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GNSS Signal Monitoring Systems

Workshop Sistemi, Servizi e Applicazioni spaziali

a sostegno delle grandi infrastrutture nazionali

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INTECS SOLUTIONS

Intecs Solutions was founded in 1974: more than 40 years working in the most technologically advanced fields

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350+ skilled engineers

MARKETS

Railways, Aerospace, Defence, Automotive & Smart System, Traffic Control

CORE COMPETENCE

HW-SW Design & Develop, Development of Hard Real Time Safety Critical System, Independent Verification and Validation, **Software Defined Radio**, **GNSS**, Automatic Test Equipment, Artificial Intelligence

Intecs experinces in GNSS signal analysis

- **SoftRec:** Galileo Test Range (SDR approach), (2004-2010)
- **G-Lab**: Galileo monitoring station (2009-2014)
- **G-PASSION**: Galileo Signal Authentication (2018-2020)
  - ***ASI/ESA*** *NAVISP element 2*
- **GIASONE**: GNSS Integrity and Authentication Services user-Oriented Network (2020-ongoing)
  - ***ASI/ESA*** *NAVISP element 2*

SoftRec	G-Lab	G-PASSION	GIASONE
2004	2009	2014	2020
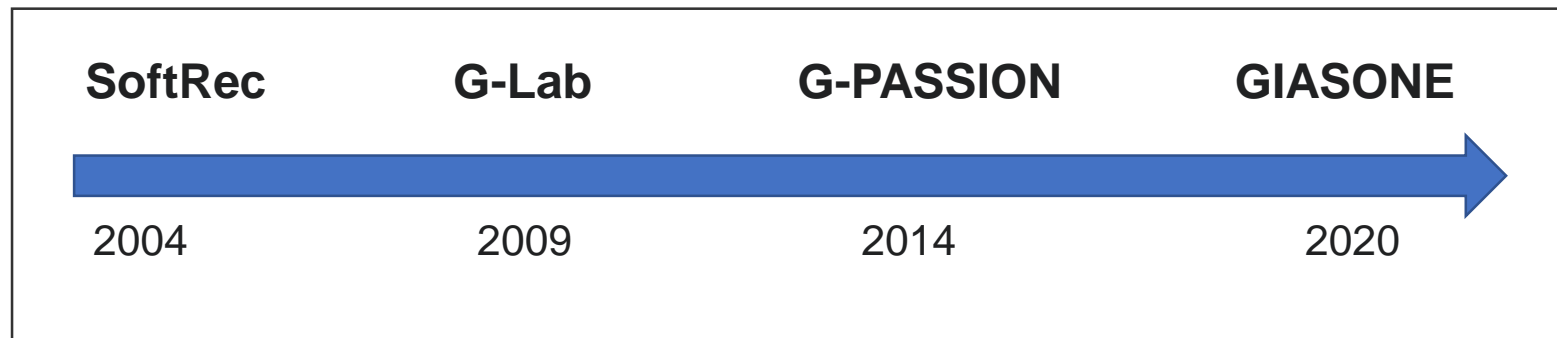
The low strength of GNSS signals at receivers makes them particularly vulnerable to electromagnetic interference.
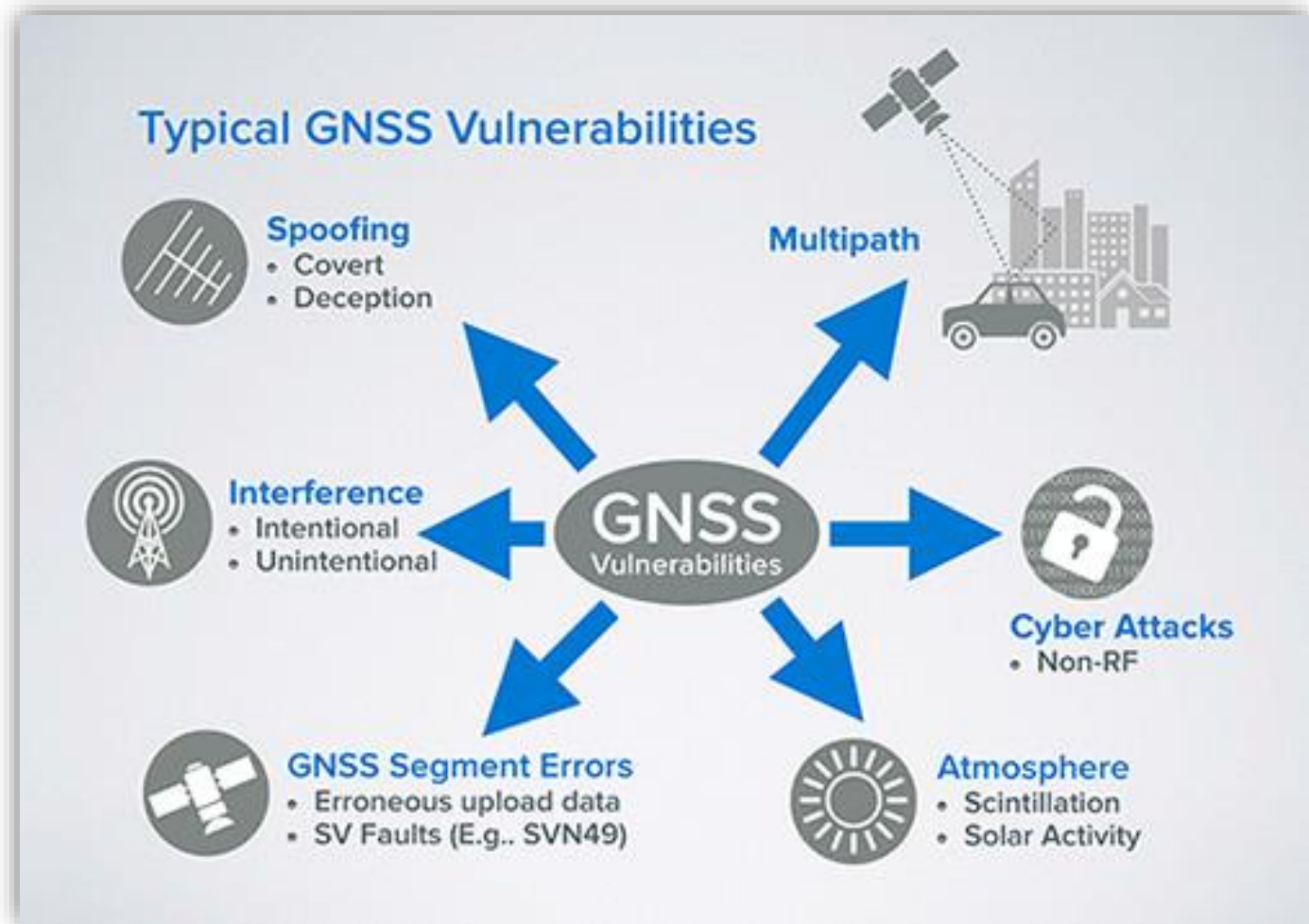
GNSS **I**ntegrity and **A**uthentication **S**ervices user-**O**riented **Ne**twork (*)

Nowadays **GNSS is widely used in almost all domains**, such as, *air-navigation*, *railways*, *maritime*, *automotive*, *precision farming*, *unmanned systems*, *time-&-synch.*, etc. It is, therefore, **essential to safeguard its integrity**(**) in order to avoid undesired or, worst, dangerous events.

(**) **Integrity** *is the measure of the trust that can be placed in the correctness of the information supplied by a navigation system. Integrity includes the ability of the system to provide timely warnings to users when the system should not be used for navigation.*
Source Navipedia

(*) GIASONE is an ASI/ESA NAVISP funded project

This scenario leads us to propose a **GNSS integrity monitoring infrastructure** able to provide a **wide set of services to the user segment in order to safeguard its operational status when using GNSS**.

Such a solution can be considered the *enabling technology* to open the way **towards a more pervasive usage of GNSS** in those sectors (such as, railways, autonomous vehicles, etc.) where its presence is still secondary or considered still not applicable.

GIASONE aims to be an **integrated GNSS monitoring and authentication system providing services for safety-critical** applications where **authentication and integrity** are required. It will provide the **users** with a **wide set of services supporting the GNSS safe navigation**.

GIASONE Services

Envisaged GIASONE Services

- Local and regional continuous real-time monitoring of GNSS Status (Galileo, GPS), including integrity monitoring with timely warnings (pseudorange residuals, cycle slip detection, CMC, doppler vs pseudorange rate, etc..)
- RFI detection, classification and localization
- Authentication service
- Recording capabilities, raw data storage for post-accident investigations
- Performance assessment
- Periodic bulletin emission

Markets

- Railways
- Air-navigation
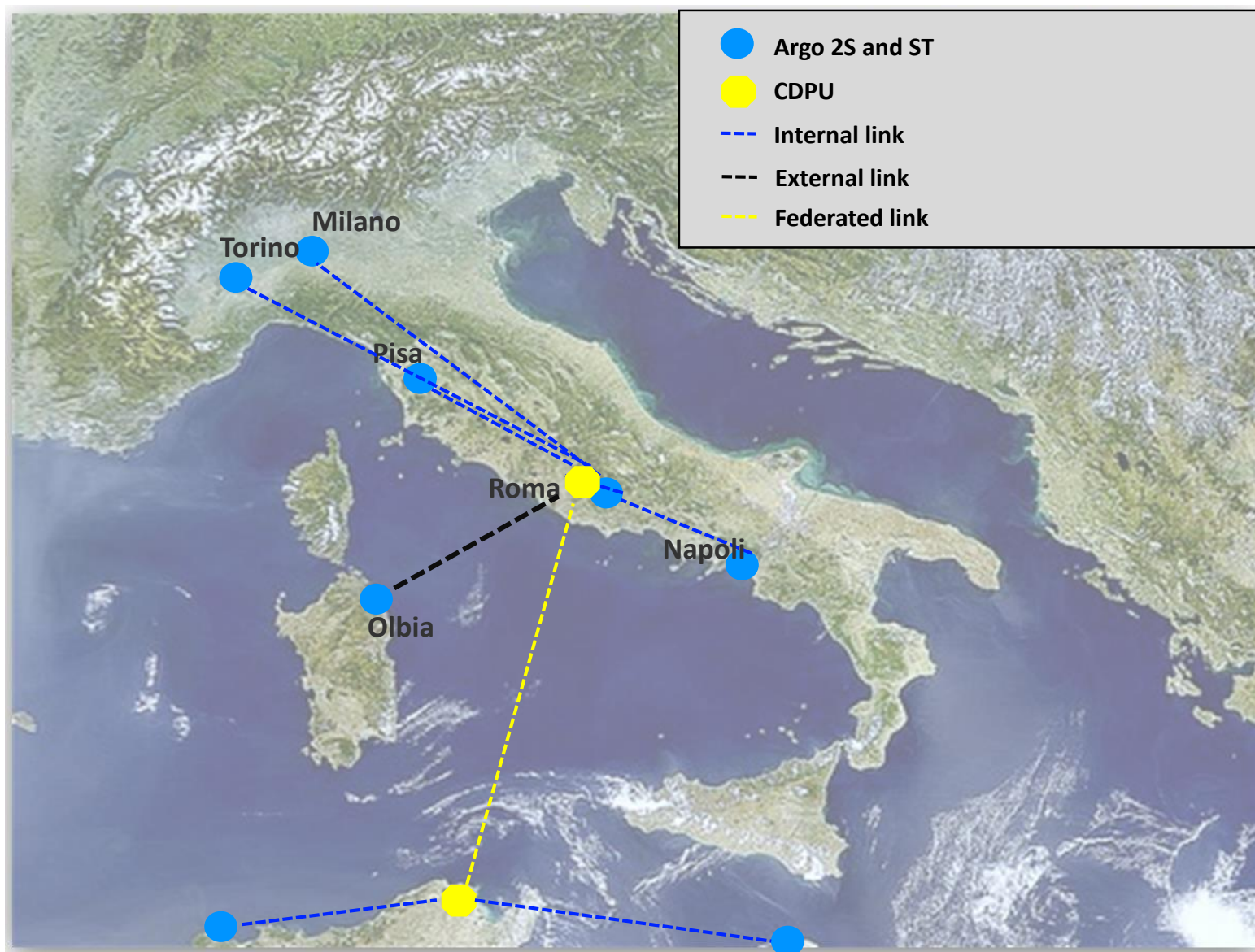- Maritime
- Automotive
- Mass-market

GIASONE services reaches all users

- Transportations (Constructor, Infrastructure Operators, Authorities)

- Location Based Services providers (travel information, roadside assistance, mobile workforce management, fraud prevention, proximity-based marketing, etc.)

- GNSS-oriented mass-market (unmanned sys., R&D, surveying and mapping, amateurs, etc.)
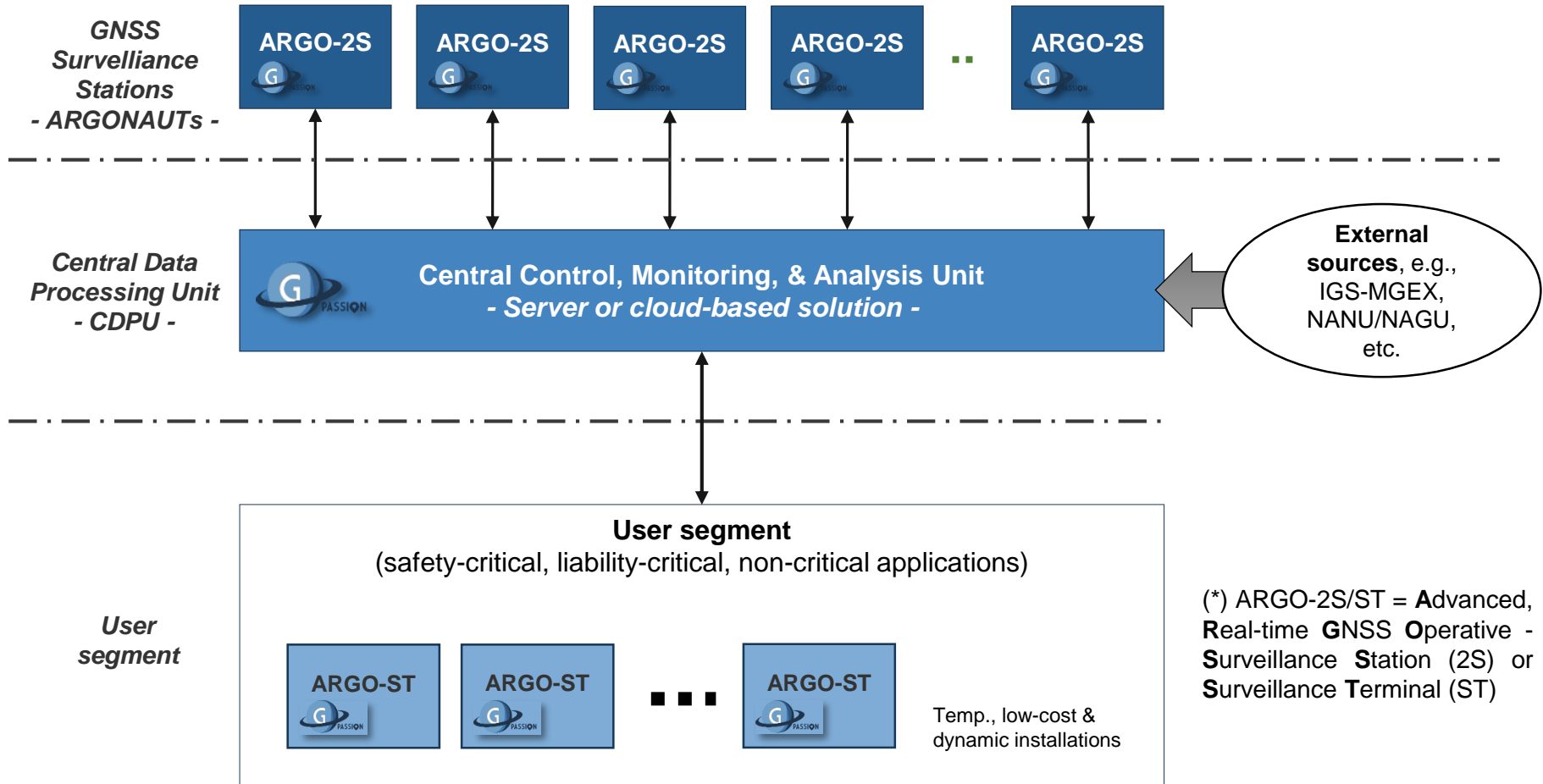
Three main components

- ## Surveillance Segment:
  - ### ARGO 2S: **A**dvanced, **R**eal-time **G**NSS **O**perative **S**urveillance **S**tation **S**egment), a GNSS surveillance station addressed to monitor the integrity of OS positioning services. snapshots used to authenticate satellite positioning services
  - ### ARGO ST: *Advanced, Real-time GNSS Operative Surveillance Terminal,* able to provide the user with a **private mobile service** (e.g. RFI detection or authentication service) with reduced performance compared to the ARGO-2S.

- ## CDPU: **C**entral **D**ata **P**rocessing **U**nit, the central unit addressed to gather data, provided by the surveillance segment, process them and provides services to the user segment, such as, bulletins on GNSS status, OS authentication, periodic performance assessment, real-time monitoring, etc. Different CDPU can be integrated or federated.

Scalable Architecture

System functional architecture

GNSS Survelliance Stations - ARGONAUTs -

ARGO-2S   ARGO-2S   ARGO-2S   ARGO-2S   ..   ARGO-2S

Central Data Processing Unit - CDPU -

Central Control, Monitoring, & Analysis Unit
- Server or cloud-based solution -

External sources, e.g., IGS-MGEX, NANU/NAGU, etc.

User segment

User segment
(safety-critical, liability-critical, non-critical applications)

ARGO-ST   ARGO-ST   ...   ARGO-ST

Temp., low-cost & dynamic installations

(*) ARGO-2S/ST = **A**dvanced, **R**eal-time **G**NSS **O**perative - **S**urveillance **S**tation (2S) or **S**urveillance **T**erminal (ST)

GIASONE is a fully-scalable, flexible, GNSS monitoring infrastructure

Site of interest
Local surveillance with ARGO-2S

Site of interest
Local surveillance with ARGO-2S

LTE/5G

**Central Data-Processing Unit (CDPU)
Data post-processing**

Site of interest
Local surveillance with ARGO-2S

Regional monitoring services from CDPU
- Performance assessment
- Periodic bulletins
- Download data
- GNSS status info

Local service with ARGO-ST
- Real-time monitoring
- RFI detection
- Authentication serv.
- Data storage

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SYSTEM ENGINEERING
SOFTWARE DEVELOPMENT
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Thank you for your attention

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