"Secure [Telecom] Networks Synchronization with GNSS„

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STDS 8

Safe Time Distribution System 8

ITSF 2017 in Warsaw
November 2017

PIK Time Systems®

STDS

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- Introduction and targets
- Purpose of the System
- Solution
- Performance and core features

Introduction and targets

- OUR TARGET - DEVELOPMENT OF AN UNIQUE SYSTEM FOR:
  - Network Synchronization
  - Safety, Resilience Improvement

Purpose of the System

Distribution of a reference time to remote stations with accuracy requested by the Customer

Remote stations are equipped with secondary atomic clock which should be synchronized to a reference clock

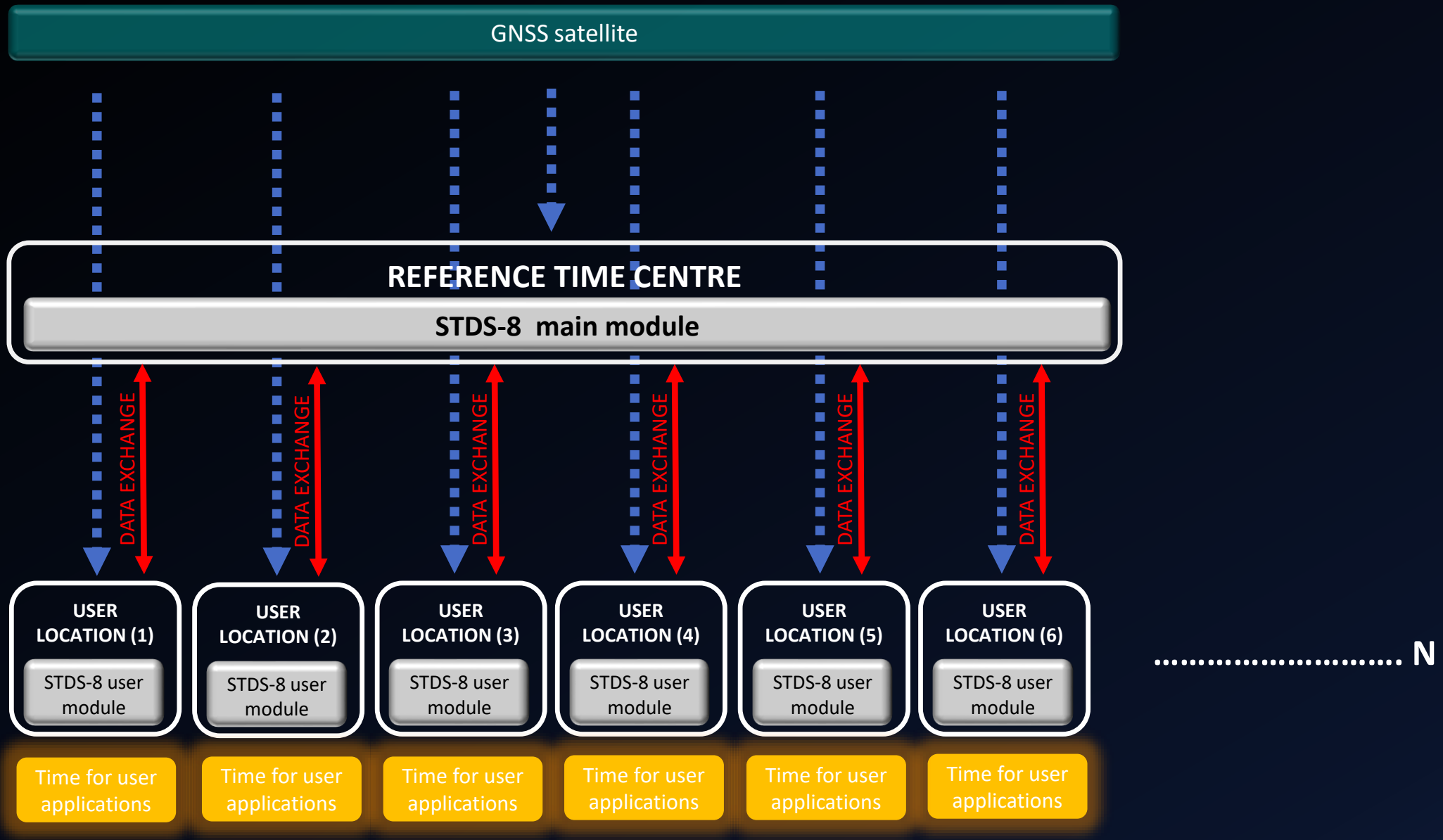
Current situation

Up to know the synchronization is based on direct readings from GNSS (mainly GPS offering good accuracy at no cost)

On the other hand such solution is a threat to users due to:

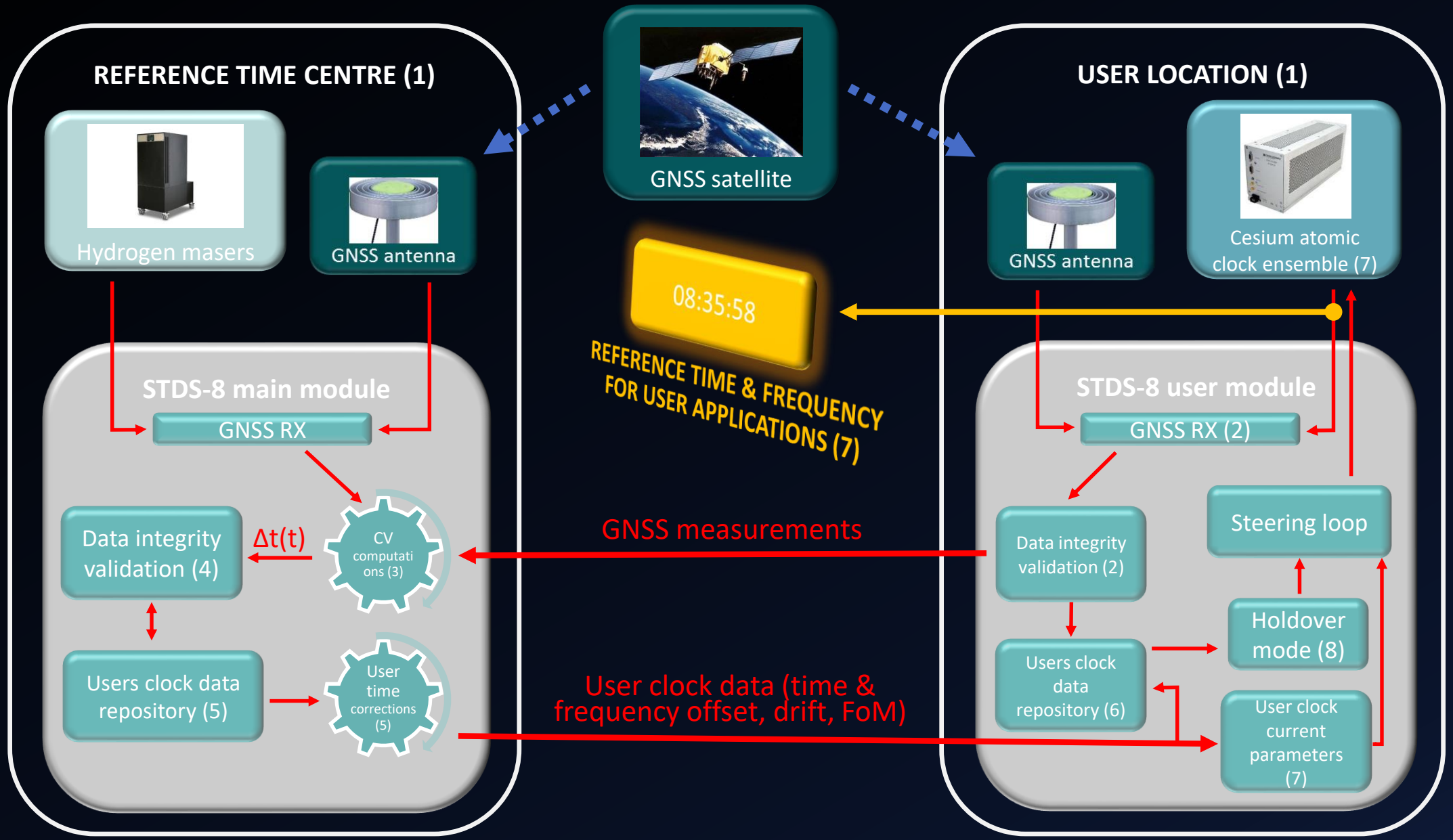
- Dependency on GPS
- Not providing a reference time
- Easy to be jammed
- Risk of spoofing
- Dramatic consequences if the time source fails or become unreliable

Solution overview



Solution architecture

STDS-8



Solution - description

(1) User and Reference Time Centre (RTC) perform simultaneous CV GNSS measurements, according to a predefined schedule;

(2) Results of the User measurements are verified before being sent to the RTC;

(3) The RTC after receiving the results of the User measurements, determines the delay Δt (t) for measuring period t;

(4) Δt (t) is verified for the integrity of the measurements, using User data history;

(5) Data are stored at the RTC, in the User repository, from where they are downloaded to calculate the best possible estimation of User clock parameters. This estimation is also performed if the last measurement is determined as invalid in the data integrity check. This is because the estimates are based on the full set of data stored for the User's clock;

(6) Data are authenticated and encrypted and then transmitted to the User where they are stored in local archives;

(7) The current set of parameters is used to control the user clock which provides the physical User time realization, that can be further distributed to User applications;

(8) When current parameters are not available or not correct, the user can generate a local copy of the official time in the holdover mode but only if the local clock distribution's goodness factor reflects its current status

STDS

STDS user module

PERFORMANCE AND CORE FEATURES

STDS

STDS Local module status

Module ID – P002

System status: OK
Local time: 2017-09-19 15:10:07

Link to main module: OK
Reference time synchronization status: OK
GNSS observation status: OK

Local clocks status:	ΔT	Uncertainty
P002-1 (master clock)	0.8ns	2.3ns
P002-2	-1.2ns	2.5ns

Required synchronization level: +/- 10ns
Maximal hold-over mode time: 2 days 08h:15′:34″

OK

PERFORMANCE AND CORE FEATURES

STDS

STDS Local module status

Module ID – P002

System status: hold over mode
Local time: 2017-09-20 12:10:07

Link to main module: connection lost at 2017-09-20 00:00:00
Reference time synchronization status: ERROR
GNSS observation status: OK

Local clocks status at 2017-09-20 00:00:00:	ΔT	Uncertainty
P002-1 (master clock)	2.2ns	2.3ns
P002-2	0.7ns	2.5ns

Required synchronization level: +/- 10ns
Time to hold-over threshold: 1 day 20h:05′:07″
Predicted Δ*T* range: -6.1…2.5ns

ERROR

PERFORMANCE AND CORE FEATURES

STDS

STDS Local module status

Module ID – P002

System status: hold over mode
Local time: 2017-09-20 12:10:07

Link to main module: OK
Reference time synchronization status: Error
GNSS observation status: Error, AIM system alert

Local clocks status at 2017-09-20 00:00:00:	ΔT	Uncertainty
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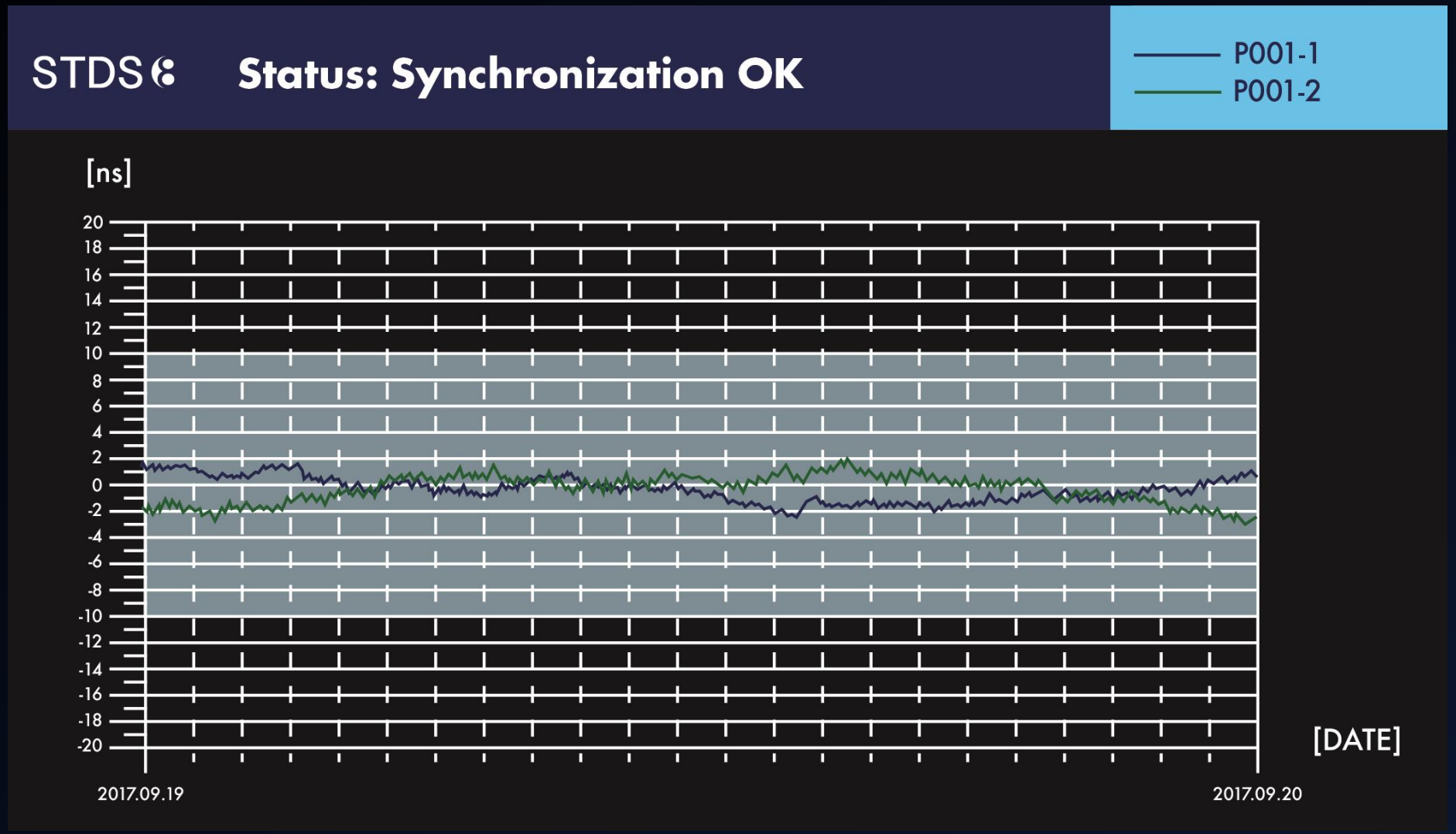
PERFORMANCE AND CORE FEATURES



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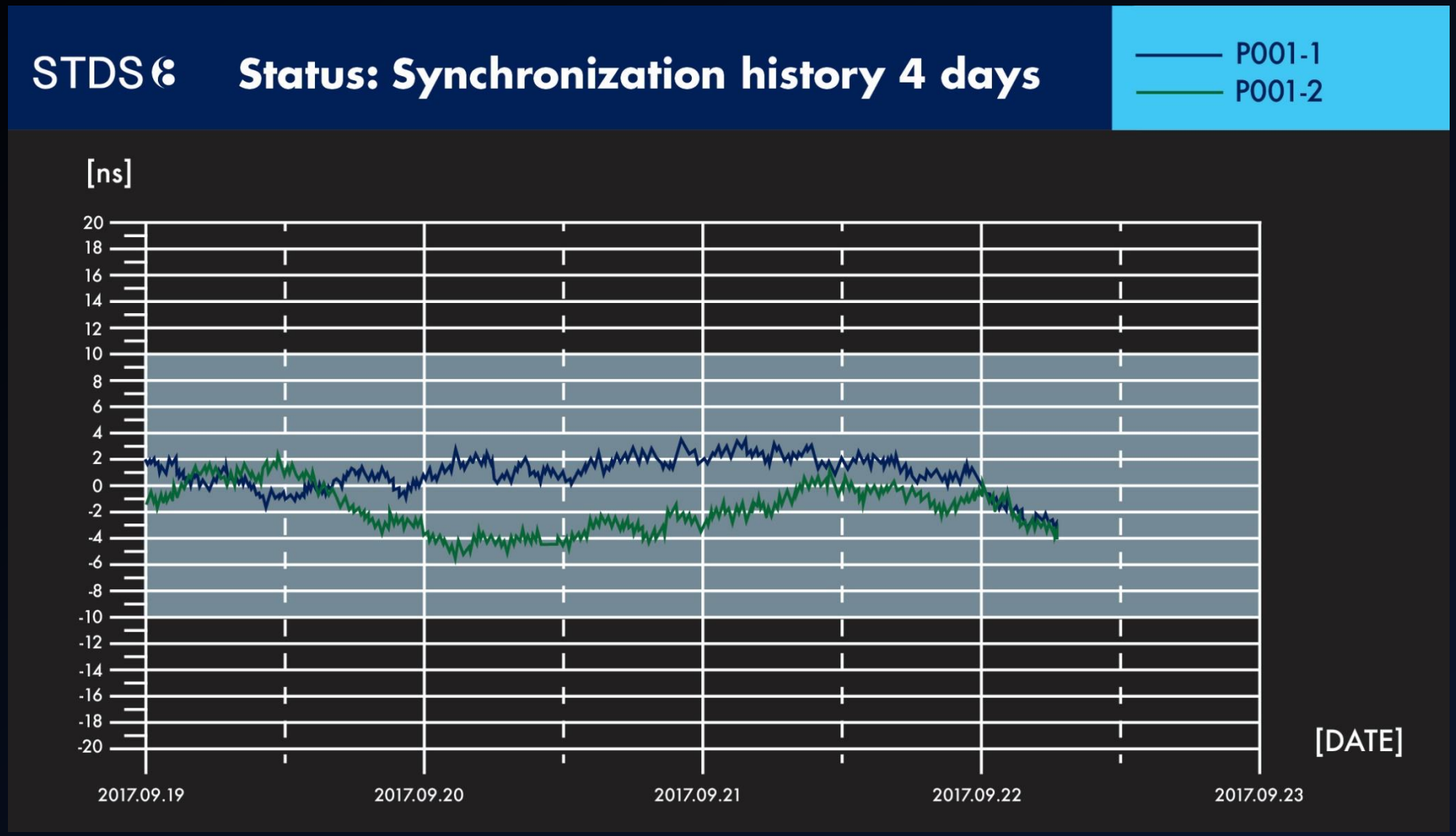

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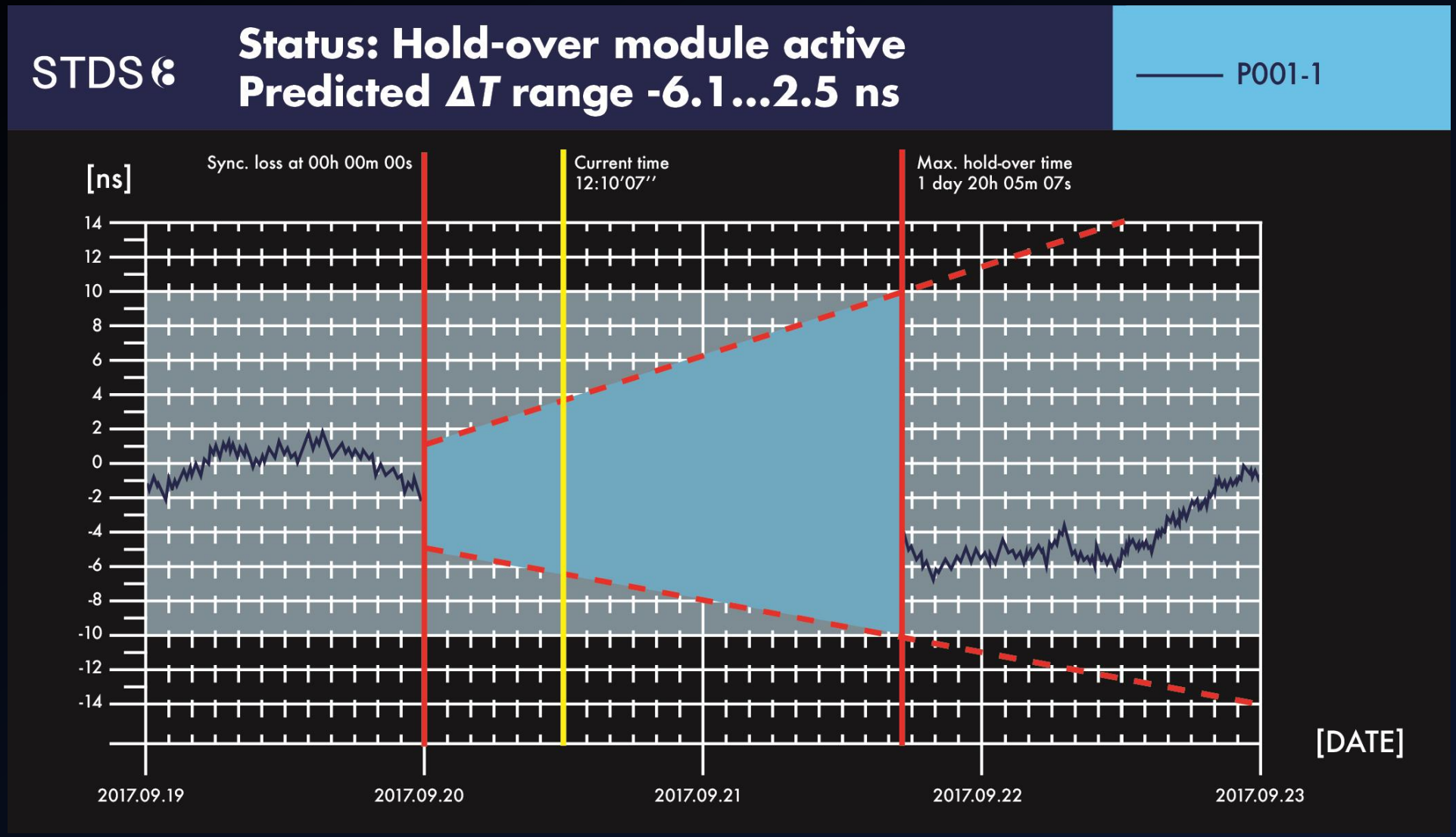

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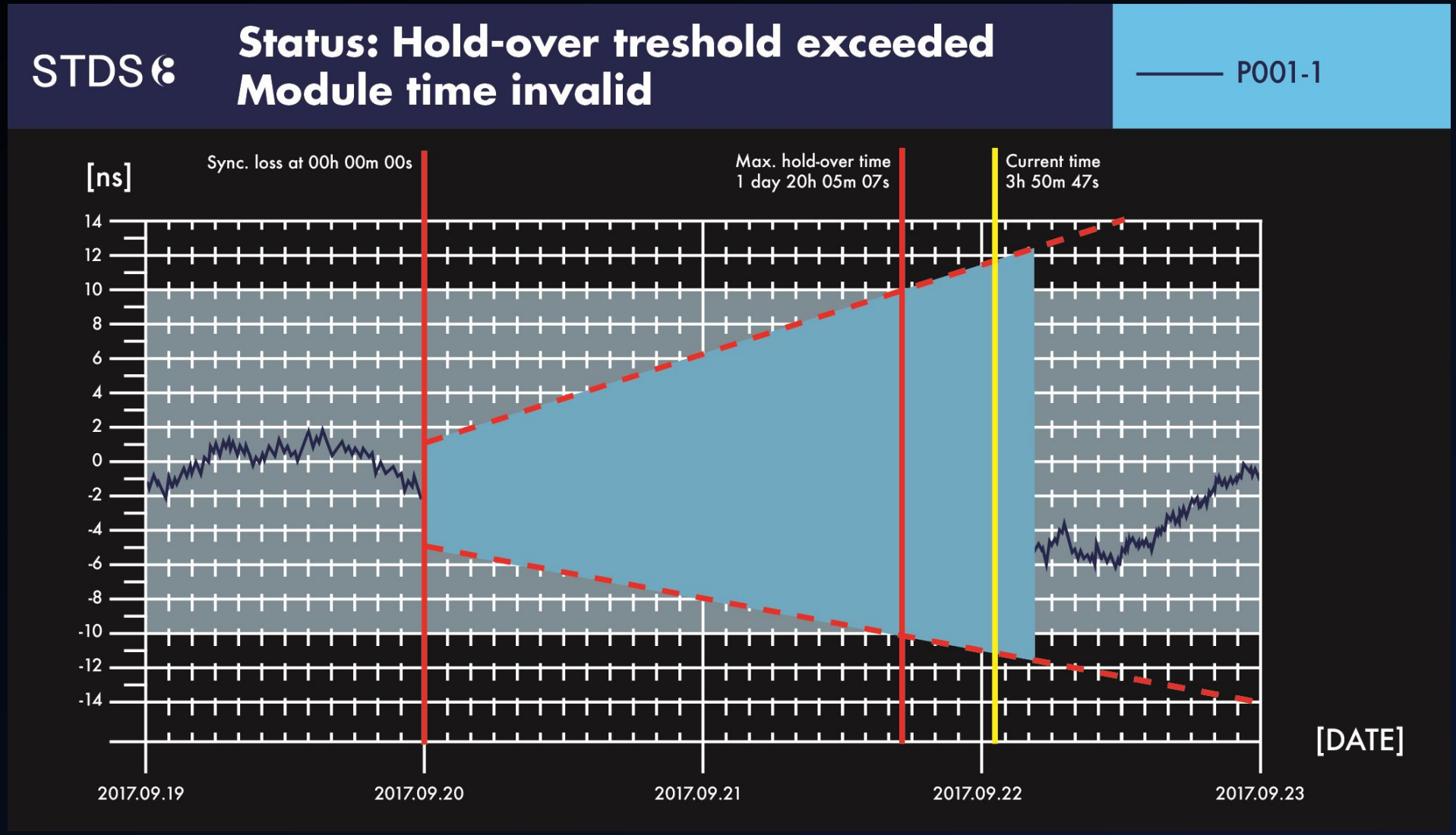

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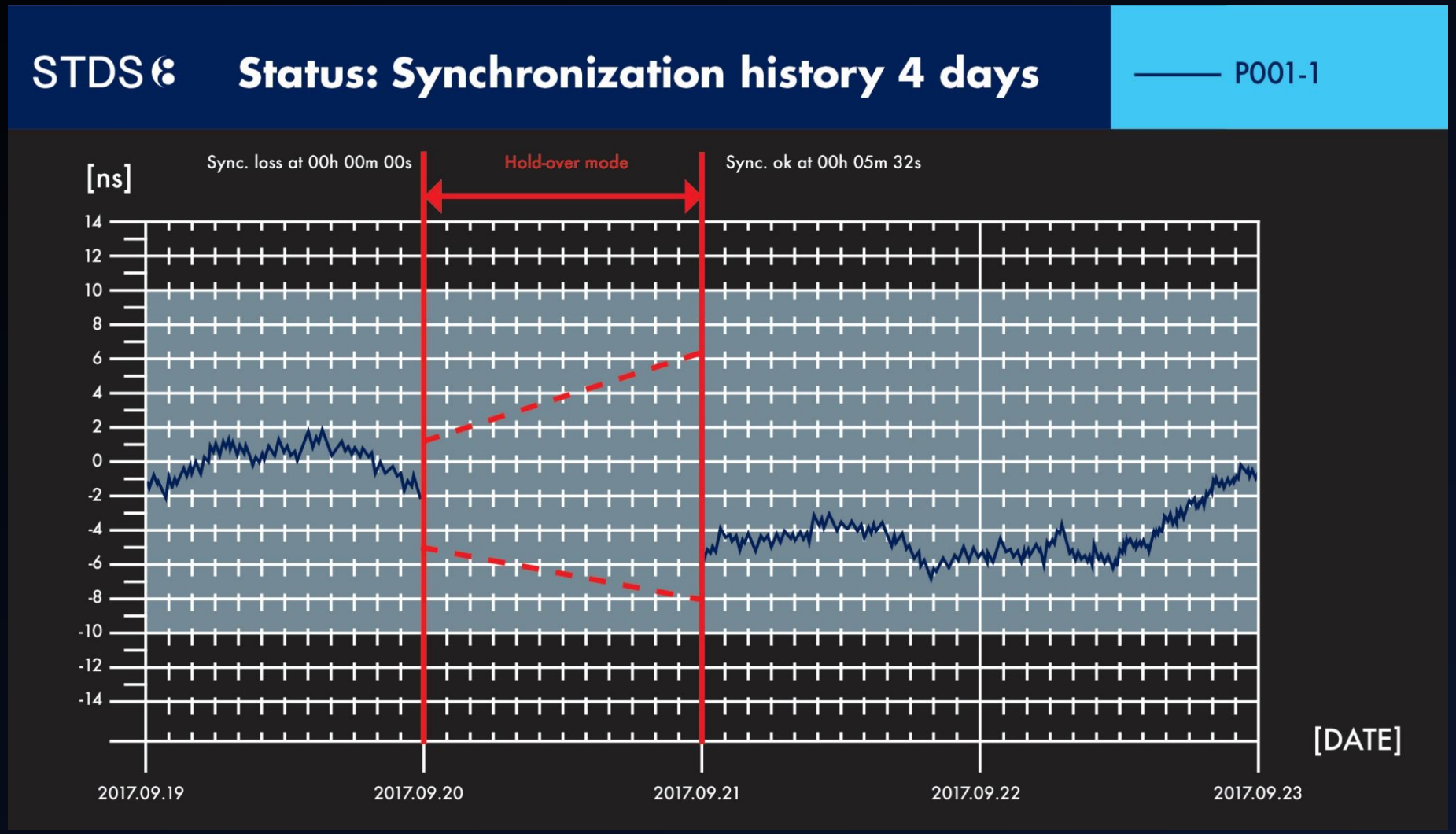

PERFORMANCE AND CORE FEATURES

AUTONOMUS

The use of local atomic clocks at User premises allows independent integration of a local time from a stable frequency source (atomic clocks) with the time disseminated from the Master Reference Time Centre.
Such solution allows to add autonomous local integrity to the time distributed from Master Reference Time Centre;

REFERENCE TIME

The use of the CV (Common View) technique, based on GNSS signals, to transfer accurate reference time. In such solution, GNSS is only a medium for time comparison not a source of time as in other systems;

TRACEBILITY

Data integrity validation system at Master Reference Time Centre constantly monitors User atomic clocks and tracks their behavior with respect to the reference time from the Master Reference Time Centre. All data are stored for the future verification. Clocks behavior can be tracked and checked with help of www interface at any time;

AUTONOMOUS INTEGRITY MONITORING

Autonomous integrity monitoring detects and removes outlier resulting from a measurement error or counterfeit attempt.

PERFORMANCE AND CORE FEATURES

The quality of the local atomic clocks essentially defining:

- the width of the acceptance window,

- the maximum time interval in the holdover mode.

The availability of a local atomic clocks acting as a flywheel to autonomously integrate time in absence of measurements and correction is a guarantee of robustness of the system; the degradation in accuracy is relatively graceful over time, depending on the quality of the local oscillator and the user needs.