fundamental Element Program) GSA/GRANT/05/2017-02
- Development and validation of new technologies in prototypes by 2021

orolia

NavCert

NLS FINNISH GEOSPATIAL RESEARCH INSTITUTE FGI

FDC

nlr

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GEARS OBJECTIVES

- OBJ# 1 Improving performances and resilience of Galileo and GNSS Timing receiver:

Key timing accuracy target < 50 ns UTC

High integrity with embedded monitoring using RAIM for example

No calibration needed.

- OBJ# 2 Develop and demonstrate the effectiveness of unique Galileo services to operators
- OBJ# 3 Strengthen market adoption through Standardisation activities

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GNSS AND TIME REFERENCES - AGENDA

SOLUTIONS FOR GNSS AND TIME REFERENCES

NEW GUARD ANTENNA

NEW GALILEO/GPS/GNSS RECEIVER WITH IDM

GEARS CLOCK SAFETY ARCHITECTURE

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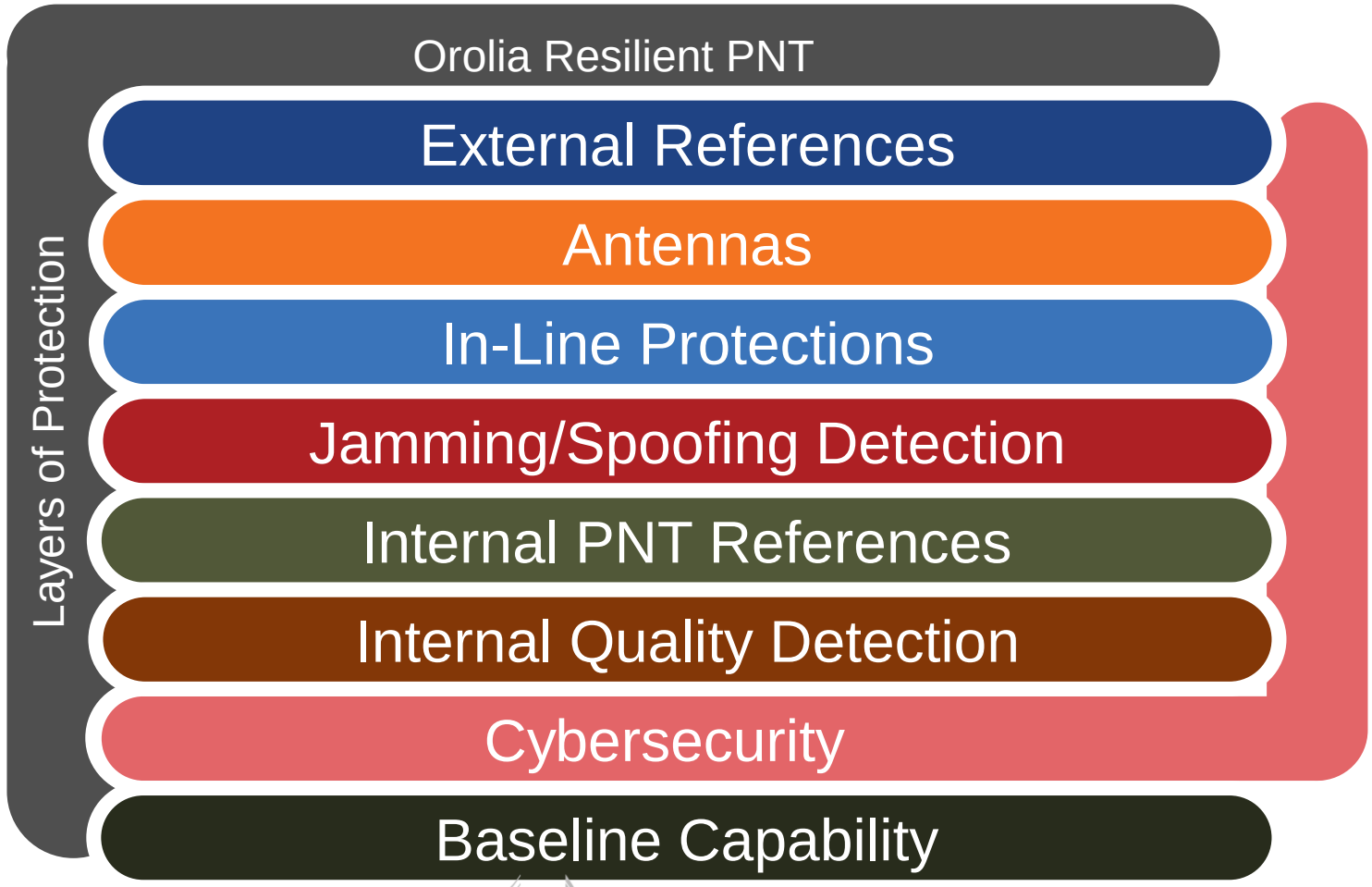
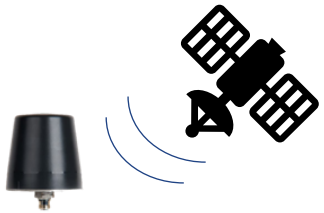
OROLIA LAYERED APPROACH FOR RESILIENT PNT





Signals containing PNT reference info

Prevent bad signals from entering system

Clean jamming from signals

Detect residual jamming/spoofing

Leverage internal PNT information

Detect (residual) anomalies/failures

Prevent cyber attacks through the system

Supporting/transverse technologies

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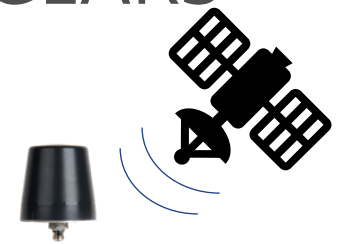
NEW RESILIENT PNT SOLUTIONS WITH GEARS



Orolia Resilient PNT

Layers of Protection

- Galileo/GPS/GNSS
- STL
- 8230
- 8230AJ
- GPSdome
- GUARD
- IDM receiver
- Iono-tropo corrections
- Atomic Clocks
- OSNMA
- IMU
- Resilient GNSS signal processing
- Advanced Safety & Security
- FlexFusion
- Threat Simulation

Strong focus on Galileo signals

Spatial filtering of RFI in up to 3 directions

Digital filtering in frequency domain

Ionos & troposphere corrections

OSNMA for authentication

Detect (residual) anomalies/failures

Provide advanced safety and security

Supporting/transverse technologies

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GEARS: NEW SAFETY AND SECURITY ARCHITECTURE FOR TIMING

GEARS will allow to enhance or create several new elements of safety or security at different layers but with a focus on three new building blocks:

1. GUARD: CRPA technology for RFI suppression specially designed for infrastructures
2. NEW GNSS Receiver with IDM: fully safe and secured Multiple Constellation and Multiple Frequency (MCMF) Galileo and other GNSS receivers with NeQuick correction (when used in single frequency), OSNMA authentication and special IDM capabilities
3. New Secured and Safe Clock: can be used to build a fully redundant timing system with no single point of failure and then high availability.

3D model of the architecture prototypes

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NEW TECHNOLOGY TO PROTECT GALILEO AGAINST JAMMING

Resilience - Radio Frequency Interference (RFI) can seriously degrade time availability from GNSS constellations:

- 4-element Controlled Reception Pattern Antenna (CRPA) with null forming for spatial filtering
- Protect Galileo and other constellations and 3 simultaneous frequency bands
- Protection against up to 3 simultaneous sources of RFI

Integrity – embedded multi-constellation and multi-frequency receivers:

- Supports OSNMA authentication mechanism
- RAIM implementation

Ease of use in critical infrastructures :

- No initial or periodical calibration needed
- Full master/slave PTP to directly sync any network
- Optimized for Orolia clocks but also works with any GNSS receivers
- GNSS signals and data sent over Ethernet network or RF signal
- Power over Ethernet or external 12-24V DC power supply

3D model of the CRPA prototype

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NEW GALILEO/GNSS RECEIVER WITH IDM TECHNOLOGY

Resilience - Radio Frequency Interference (RFI) can seriously degrade time availability from GNSS constellations:

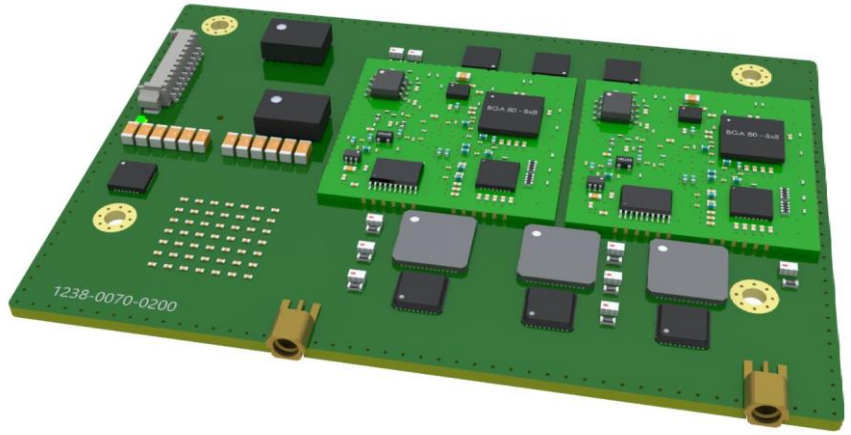
- Digital filtering in frequency domain of most of the RFI before correlation
- Filters the top 5 main types of jamming: Wide Sweep (fast repeat rate), Multiple Narrow band, Triangular, Tick type and CW
- Supports Galileo and other constellations and 3 frequency bands

Integrity – embedded multi-constellation and multi-frequency receivers:

- Dual receivers to use two constellations simultaneously but separately i.e. Galileo and GPS for example
- Supports OSNMA authentication mechanism

Ease of use:

- Can be integrated in Orolia clocks and antennas but can also work with any other applications
- GNSS signals and data sent fully digitalized in high resolution



3D model of the new receiver prototype

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GEARS CLOCK SAFETY ARCHITECTURE

A system can be defined as functionally safe if it always operates correctly and predictability. More importantly, in the event of failures, the system must remain safe for people. A safe system can't break and if it does it can't hurt its users.

- Appliances supporting critical infrastructures must be highly available (typically in the class of 7 nines i.e. available 99.99999% of the time). This practically means 3.2 seconds of downtime on a system running 24/7 during 1 year.
- High availability requires high reliability and redundancy

Redundancy – every Clock critical functions are redundant:

- Dual receivers using two different constellations i.e. Galileo and GPS
- Each receiver using dual frequencies
- Dual redundant power supplies

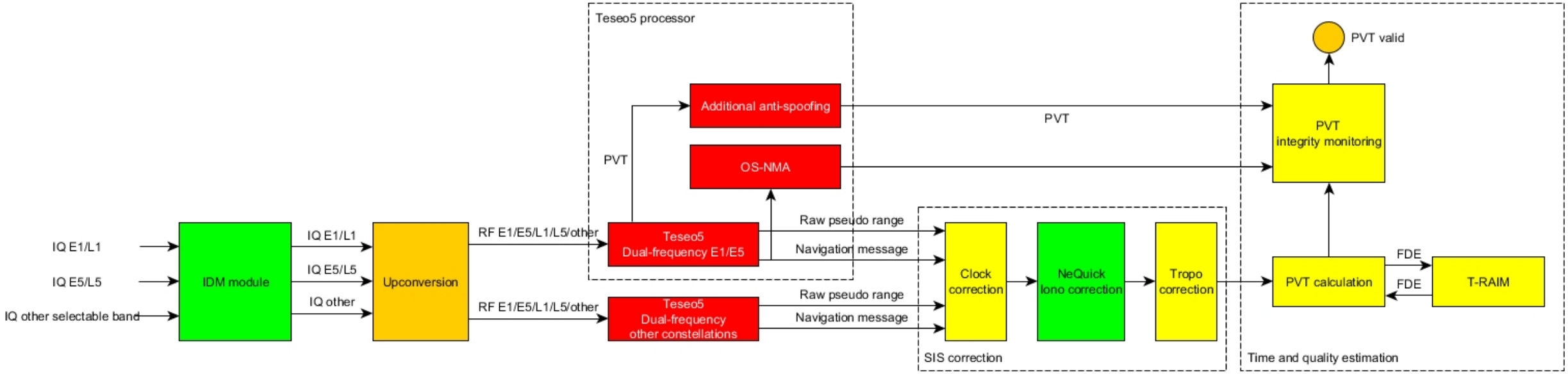
Ease of use of redundant Clocks in critical infrastructures :

- GEARS Clock designed is optimized in C-SWAP (Cost and Size and Power) to easily use two redundant Clocks in a system
- Redundant Clock in hot stand-by mode with automatic fail-safe mode allowing seamless switching.

GEARS CLOCK RESILIENT GNSS TIMING PROCESSING

To ensure functional safety of the timing function a resilient GNSS Timing processing architecture will be implemented in the Clock.

- End-to-End GNSS signal processing with specific modules to ensure resilient timing
- Dual GNSS processing to avoid propagation of constellations system-level failures
- Several clock, ionospheric and troposheric corrections implemented.



GEARS STANDARDIZATION ACTIVITIES

- The GEARS project team has considered different existing standards and organization to push forward a new European Galileo-based standard for critical infrastructures
- Following the two examples of the European Norm (EN) 16803 Series - GNSS Based positioning terminals, CEN/CENELEC And Technical Specifications (TS) 103 246 Series – GNSS Based locations systems, ETSI.
- Part of the project a Technical Specification of a possible standard is under development.