

EUROPEAN
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#EUSpaceWeek

ONLINE EDITION

Infrastructure Panel

User Consultation Platform #3

Valeria Catalano - GSA

Christophe Taillandier – FDC

Michal Babacek - GSA

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European
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User Consultation Platform#3

The User Consultation Platform (UCP) is a *space* where users meet to discuss their needs for applications relying on Location, Navigation, Timing, Earth Observation, and Secure Telecommunications. New entry for the 2020 edition, the UCP will include other Copernicus users and *GOVSATCOM* users in addition to the classic EGNSS ones.

Agenda

9:00 – 9:20	Welcome and introduction
9:20 – 9:40	Galileo differentiators: Authentication and Governmental Authorized Applications Jean Pierre Barboux, Valeria Catalano, GSA
09:40– 10:40	New Development in T&S GEARS Receiver for Critical Infrastructure Gilles Boime, Orolia GIANO Receiver for Critical Infrastructure Livio Marradi, Thales Alenia Space Italia ROOT project: Secure Synchronisation Requirements for Telecom Networks Ivan De Francesca, Telefonica UTC via GNSS as a time source for telecommunication systems Helmut Fabian, A1 Telekom Austria
10:40 – 11:10	Update of User Requirements - Session 1 Discussion on User Needs and Requirements moderated by Christophe Taillandier, FDC
11:10 – 11:30	Break

Agenda

11:30 – 12:30

Update of User Requirements - Session 2

User requirements for new Timing and Synchronisation functions: integrity, trusted time distribution, certified time steering and robust accurate time

Description and discussion on requirements and possible impacts in case of functions disruption moderated by **Valeria Catalano** (GSA)

12:30 – 12:45

Synergies with Copernicus

Copernicus data and products

Cristina Ananasso, European Commission

AMPERE: electrical asset mapping in emerging countries worldwide using Galileo and Copernicus

Marco Nisi, Sistematica

12:45 – 13:00

Final Q&A

How to interact, discuss and vote?



Join on sli.do
#1493

We will ask sli.do to:

- Gather your questions during the presentation
- Get your answer to polls



Slido best practices

- Indicate your name and company when asking a question
- Like the questions for improved visibility



Galileo differentiators

- Authentication
- Governmental Authorized Applications

Galileo Authentication

Open Service Authentication (OSNMA)

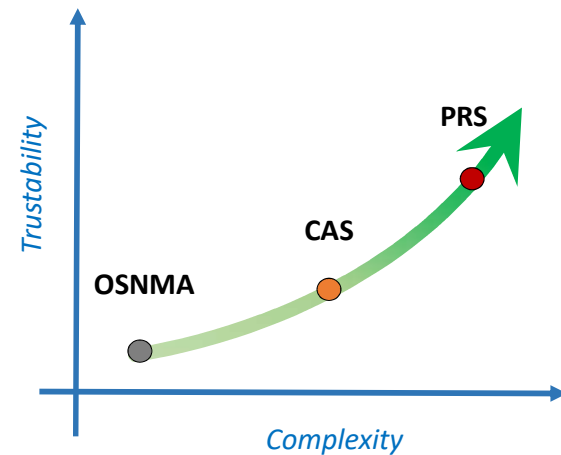
- provides Navigation Message Authentication, which allows the computation of a user's position using authenticated data extracted from the navigation message.

Commercial Authentication Service (CAS)

- complements the OS, providing controlled access and signals authentication (by signal pilot component) function to users.

Public Regulated Service (PRS)

- provides the highest level of service continuity and authentication (on signal and message). In cases of malicious interference, PRS increases the likelihood of continuous availability of the Signal-in-Space (robustness).
- implements Governmental access control.



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Open Service Navigation Message Authentication

User Consultation Platform 2020

Jean Pierre Barboux

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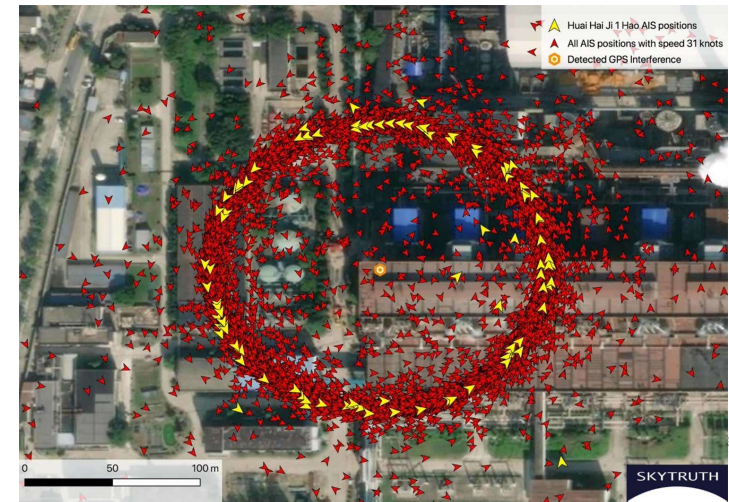
Why is Authentication needed?

GNSS is known to be vulnerable to jamming and spoofing

- Service disruption or denial incidents are more and more frequently observed
- Potentially severe consequences, especially for safety or liability critical applications

The role of authentication is to *detect* spoofing events

- Thus to avoid or mitigate their consequences



Source: GPS World

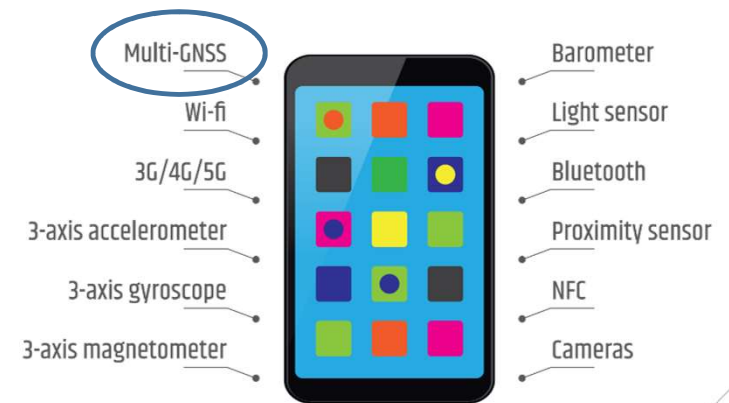
[Chinese GPS spoofing circles could hide Iran oil shipments](#)

GNSS Authentication

GNSS authentication is one important contributor to the overall trustworthiness of PVT based applications. → Not the only one!

GNSS authentication can be done at two complementary levels:

- **Data level**, to authenticate the broadcast navigation messages;
- **Range level**, to authenticate the measured ranges to the satellites;



Combining the 2 allows authentication of the GNSS solution

What is OS-NMA and how does it work?

OS-NMA is a **data authentication** function

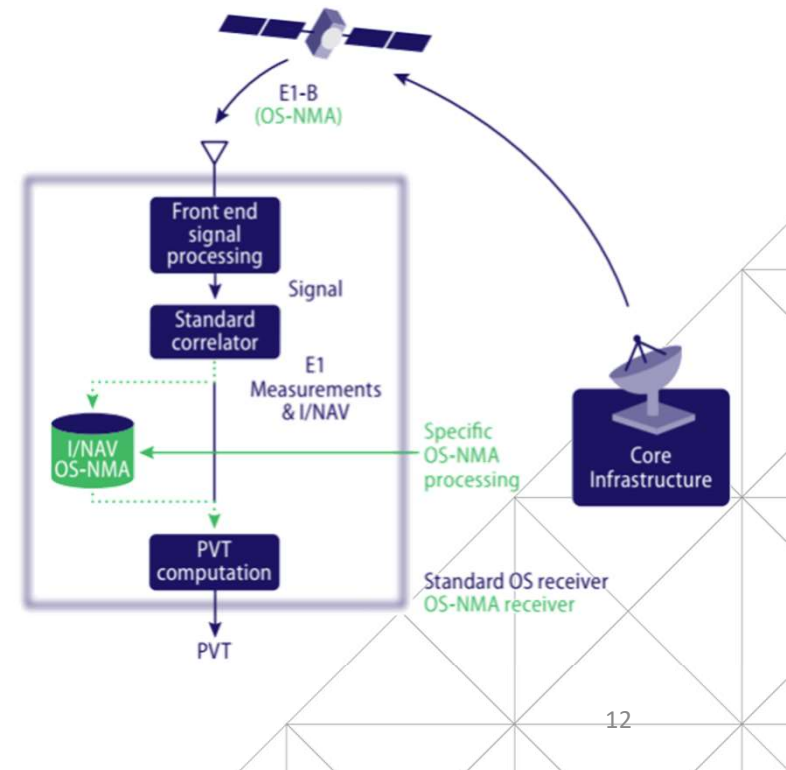
- Worldwide, Free of charge, with no impact on OS performance or on existing receivers (backward compatible).

Based on transmission of cryptographic material in previously reserved fields on the I/NAV message on the E1B signal component

- Only OS-NMA ready receivers can decode these fields and authenticate the Galileo navigation data

Technical requirements

- (i) Continuous E1B tracking
- (ii) Availability of a trustable knowledge of time
- (iii) Capability to store and ensure the integrity of a public key



OS-NMA characteristics

Characteristic	OS-NMA
GNSS receiver minimal capabilities	Single frequency E1
Object of authentication	Nav Data (E1B I/Nav and E5b I/Nav, capability for E5a F/Nav if required)
Required components	E1B
Need of a network connection	No
Authentication	Clock & Ephemeris Data (CED), Delayed
Time to first Authentication	One to several minutes
Anti-tampering characteristic for receiver	Not needed: the receiver only stores a public key
Other requirements	Loose time synchronisation

OS-NMA Roadmap



PUBLIC NOTE	OS-NMA INFO NOTE v1.0	OS-NMA INFO NOTE v1.1	OS-NMA INFO NOTE v2.0
TECHNICAL BASELINE	USER ICD, RX GUIDELINES FOR PUBLIC TESTING –AS DESIGNED	USER ICD, RX GUIDELINES FOR PUBLIC TESTING PUBLISHED	OS-NMA USER ICD, Rx GUIDELINES, SERVICE DEFINITION PUBLISHED
OBJECTIVE	SYSTEM READINESS OPERATIONS READINESS	(I) USERS FEEDBACKS (II) SUPPORT MARKET AND PRODUCTS DEVELOPMENT (III) FINE TUNING (UPSTREAM AND DOWNSTREAM)	BENEFIT FOR USERS AND SOCIETY

Any questions?

For service related information

www.gsc-europa.eu

For market related aspects

MARKET@gsa.europa.eu

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Governmental Authorized Applications

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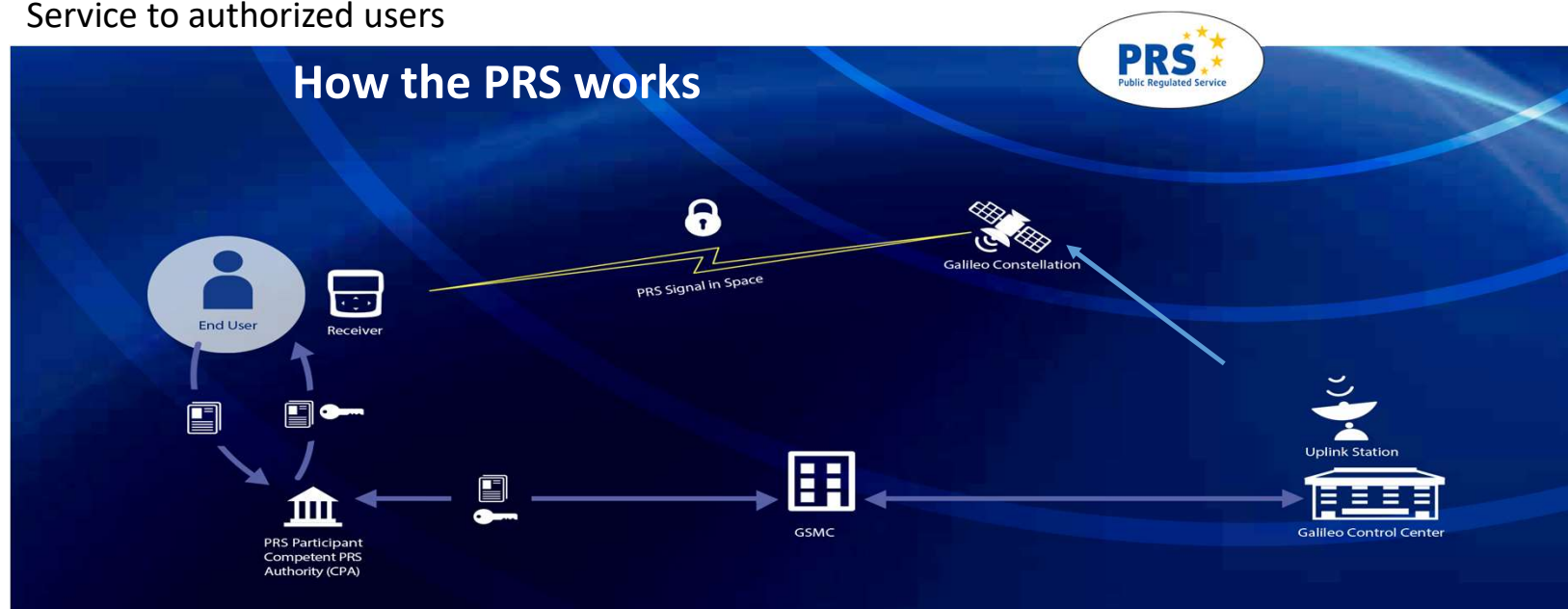
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How PRS works

Active contribution from different stakeholders involved in PRS is required to ensure delivery of the Service to authorized users



The Galileo Security Monitoring Centre (GSMC), monitors and takes action regarding security threats, security alerts and the operational status of the Galileo system's components.

Trustable applications in Timing & synchronisation

Trustable Applications provide increased performance compared with standard positioning service, in the aspect of guaranteed continuity and reliable position and timing information (according to the Galileo Service SDD), are required to strengthen the strategic and critical systems of the society (e.g. *financial transactions, telecommunication or energy infrastructure*). The applications are accessible upon prior authorization by the relevant authority and, depending on User Requirements, could be served by any of the Galileo services that provide Authentication (OSNMA, CAS or PRS).

OSNMA

CAS

PRS

Possible areas of applications

- Telecommunications and energy networks for synchronisation
 - Protection of critical infrastructure against blackout (e.g. power grids etc.)
 - Estimated cost of two days' outage (California, 2019) is ~ €2.1bn (\$2.5bn)
- Financial transactions requiring timestamping
 - Non-cash payments in the euro area totalled €162.1 trillion in 2019.



T&S questions

Based on your knowledge and publicly reported incidents related to timing and synchronization infrastructure:

1. In addition to previous presented applications are other applications which require increased level of trustability?
2. Are you carrying out any current/future initiatives in this field?

New Development in T&S

- **GEARS Receiver for Critical Infrastructure**
Gilles Boime, Orolia
- **GIANO Receiver for Critical Infrastructure**
Livio Marradi, Thales Alenia Space Italia
- **ROOT project: Secure Synchronisation Requirements for Telecom Networks**
Ivan De Francesca, Telefonica
- **UTC via GNSS as a time source for telecommunication systems**
Helmut Fabian, A1 Telekom Austria

Together we defined the EGNSS downstream funding priorities

You spoke, we listened!

User Consultation Platforms, public consultation with the Member States, public consultation with industry and academia, GSA's Administrative Board Workshops



White paper on EGNSS downstream funding priorities and funding tools for the years 2021-2027:

- ✓ Opportunities and needs after 2020;
- ✓ Galileo market uptake through Horizon Europe;
- ✓ Innovation procurement for public sector, space-based entrepreneurship;
- ✓ Key recommendations.

<https://www.gsa.europa.eu/european-gnss-downstream-research-innovation-priorities-and-consultation-results-0>



Your feedback is crucial for shaping the future of EGNSS R&D



- What are the emerging EGNSS applications that are using synergies with Copernicus?
- What financing tools could be used to support further market uptake of applications in your market segment? (e.g. Grants, Innovation procurement, acceleration)
- What large implementation projects are emerging in your market segment?

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User Requirements for New Timing and Synchronisation functions

User Consultation Platform #3

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Objectives of this session

- Short description of the T&S function and discussion on requirements
- Analysis of the impacts in case of functions disruption



New T&S functions leveraging the outcomes of R&D projects

T&S functions	Description	TLC	Power grids	Finance	Labs
1. Time integrity	Validation and performance assessment of the timing information disseminated by the Galileo System	✓✓	✓✓	✓✓	✓✓
2. Trusted time distribution and remote audit	Dissemination of UTC time and frequency over Internet using NTP (or PTP) and remote assessment of the client clock synchronisation by providing audits and report	✓	✓	✓✓	✓
3. Certified Time steering and monitoring	Certified synchronization of the user clock with respect to the reference time	✓	✓✓	✓✓	✓
4. Robust accurate time	Robust synchronization of a network of remote atomic oscillators against GNSS signals and system failures and/or attacks like jamming or spoofing	✓✓	✓✓	✓	✓✓

Timing Integrity description

T&S function#1

Timing Integrity
(Dashboard)

Deliver a time integrity service to the GNSS users, by providing integrity information to improve user timing accuracy as well as positioning.

Basically a key feature that intends to provide users with validation and performance assessment of the timing information disseminated for example by the Galileo System. This is especially important for critical infrastructure operators

Key Functionalities

- Ensure, that the **accuracy of the time estimated at user level is within certain limits with respect to the reference time**
- Improve the integrity of Galileo system by **providing to the user a “confidence level indicator” (CLI)** of the timing information
- **Monitor the status of Galileo satellite clocks detecting in real time possible anomalies and generating automatic alerts** in case the satellite is considered unusable (within a “Time to Alert”)

Timing Integrity requirements

- The time Integrity function shall continuously, in real time monitor the Galileo SIS w.r.t. navigation message, possible satellite clock non-stationarities (phase jumps, frequency jumps and variance changes) which may impact user timing accuracy
- The Galileo Time integrity function shall, within the time to alert, provide to the user a Confidence Level Indicator (CLI). The CLI shall include three possible states for each considered Galileo satellite clock:
 - **Monitored:** the SV is received and processed and its clocks behave within specifications
 - **Not Monitored:** the clock corrections for the given SV are not received and computed
 - **Do Not Use:** the satellite clocks are not behaving within specification. Consequently this SV should be excluded by the user from the timing information and position determination
- The Time to Alert of the CLI shall be less than 20 minutes

Q: Do you agree?

Timing Integrity requirements

- The availability of the Galileo Time integrity function shall be better than 95% over a 1 year interval

Q: Do you agree with this figure or do you suggest a more demanding req?

- The Galileo Time integrity function shall be able to provide to the user the performance of the Galileo OS Navigation Message timing information on a daily basis

Q: Do you agree?

- The Galileo Time integrity function shall implement sufficient measures to ensure the security of this function

Q: Can you suggest some secure measures that could be implemented?

Time Distribution and Remote Audit description

T&S function#2

Trusted Time Distribution
and Remote Audit

Enable remote assessment of the client clock synchronisation by providing audits and report.

It will allow the dissemination of UTC time and frequency over Internet using NTP (or PTP depending on feasibility), and will enable remote assessment of the client clock synchronisation by providing audits and reports.

Key Functionalities

- **Trusted distribution of UTC time:** done in a cryptographically secured manner via TCP/IP based networks using NTP. However, the function is not limited to NTP, as also PTPv2 (IEEE1588) or White Rabbit might be used. The utilisation of Public Key Infrastructure (PKI) certificates results in a time that can neither be modified nor tampered.
- **Remote Audit:** The distribution of UTC to the end user is carried out by UT (User Terminal) which receives cryptographically authenticated time from a Time Signal Generator (TSG). While providing UT with time, TSG, who receives UTC time from TRF (Time Reference Facility), simultaneously performs time audits. The logs of all audits logs are being stored in a local database.
- **Retrospective time verification:** Time can be verified retrospectively at any specific past moment, resulting in either a VALID or INVALID response. The determination of the validity of the time is dependent on the maximum predefined offset error between the time at UT and TRF (Time Reference Facility).

Time Distribution and Remote Audit requirements

- The Trusted Time Distribution and Remote Audit function shall provide to the End User a Reference Time Scale aligned to UTC
- The End User time offset error versus the source time, due to transmission delays, shall be estimated and audited continuously in real time by the Service
- The End User time offset error to the source time shall be better or equal to 30microseconds (1sigma) over LAN, 10 ms over internet connections with microseconds resolution

Q: Do you agree?

Time Distribution and Remote Audit requirements

- The Trusted Time Distribution shall have an availability of 99% over any yearly interval.
- The Remote Audit Service shall have an availability of 90-95% over any yearly interval.

Q: Do you agree with these figures or do you suggest a more demanding reqs?

- The Trusted Time Distribution and Remote Audit function shall implement sufficient measures to ensure the security of the service

Q: Can you suggest some secure measures that could be implemented?

Time Distribution and Remote Audit requirements

- The Trusted Time Distribution and Remote Audit service shall provide to the end user a Time VALID/INVALID factor
- The Time VALID/INVALID factor shall be set to invalid in case the End User Time offset error exceeds ± 1 ms for LAN and ± 10 ms for public internet
- The Time VALID/INVALID factor shall have a time to alert of 15 minutes
- The Trusted Time Distribution and Remote Audit Service shall support a holdover mode in case of network failures. The service shall be able to determine a-posteriori if the end user times were VALID/INVALID during the holdover

Q: Do you agree?

Certified Time Steering and Monitoring description

T&S function#3

Certified Time Steering and Monitoring

Improve the stability of oscillators slaved to Galileo by real-time correction streaming

Key Functionalities

Time Signal Generator (TSG)

- Collecting real-time GNSS observations in RTCM streams from both the UT and TRF
- **Calculating, in real time, the time difference between the user clock and the TRF reference time**
- Distributing the real-time oscillator steering data in RTCM streams to the UT
- Generating functional flags about the operational status of the TSG, UT, and the internet link between TSG and UT and distributing them to the SDH
- Generating functional flags about the availability of the real-time streams from both the UT and TRF and distributing them to the SDH
- Calculating the latency of TSG output, the real-time oscillator steering data, with respect to the received real-time GNSS data from the UT and distributing these data to the SDH

Service Data Handling (SDH)

- **Distributing the user account status data to the TSG**
- Collecting TSG and UT operational status data, the operational status of the link between the TSG and UT to save them in SPFDB
- Collecting the latency of the real-time oscillator steering data, the functional flags about the availability of the real-time streams from both the UT and TRF and arranging them in ascii files to save in the SPFDB. These files will later be uploaded to the SMF to produce the KPIs: NTRIP outage and oscillator steering data latency

User Terminal (UT)

- Receiving GNSS signals
- Generating and distributing the real-time GNSS observations in RTCM streams to the TSG
- **Collecting the real-time oscillator steering data in RTCM streams from the TSG**
- Producing steering corrections, based on Proportional-Integral-Derivative algorithm, from the real-time oscillator steering data received from the TSG, in order to discipline the user oscillator
- Generating the applied historical steering parameters (i.e. oscillator control voltage) file and distributing it to the SDH

Certified Time Steering and Monitoring description

- The Certified Time Steering and Monitoring function shall provide user oscillator steering data to allow alignment of a remote clock
- The Certified Time Steering and Monitoring function shall provide oscillator steering data such that the offset of the remote clock (GST and UTC) shall be known with a maximum accuracy of 30 ns (95% confidence level) at any time, depending on the remote clock performances
- The Certified Time Steering and Monitoring function shall be able to receive raw Galileo measurements as collected in real time by the user.
- The oscillator steering data provided to the end user shall be monitored w.r.t. performance, integrity and availability

Q: Do you agree?

Certified Time Steering and Monitoring description

- The availability of the Certified Time Steering and Monitoring function shall be better than 95% over 1 year

Q: Do you agree?

- The Certified Time Steering and Monitoring function shall implement sufficient measures to ensure the security of the service

Q: Can you suggest some secure measures that could be implemented?

Robust Accurate Time description

T&S function#4

Robust Accurate Time

Offer robustness against GNSS signals interruptions (e.g. propagation delay) and/or attacks like jamming or spoofing and robustness against failures or attacks to communication network

Key Functionalities

- **Performance:** the main functional mission is the synchronisation of a network of atomic clocks up to thousands km apart using GNSS (e.g. namely GALILEO and GPS) with accuracy up to 2-5ns and stability up to $1e-14$ (Allan Deviation evaluated at 24h)
- **Availability and robustness:** to be able to deliver high level of availability providing resilience to ground communication failures and to GNSS signals impairments (interruption/degradation of satellite systems, local jamming and local spoofing)
- **Scalability** to, e.g.: number of nodes, geographical coverage, network reconfiguration, clock performance at each node, etc.
- **Maintainability:** thanks to the scalability feature it is quite easy to move out one node for maintenance
- **Security:** it offers a multi-layer approach to authentication, integrity and confidentiality. All layers are implemented through different asymmetric crypto certificates. All communications are point to point and each point-to-point link takes place on a dedicated virtual network, all data transmitted is signed using a certification authority kept internal to the system (all nodes of the network are manually pre-loaded with CA keys)
- **Compatibility and Ease of Integration:** TS#4 is designed not only for new systems or new installation but to be easy integrated in already operational systems. It requires a GNSS antenna, a small rack (the terminal) and a network connection with just two other nodes of the network. This means that it is able to overlay and adapt its logical infrastructure to existing ones.

Robust Accurate Time requirements

- The robust accurate time function shall synchronise a network of remote atomic oscillators worldwide distributed
- The robust accurate time function shall provide steering data with accuracy of 30 ns and stability up to $1e-14$ (Allan Deviation evaluated at 24h) w.r.t. UTC and/or to an internal reference time scale, depending on user clock performances
- The robust accurate time function shall provide notification and alerting in case of failure
- The robust accurate time function shall continuously monitor the performance of the system
- The availability of the robust accurate time function shall be better than 95% over a 1 year interval

Q: Do you agree?

Business Impact TF#1

Timing Function	Incident	Impact	Rationale
TF#1	Integrity non-availability	Low	In case of interruption of the function → delay in the validation of the Galileo performances In case of unavailability of the Galileo time info → networks can keep functioning using current GNSS technology
	Integrity erroneous validation	Low	CI operators have a logical check of the integrity information to avoid the Confidence Level Indicators that lead to have all Galileo satellites marked not usable In case of erroneous validation → non-usability of the best satellites while leaving usable the others with a slightly degraded performance → impact only in case no alternative timing sources are used

Q: Do you agree with this analysis?

Business Impact TF#2

Timing Function	Incident	Impact	Rationale
TF#2	Timing distribution non-availability	Low	Use of backup time distribution
	Remote audit non-availability	Low	Delay in the audit and the time validation without impacting the outcome of the audit
	Erroneous remote audit	Low/medium	A-posteriori assessment→ Possibility to cross-check the results of the audit with other NTP providers→ an erroneous NTP will not be detected until it will be greater than the performance either of the backup solution or of the cross-check with other NTPs Medium impact if the audit is done legal demonstrate the traceability to UTC

Q: Do you agree with this analysis?

Business Impact TF#3

Timing Function	Incident	Impact	Rationale
TF#3	Certified Time steering and monitoring non-availability	Low/medium	<p>Non-availability period < discontinuity period of steering correction provision → no impact</p> <p>Non-availability period > discontinuity period of steering correction provision → delay in the user clock monitoring and steering correction distribution; impact depending on the user clock features and duration of the non-availability</p> <p>Performance degradation → impact depends on different User accuracy requirements</p> <p>Medium in Energy market → limitation of the capacity of identifying node failure cause without impacting the function provision</p>
	Erroneous Certified Time steering and monitoring	Low/medium	<p>Degradation on the synchronisation performance → impact only in case no alternative timing sources are used</p> <p>Medium in Energy market → limitation of the capacity of identifying node failure cause without impacting the function provision</p>

Q: Do you agree with this analysis?

Business Impact TF#4

Timing Function	Incident	Impact	Rationale
TF#4	Robust accurate time non-availability	Low	Operators have their own back-up system for validation, all different systems shall be properly monitored to avoid impact on the performance during any switch-over Performance degradation → impact depends on different User accuracy requirements Only critical in case of simultaneous failure of primary and back-up time source
	Erroneous Robust accurate time	Low	Degradation of synchronization performances bounded by the back-up solution → high impact in case no alternative timing sources are used Only critical in case of simultaneous failure of primary and back-up time source

Q: Do you agree with this analysis?

Synergies with Copernicus

- Copernicus data and products

Cristina Ananasso, European Commission

- AMPERE: electrical asset mapping in emerging countries worldwide using Galileo and Copernicus

Marco Nisi, Sistematica

- Q&A

Linking space to user needs



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