The GALILEA Project: new ideas on added value real/near real time GNSS services from regional networks.

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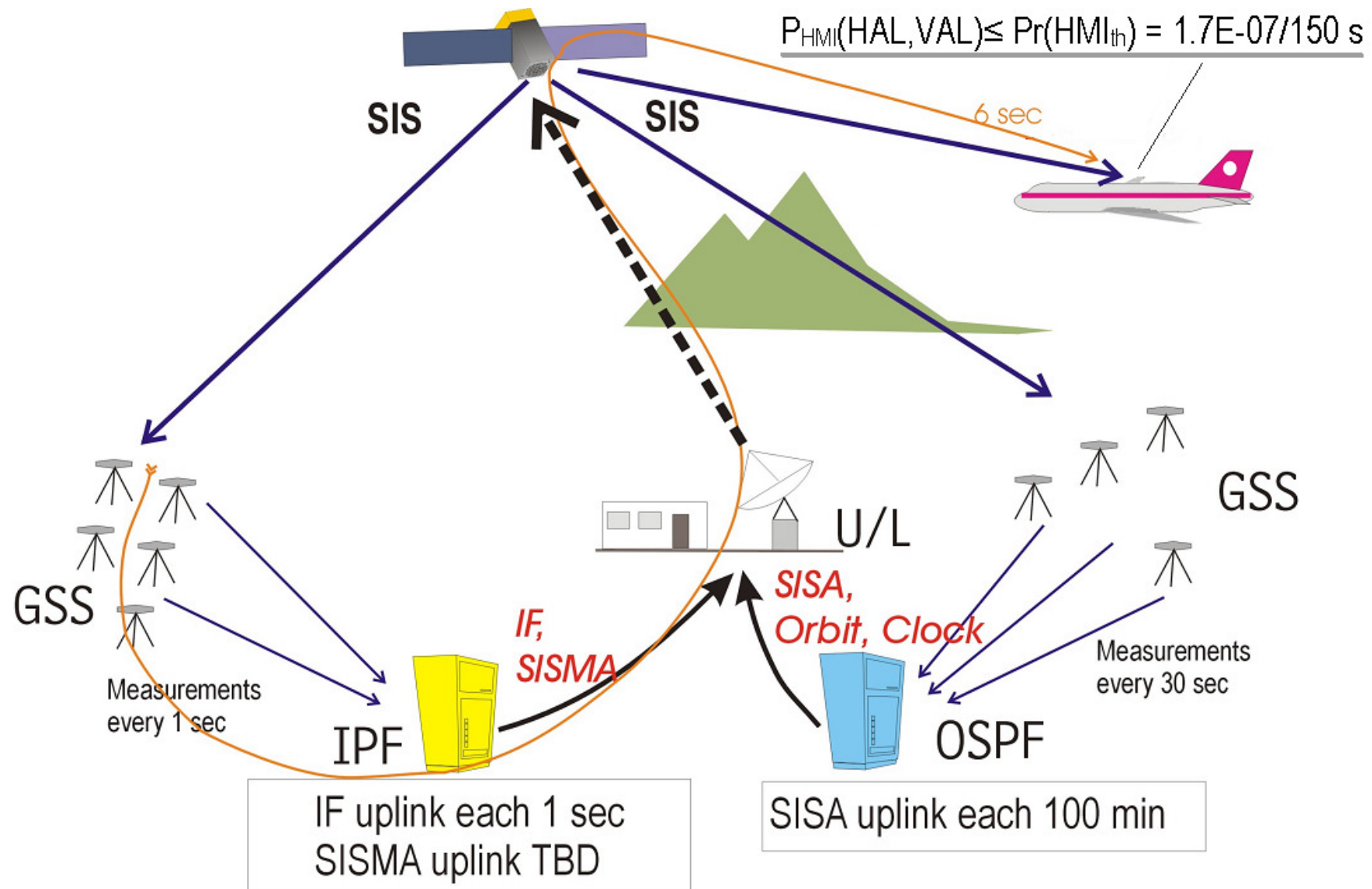Budapest University of Technology and Economics
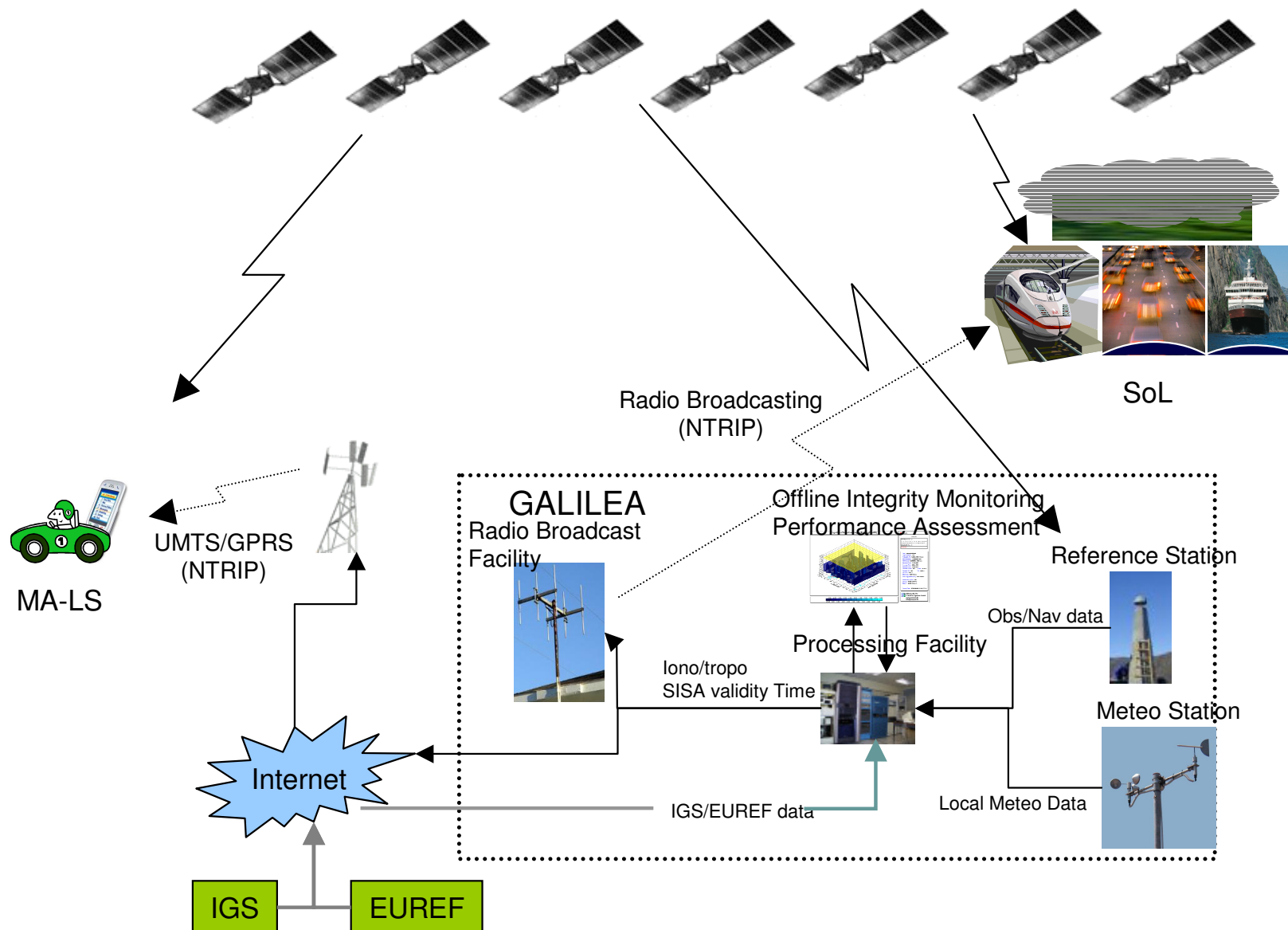
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European GNSS Supervisory Authority

The GALILEA project

- The Galileo Call 2423, "Innovation by SME", solicited the Development of the Galileo Local Integrity Concept and Local Augmentations.

- The GALILEA (Galileo Local Elements Augmentation) project focuses on new methods and algorithms to locally predict, monitor and possibly improve in near real time the service performance. Specifically, it deals with:
  - SISE prediction
  - User position dependent iono/tropo corrections
  - Integrity monitoring
  - Data transmission

# GALILEO Global Integrity Risk Concept

$$P_{HMI}(HAL, VAL) \leq Pr(HMI_{th}) = 1.7E\text{-}07/150\ s$$

SIS

SIS

6 sec

GSS

GSS

Measurements every 30 sec

U/L

SISA, Orbit, Clock

IF, SISMA

Measurements every 1 sec

IPF

OSPF

IF uplink each 1 sec
SISMA uplink TBD

SISA uplink each 100 min

GALILEA: local element as a provider of a full range of improvements: SIS, early IF warning, tropo/iono, broadcast, offline integrity monitoring

➤ *Objective:*

GSA

Sat position
from IGS
$(x_{IGS}, y_{IGS}, z_{IGS})$

Δr

Sat position from
navigation message
$(x_{NAV}, y_{NAV}, z_{NAV})$

Earth

Reference
Station
(x_s, y_s, z_s)

The task of the IGS module is the comparison between the IGS ephemeris (sp3 files) and the navigation data in order to compute the Orbital and Clock Error (OCE) as an index of the Signal In Space Error (SISE)
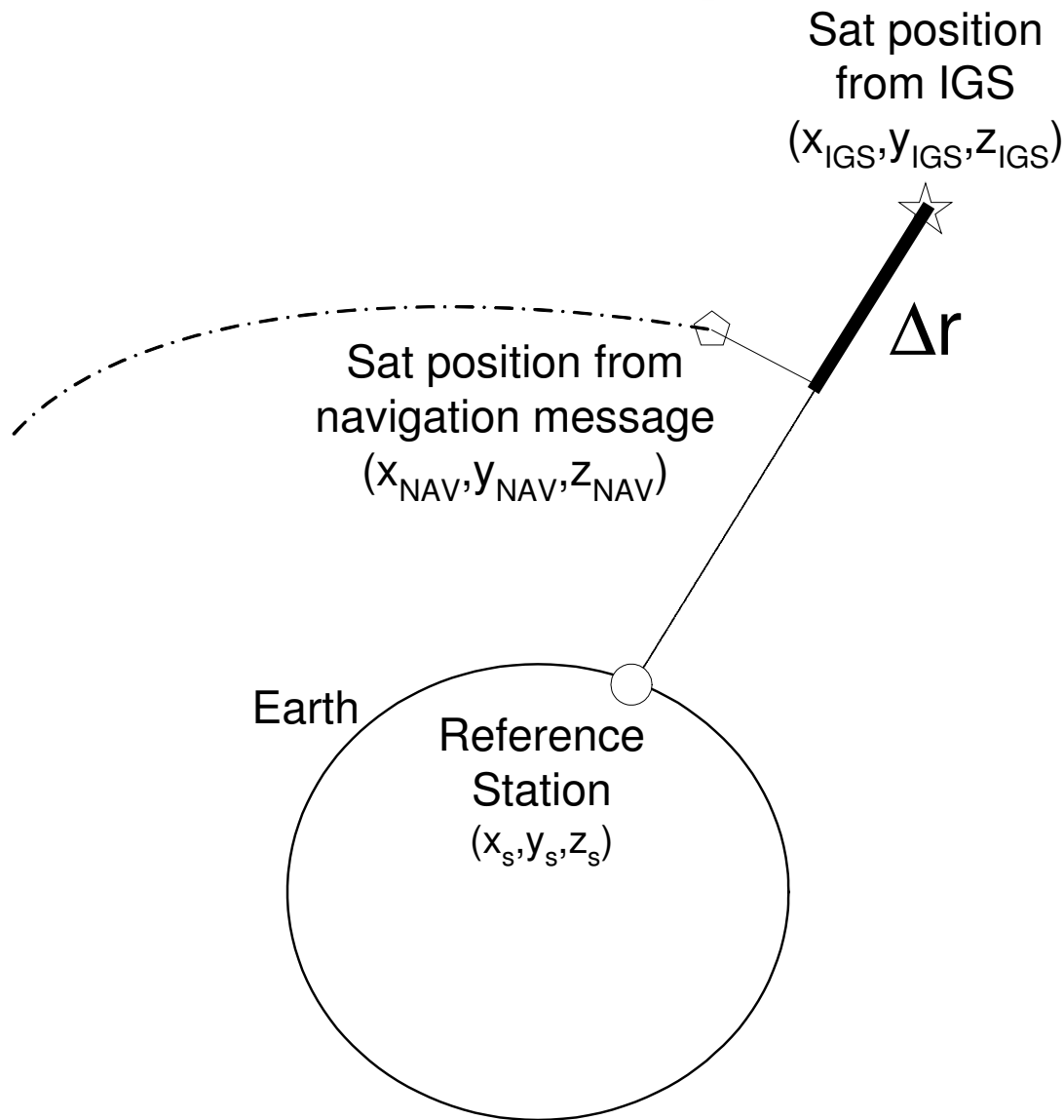
➤ *Objective:*

OCE, SV1
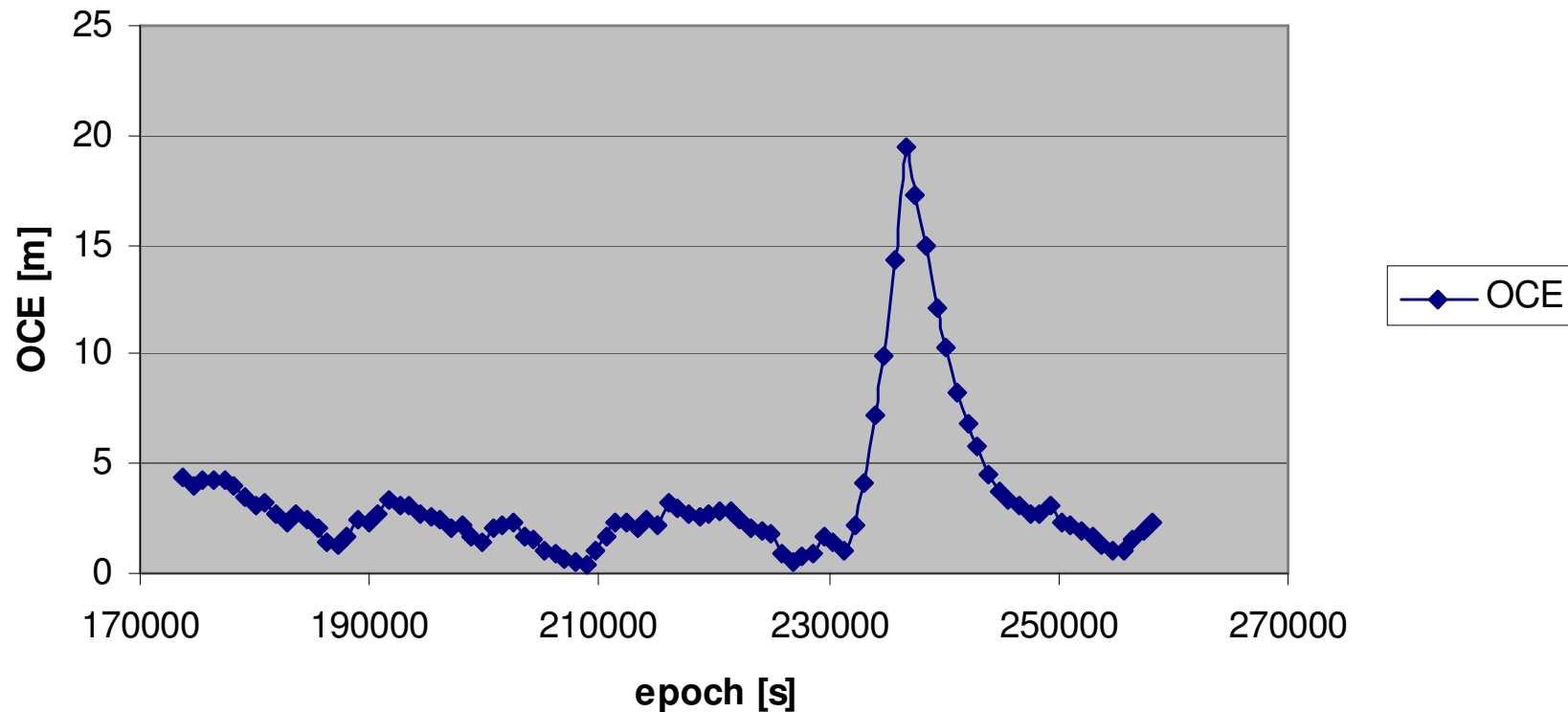
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Error (SISE)
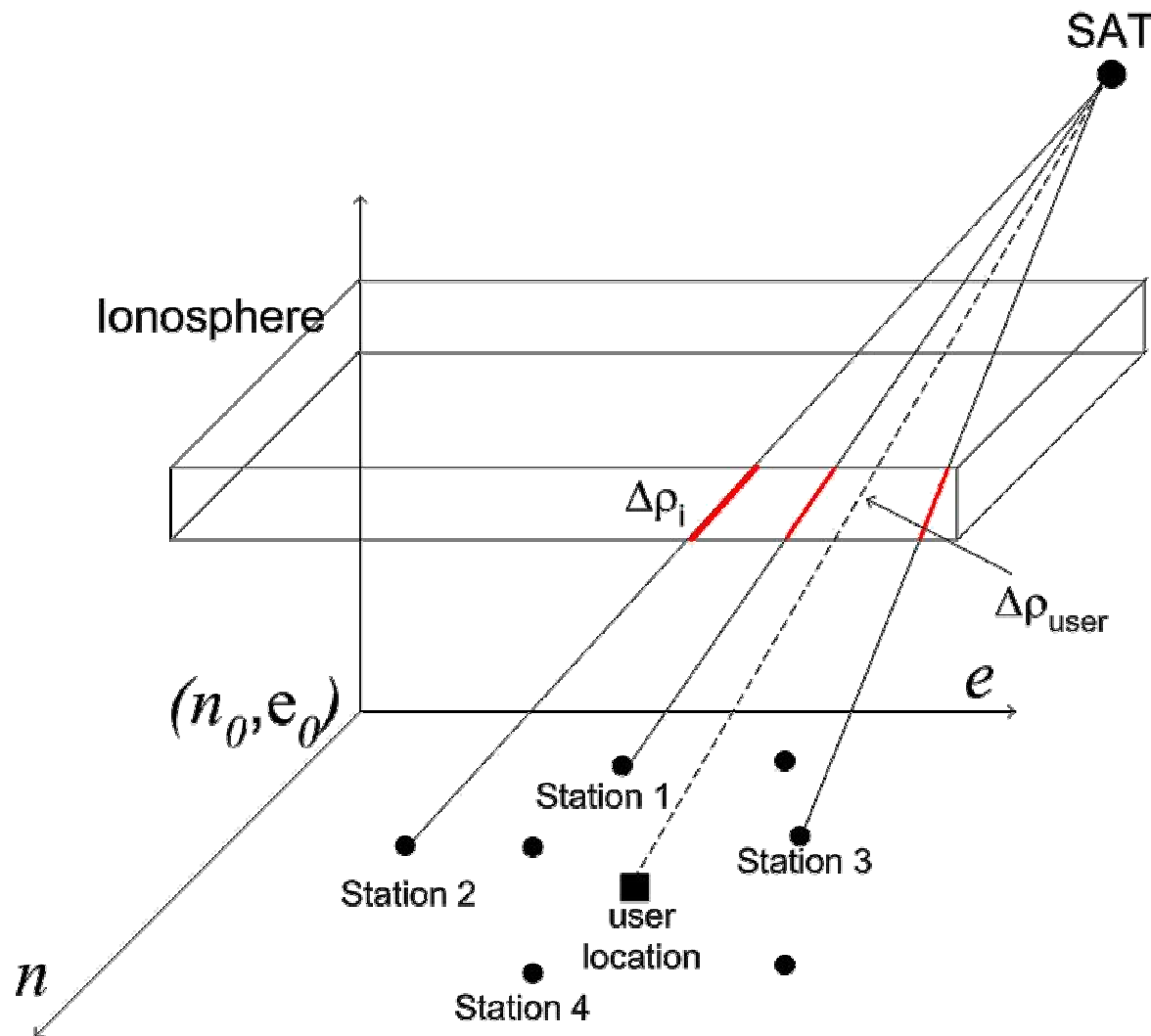
- ➢ merging of different satellites data to compute the iono/tropo coefficients

- ➢ interpolation of zenith delays to grid nodes or to a location nearest to the user

- ➢ Pack into a message and broadcast via Ntrip

NTRIP v2 Caster for GALILEA

- ■ *Sourcetable, meta data*

GALILEA SISE & Tropo Dissemination

- **Client Access, SISE & Tropo Meta Data**

Validation with real data

GNSS and Meteo stations
available for the Validation Campaign

KECS ● GPS Reference Station

Jászapáti △ Meteo Station

PENC △ GPS Reference Station
with on-site meteo station

0   50 km

Validation with real data

Acquisition of Meteo Data

Max. diff. 7 hPa

ca. 14 mm in tropo delay

➢ *Iono/tropo grid:*
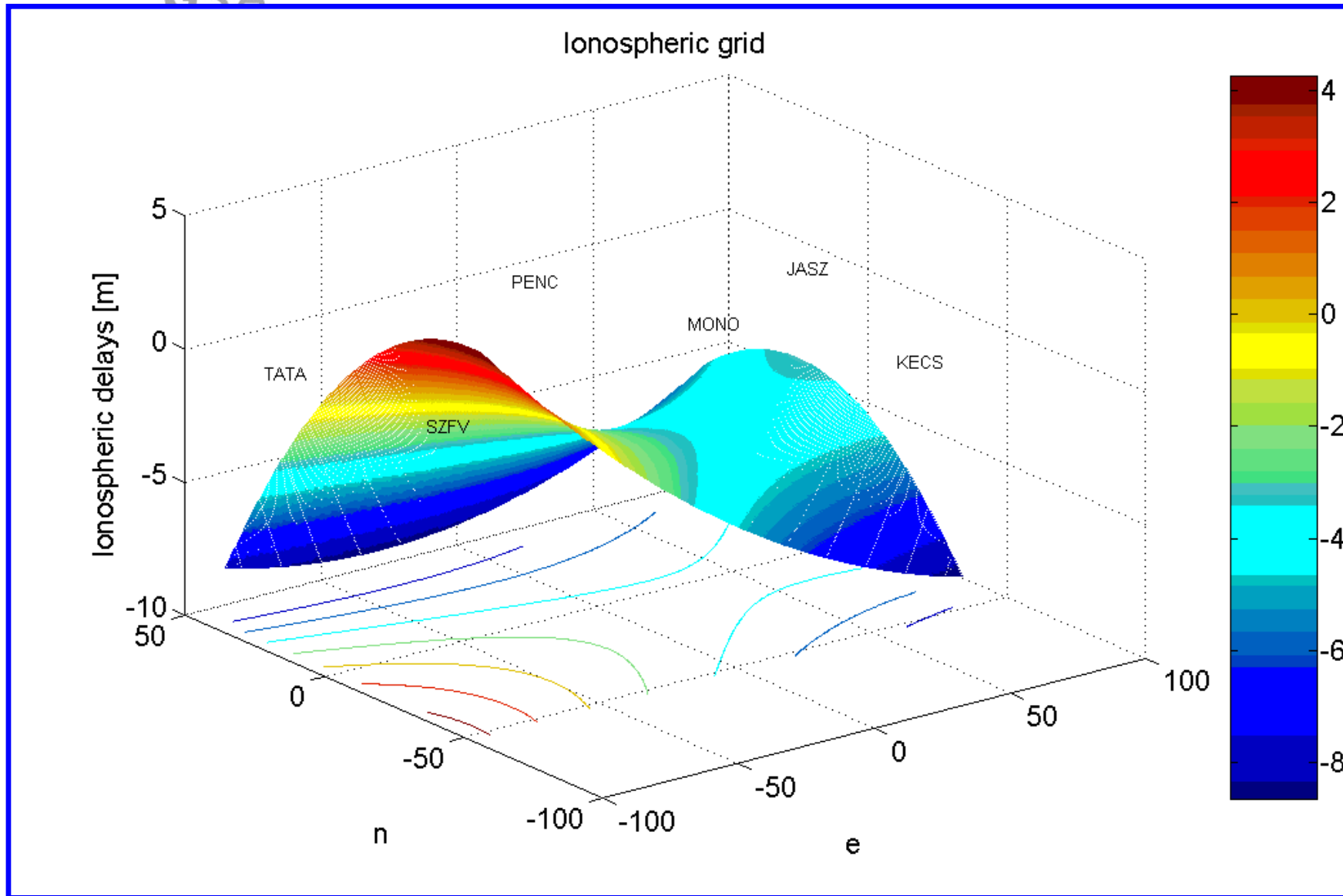
➢ *Iono/tropo grid:*

Ionospheric grid
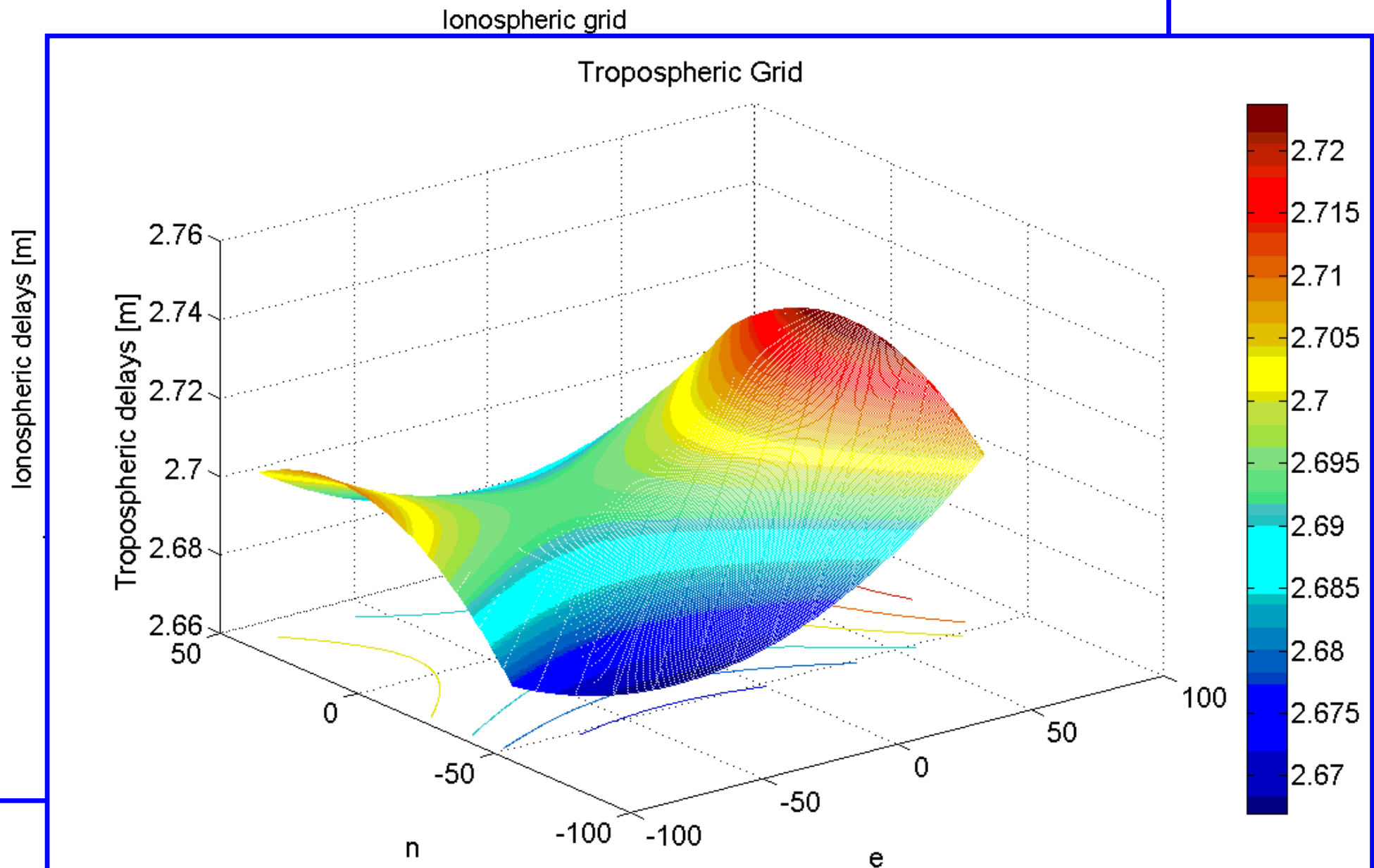
Study Objective: GALILEA Integrity Monitoring Module (IMM) Offline Performance Assessment

The Integrity Risk (IR) and/or the User Protection Level (xPL) are computed. The IR and xPL are then compared with the envisaged service levels.
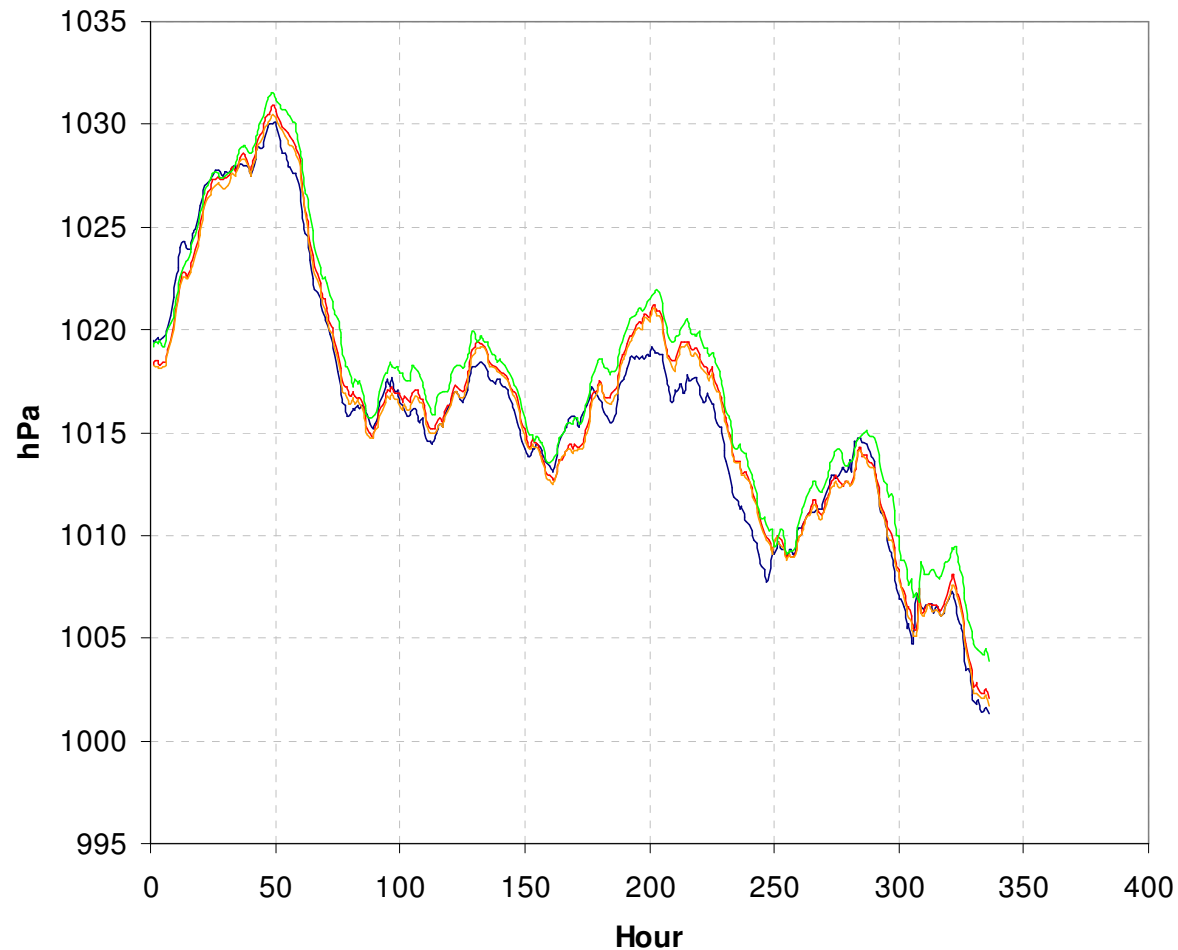
SoL

Radio Broadcasting
(NTRIP)

MA-LS

UMTS/GPRS
(NTRIP)

GALILEA
Radio Broadcast
Facility

Offline Integrity Monitoring
Performance Assessment

Reference Station

Obs/Nav data

Processing Facility

Iono/tropo
SISA validity Time

Meteo Station

Internet

IGS/EUREF data

Local Meteo Data

IGS

EUREF

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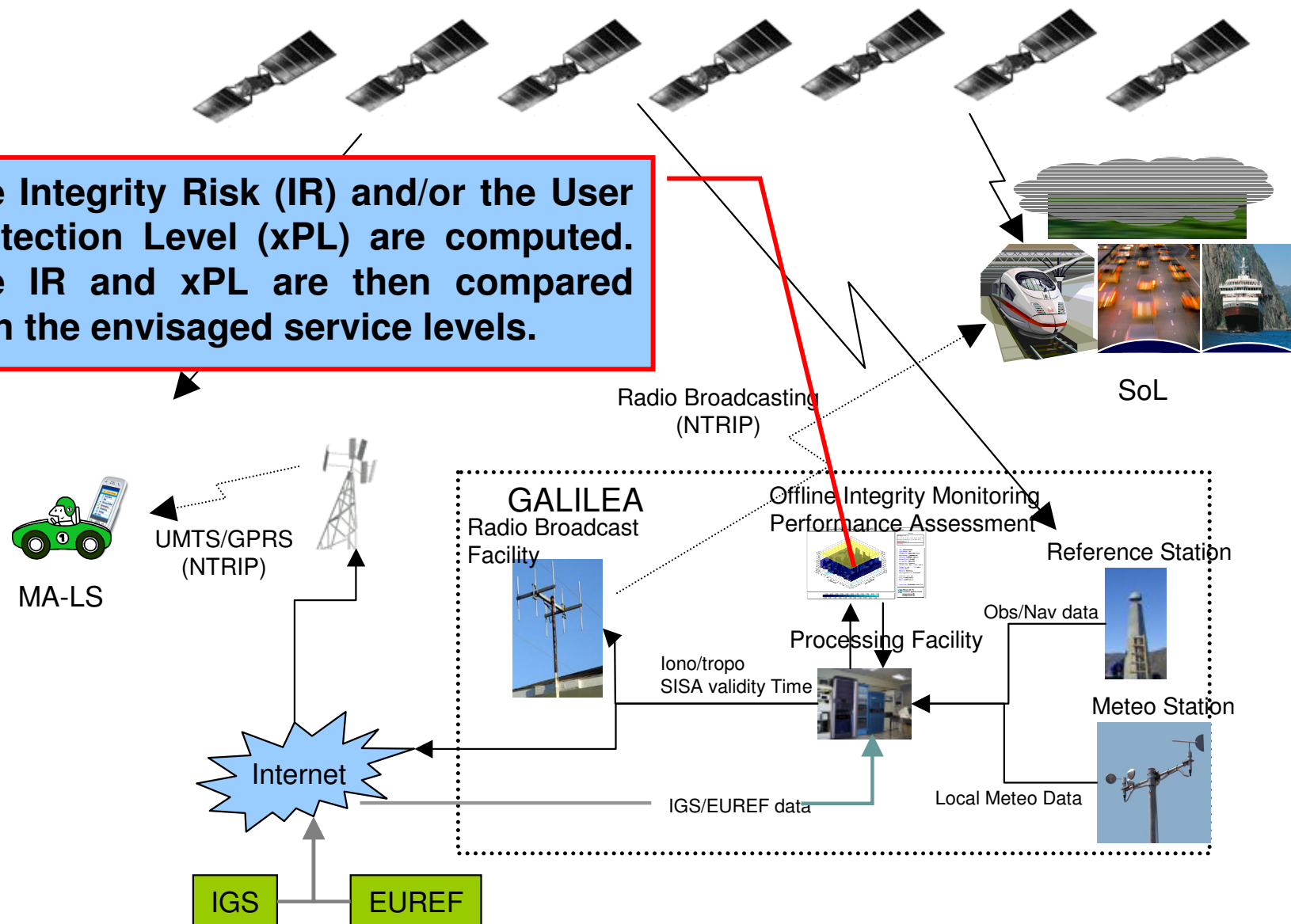
EPCM - Conclusions

- The merge of global (IGS orbital and clock predictions) and local (observations) data in a single integrity information (SISE prediction) has proved to be a feasible concept.

- The interpolation of the iono/tropo corrections in the local area has shown the capability to improve the user position accuracy.

- Local Galileo adapted GBAS-like Concept does achieve CAT-I requirements with good Margin and has a high Potential to reach good CAT-II/III Integrity Monitoring performance. Availability could still be insufficient considering Critical Satellites and Degraded Modes.

- Real-time dissemination of GALILEA results SISE & Tropo up and running

- Work on new standard for real-time dissemination of SISE, Tropo etc.

- ToDo: Develop GALILEA software tools towards real-time capability