25th March 2022

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Deputy Head of GEOLOC Lab

Standardization activies in GEOLOC Lab

TC5-WG1 "Navigation and positioning receivers for road applications"

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AGENDA

1. A bit of history
2. Scope of CEN-TC5-WG1
3. Record & Replay: the method of EN16803
4. EC funded projects in link with EN16803
5. Liaisons with other standardization groups

1 A bit of history

Rationales

- Over 20 years, GEOLOC team is expert in terms of assessment tests of the positioning systems (RTK device test)
- Involved in many European research projects, GEOLOC is a recognized actor in GNSS domain
- 2010: GEOLOC becomes homologation service for the deployment of the French “ECOTaxe poids lourds”
- Lake of standards in the world of GNSS assessment led Europe to setup a new WG to tackle this issue:
  CEN-TC5-WG1 “*Navigation and positioning receivers for road applications*”

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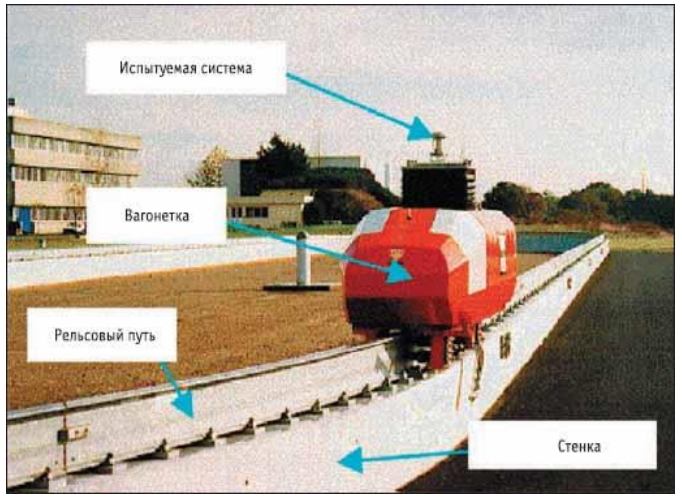
before 2006



2006

after 2006

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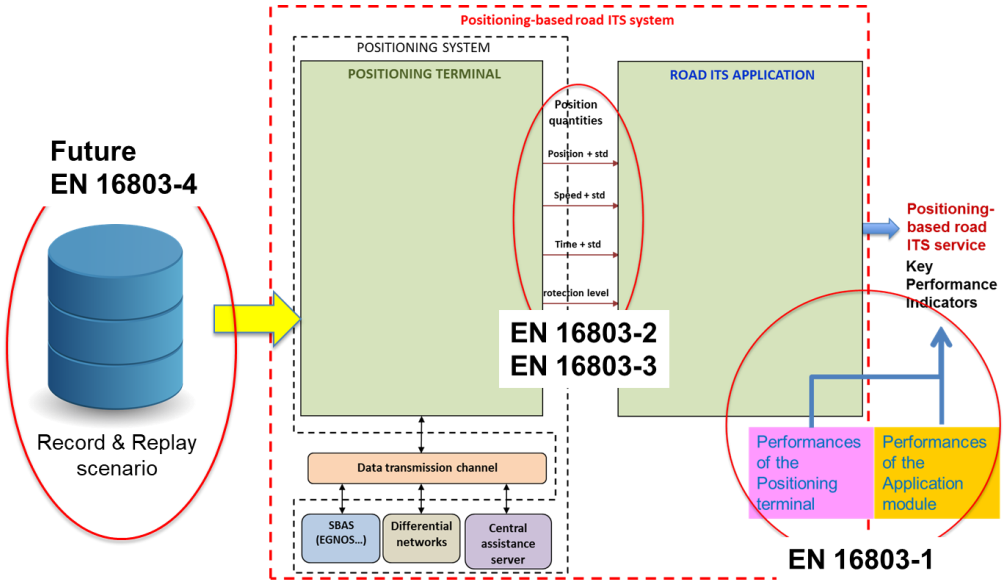
2 Scope of CEN-TC5-WG1

Rationales

- To develop standards on the Use of GNSS-based positioning for road Intelligent Transport Systems (ITS).
- These standards are in line with the Space mandate Sectorial Dossier 1, except that WG1 does not cover airport services.



- WG1 is currently focused on delivering standards from the EN 16803 series (**Assessment Methodologies**), able to
  - Test GNSS devices under controlled environment (metrology)
  - With realistic (even real) GNSS signals
  - With affordable test means (*replayer* or *playback system*)
  - For road domain ; but extendable to others
  - Thanks to relevant metrics and methodologies

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Members of TC5-WG1

- 26 members, 8 countries:

  France / Germany / Italy / Netherlands / Norway / Spain / Switzerland / United Kingdom

- overview:

- 1 one pending : STmicroelectronics (France)
- 1 potential new member : Saphyrion (Switzerland)

Organization

- TC5-WG1 : led by GEOLOC since its creation.
  Currently led by Miguel ORTIZ (convenor)
- Secretary led by BNAE
  (Bureau de Normalisation de l'Aéronautique et de l'Espace)
- 2 meetings per year
- Guests are regularly invited:

Shelby Savage
Lead Communications Engineer at
MITRE (Massachusetts-USA)

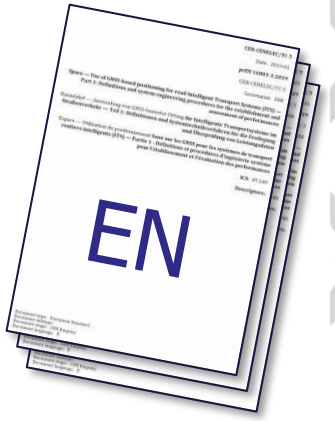
Alberto Fernández Wyttenbach
Market Segment Leader at
European GNSS Agency (EUSPA)

Roberto Capua
Responsible for GNSS R&D at Sogei
Chairman of RTCM SC 134

SAPHYRION
communication technologies

EN16803: publication status

- EN16803 : *Use of GNSS-based positioning for road Intelligent Transport Systems (ITS)*
- 1st Part published since 2016
- In 2020, 3 new publications:
  - Part1-Rev1: *Definitions and system engineering procedures for the establishment and assessment of performances*
  - Part2: *Assessment of basic performances of GNSS-based positioning terminals*
  - Part3: *Assessment of security performances of GNSS-based positioning terminals*
    *(addressing **jamming & spoofing issues**)*
- In 2022, future work:
  - Part4: *Definition & Validation of Test Scenario**
  - *Based on GPSTART-2 results*



EN: European Norme

NEW
NWI
Feb2022

**temporary title*

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Full list of publications of CEN-TC5-WG1

Ref	Title of CEN/CENELEC deliverables	Start Date	Last steps	Standard
WI1	**Revision of EN 16803-1 / Part 1: Definitions and system engineering procedures for the establishment and assessment of performances.**	**2017-09-06**	**Publication Nov. 2020**	**Nov. 2020**
WI2	17448 Metrics and performance levels 17465 Field tests definition for basic performances	**January 2019** **January 2019**	**TR Vote : Approved December 2019** **TR Vote : Approved January 2020**	**Mar 2020** **May 2020**
WI3	17447 PVT error models	**January 2019**	**TR Vote : Approved November 2019**	**Feb 2020**
WI4	**EN 16803-2 / Part 2: Assessment of basic performances of GNSS-based positioning terminals**	**2017-03-06**	**Publication Sept. 2020**	**Sept 2020**
WI5	17464 Security attacks definition	**January 2019**	**TR Vote : Approved December 2019**	**Aug 2020**
WI6	17475 Test facilities	**January 2019**	**TR Vote : On-going**	**May 2020**
WI7	**EN 16803-3 / Part 3: Assessment of security performances of GNSS-based positioning terminals**	**2017-03-06**	**Publication Sept. 2020**	**Sept 2020**
WI8	**EN 16803-4 / Part 4: Definitions and system engineering procedures for record and replay design and validation (TBC)**	NEW Feb2022	**New work item** **(will be launched Feb2022)**	**TBD**

- EN16803 access: *https://shop.bsigroup.com/SearchResults/?q=16803*
- All documents published by CEN-TC5-WG1:
  https://shop.bsigroup.com/SearchResults/?q=%22Use%20of%20GNSS-based%20positioning%22
  https://www.boutique.afnor.org/recherche/resultats/mot/%22Use%20of%20GNSS-based%20positioning%22

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3 Record & Replay: the method of EN16803

Rationales of « Records & Replay » method

⇒ Record&Replay = Best of {Field Test + Simulation}

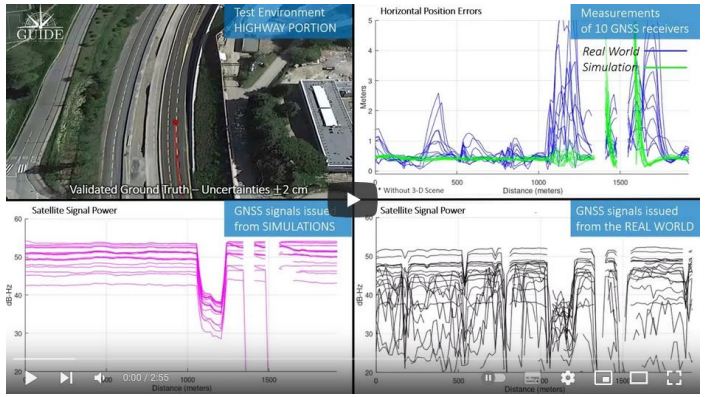
real signal repeatable

⇒ GNSS lab GUIDE : first lab accreditated by COFRAC in **september 2021**.

⇒ NF EN ISO/IEC 17025: Testing and calibration laboratories

⇒ For methods based on EN16803: standards developped in the scope of CEN-TC5-WG1

⇒ Real added value compared to simulation methods :



https://www.youtube.com/watch?v=Jj7xnHcI2Uk

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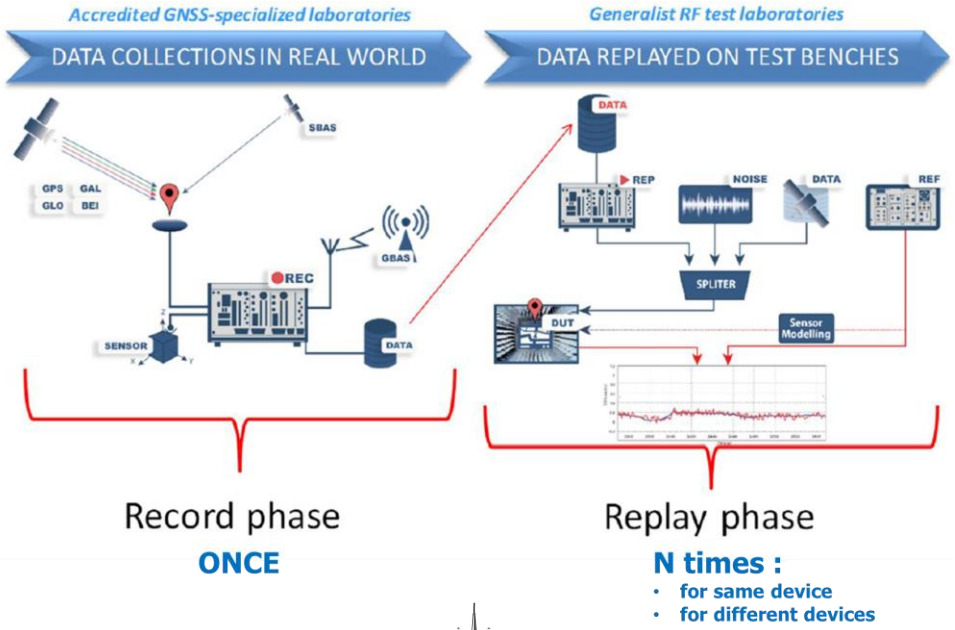
EN16803: the "Record & Replay"* methodology

- EN16803 main methodology : Record and Replay



- Examples of use of EN16803 realized by GUIDE this year:
  - Ublox F9P : 50 replays (standalone / urban env.)
    https://www.youtube.com/watch?v=AdcxsSzw_F4
  - Septentrio MosaicX5 : 20 replays (standalone / sbas / urban env.).
    Download report for free :
    https://guide-gnss.com/guide-gnss-test-reports-septentrio-mosaicx5/

Direct links:

YouTube

PDF

also known as "Record and Playback"

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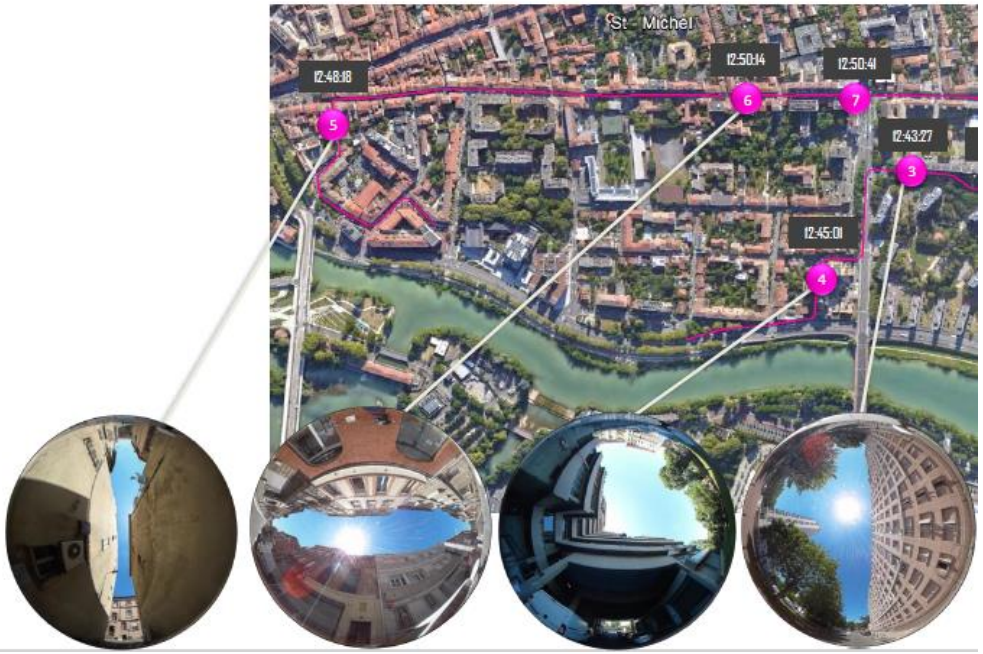
Using EN16803 : example in an Urban Environment

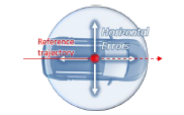
URBAN ENVIRONMENT

Overview of different environments on the course

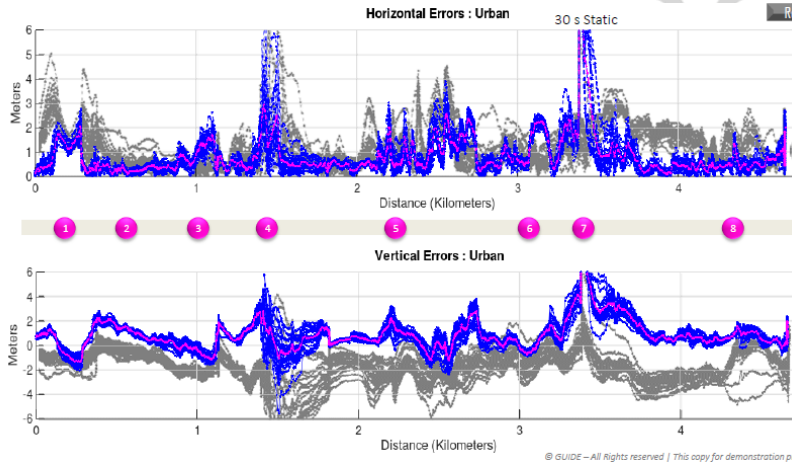


1 Record phase

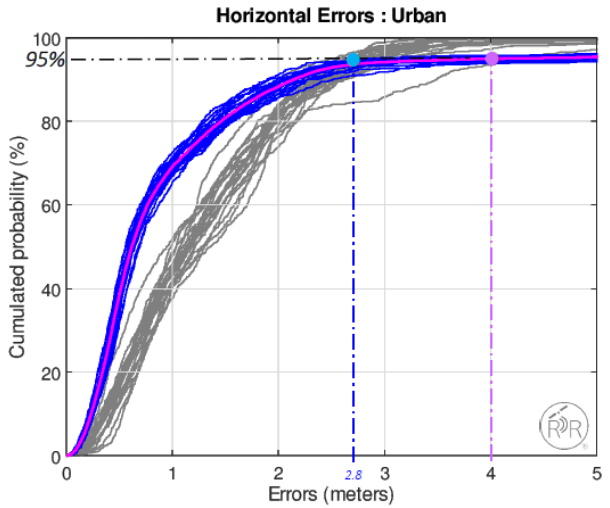
2 Replay phase



DUT Measurements
Batch of positions SBAS
Mean of positions SBAS
Batch of positions Standalone



3 Analysis



Results

	50 %*		
	Err Mean	Err Max	St Dev
Horizontal	0.60 m	0.70 m	0.05 m
	75 %*		
	Err Mean	Err Max	St Dev
Horizontal	1.30 m	1.40 m	0.10 m
	95 %*		
	Err Mean	Err max	St Dev
Horizontal	4.00 m	6.10 m	0.10 m

*Referred to SBAS corrections active

4. EC funded projects in link with EN16803

GPSTART (2017-2018)

GNSS

Performance

STAndardization for

Road **T**ransport

- Consortium:

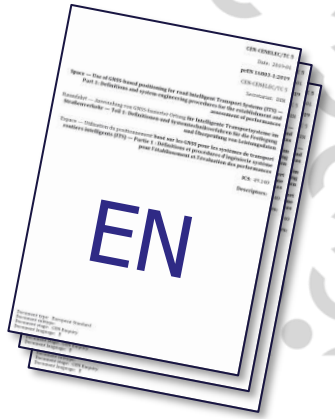
FDC, FREE, GUIDE, gmv INNOVATING SOLUTIONS, Qascom Trust is Nice, Control is Better., RAPP, TELESPAZIO a LEONARDO and THALES company

WP1 : Assessment for Basic performances

- **WP1.1 (GMV)** Metrics and performance levels detailed definition
- **WP1.2 (GUIDE)** Field tests definition for basic performances
- **WP1.3 (TPZ)** Error models development

WP2 : Security performances

- **WP2.1 (FDC)** Security attacks and security metrics definition
- **WP2.2 (QASCOM)** Field tests definition for security performances



EN16803
Part1
Part2
Part3

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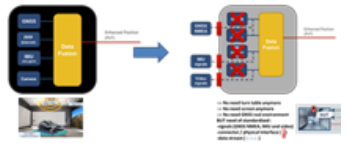
GPSTART 2 (2019-2022)

- EC expectations :
  - EGNSS downstream standardization (Cf VVA/GMW/LS study)
  - Absolute positioning (GNSS / GALILEO)
  - GALILEO differentiators (OSNMA, HAS (PPP over E6))
  - Autonomous Driving
- CEN-TC5-WG1 expectations
  - Navigation & Positioning receivers for Road applications
  - Augmented hybrid GNSS & Integrity assessment
  - Fair competition between suppliers
  - Interoperability
  - Grey box concept
  - EN16803-4 : How to design R&R scenario ?
  - Potential revisions of previous parts of EN16803



- Consortium:

Name	Acronym Country	logo
M3 Systems Belgium SPRL	M3S BE	
GNSS Usage Innovation and Development of Excellence	GUIDE FR	
Technische Universität Braunschweig	TUBS DE	
Radiolabs	RDL IT	

- Overall status:
  - WG1 has proposed GPSTART2 project to EC
  - Proposition has been accepted by EC
  - Call for tender published 16th April 2019.
  - Selection panel met on 1st of July 2019. Consortium led by M3S was chosen.
  - Kickoff meeting of GPSTART2 held on 9th October 2019.
  - 7th Progress meeting : 25th June 2021.
  - 8th Progress meeting / Closure meeting : ~~22nd November 2021.~~ (Cancelled due to Covid).
  - Transformation of GP-START2 deliverables into CEN norms will begin in 2022.

- Scope of the project
  - Design & Validation of “Record & Replay” scenario that could define a future EN16803-4
  - Refinement of the PVT error model for the Sensitivity analysis method standardized in EN 16803-1
  - Integrity assessment for GBPT (needed for Autonomous Vehicles)
  - Assessment of hybrid GNSS device (needed for Autonomous Vehicles)

EN16803 Part1-Rev Part2-Rev Part3-Rev Part4

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- Tasks description

WP1 : Methodology for the recording of relevant data sets
- Task 1 : Objectives and Organisation
- Task 2 : Planning and Documentation For designing Scenarios
- Task 3 : Requirements For Collecting Data
- Task 4: Requirements For Data Validation
- Task 5: Requirement For Replaying Data (Part 2 consolidation)

WP2 : Refinement of the PVT error model for the sensitivity analysis
- Task 1 : PVT error model refinement using an analytic approach
- Task 2 : PVT error model refinement using an approach based on
- Task 3 : Validation and comparison of analytic and machine learning

WP3 : GNSS integrity for the Road applications
- Task 1 : Integrity concept for road domain
- Task 2 : Identification/definition of a methodology able to assess
- Task 3 : Demonstration assessment of integrity concept

WP4 : Methodology for assessment of performances of Hybrid GNSS
- Task 1 : Definition of a test methodology for H-GBPT
- Task 2 : Identification/development of an open source algorithm
- Task 3 : Standard interfaces needed for assessment of H-GBPT in lab
- Task 4: Assessment demonstration of a H-GBPT

Simulated trajectories (with AI) versus Replayed trajectories (EN16803):

Figure A.3 – Simulated trajectories showing a turning within the urban environment *long uniform street*

Figure A.4 – Replayed trajectories showing a turning within the urban environment *long uniform street*

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After GPSTART 2 ?

- Even if GPSTART2 is not yet finished, discussions are going on at CE / CEN / EUSPA for a next standardization project.
- Among topics of interesting from a standardization point of view:
  - High demanding GNSS applications: autonomous driving / Galileo High Accuracy Service
  - Multi-hybridization (other than IMU and Odo)
  - GNSS Layer for HDMaps
  - Certification framework (to refine)
  - Promotion EN16803 to ISO level

Differentiators with current GPSTART 2 :

- Black box Hybridization approach vs Grey box for GPS2
- No more PVT error modelling
- Focus would be made on replay (IQ sample) vs record for GPS2
- Extension of the road domain to other domains

5 Liaisons with other standardization groups

Liaison with ISO TC 204

-ISO TC204-WG18 :TS21176
-Title: Cooperative intelligent transport systems (C-ITS) -- Position, velocity and time functionality in the ITS station
-common review between GMV, WG1, and TC204
-ISO stage codes = 60.60 ”International Standard published” 2020-09-17

Liaison with CEN TC278

⇒ interest from CEN/TC 278/WG 1, Electronic fee collection : presentation done 12th oct 2020
⇒ interest from BNTRA/GC ITS, meeting scheduled the 12th feb 2021:
Relevant topic on HDMaps:
Study on the Integrity and Reliability of High Definition (HD) maps for Connected and Automated Driving (CAD)
URL web
⇒ 67th plenary meeting of CEN/TC278 : presentation done 9th sept 2021

Liaison with ETSI/SES/SCN

GNSS standards based on Constellation Simulator.

New liaison with RTCM SC134 “Integrity of High Accuracy Applications”.

-Roberto Capua presented activities of RTCM SC134 to WG1 (2020-05-14)
-official liaison between CEN-TC5-WG1 and RTCM SC134 still on going. (Action BNAE)

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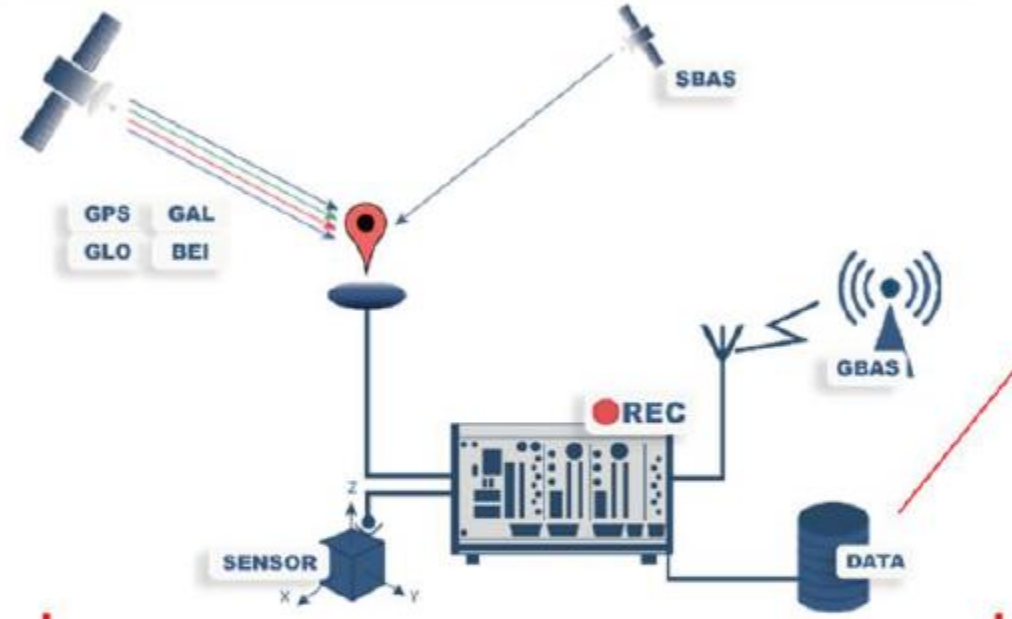
Accredited GNSS-specialized laboratories

DATA COLLECTIONS IN REAL WORLD

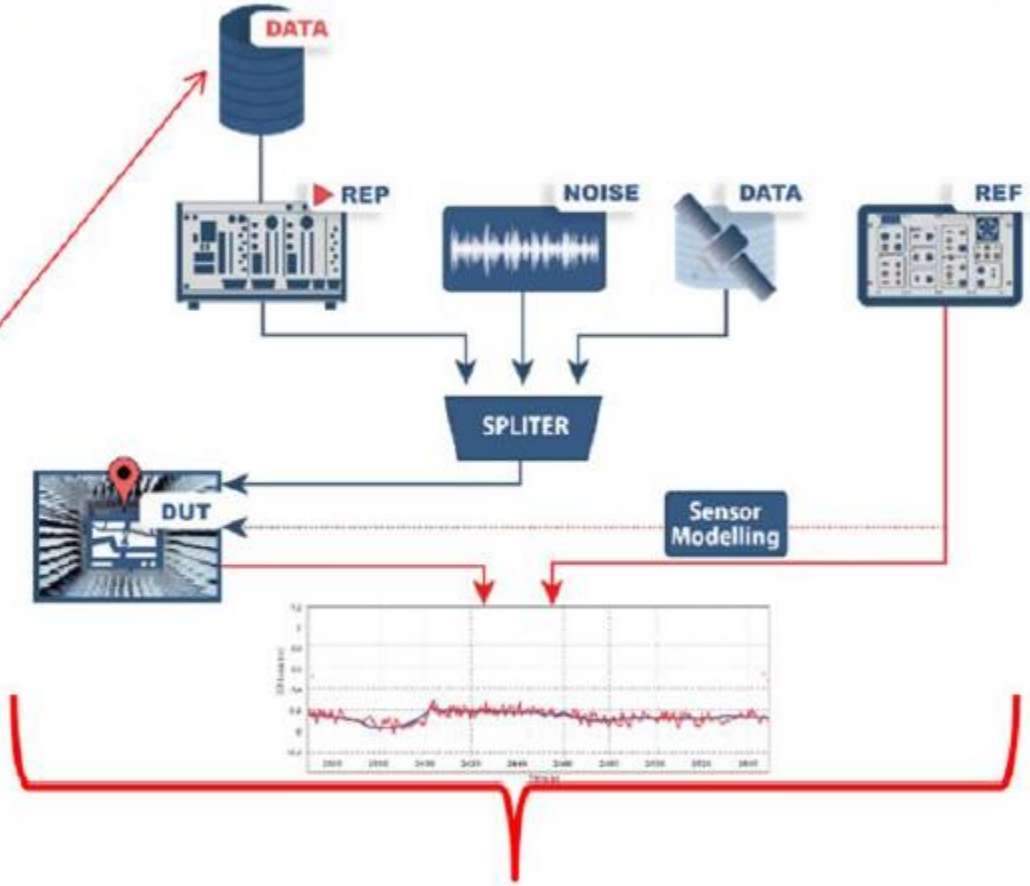


Record phase

ONCE

Generalist RF test laboratories

DATA REPLAYED ON TEST BENCHES



Replay phase

N times :

- **for same device**
- **for different devices**

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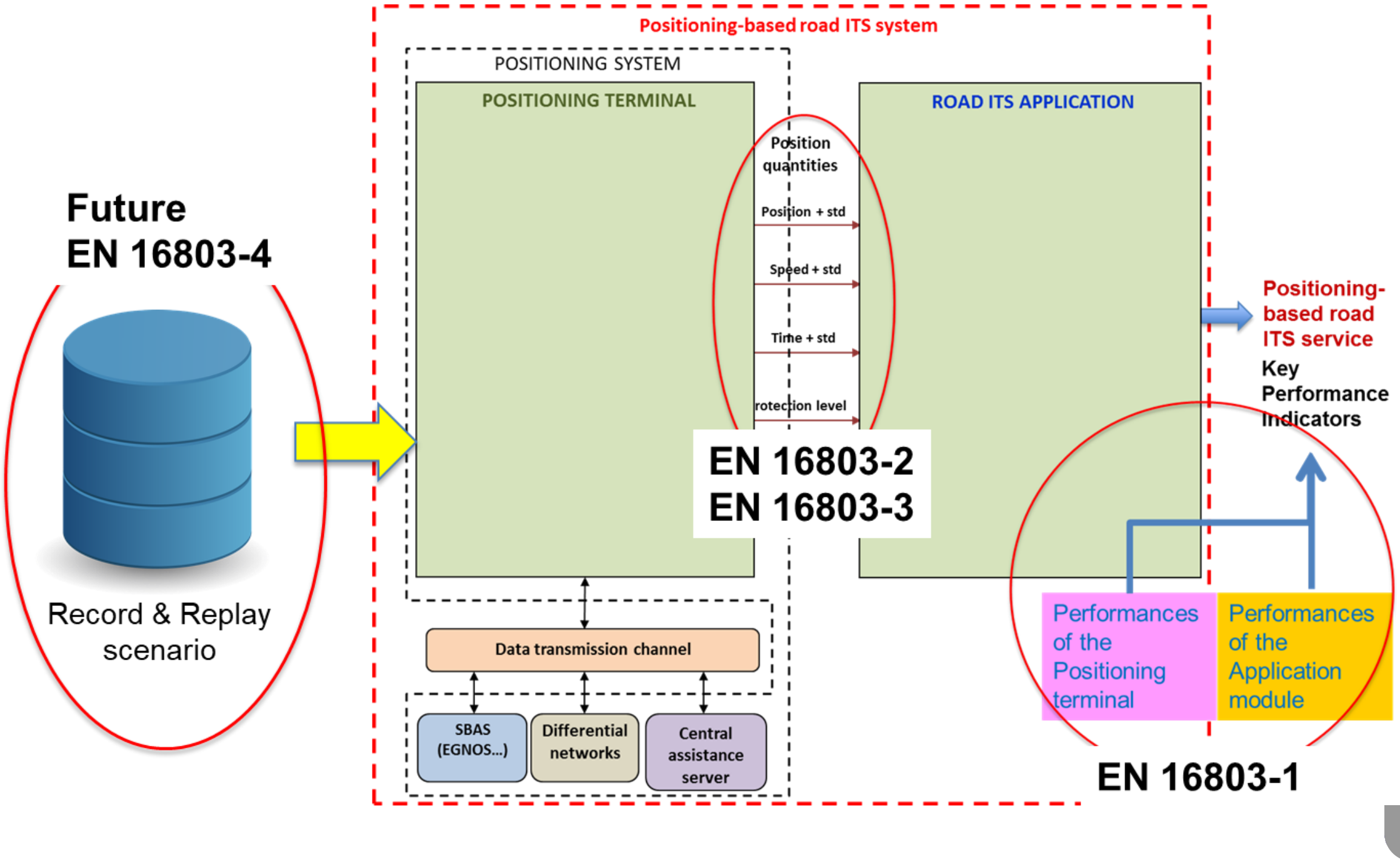
Future
EN 16803-4
Record & Replay scenario
Positioning-based road ITS system
POSITIONING SYSTEM
POSITIONING TERMINAL
ROAD ITS APPLICATION
Position quantities
Position + std
Speed + std
Time + std
rotection level
EN 16803-2
EN 16803-3
Data transmission channel
SBAS (EGNOS...)
Differential networks
Central assistance server
Positioning-based road ITS service
Key Performance Indicators
Performances of the Positioning terminal
Performances of the Application module
EN 16803-1