# Improving Quality of GNSS Vehicle Localization



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ITS&S – FP7 Easy OBU project

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# Easy-OBU research project in a nutshell:

**GSA supported international project aimed at an introduction of cheap positioning solution with improved accuracy**

**What are we doing:** we are developing and preparing market introduction of a new On-Board-Unit capable of providing more accurate location information in challenging situations (such as tunnels) at low cost

**Who we are:** an international consortium consisting of Efcon (AT), PWP Systems (DE), Austriatech (AT), ITS&S Association (CZ) and ČVUT (CZ)

**Public support:** the project is partially funded from the 7th Frame Programme of the European Union

European Commission

SEVENTH FRAMEWORK PROGRAMME

European GNSS Agency

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# Short term signal loss is a major challenge for GNSS applications

GNSS systems are currently unable to cope with loss-of-signal situations that are all but uncommon. When signal is lost, the location information becomes unavailable or very imprecise. Even with introduction of Galileo and other new systems, this problem is here to stay.

**Urban Canyons**

**Tunnels**

**Junctions with underpasses**

**Railways**

**Solutions for localization precision improvement are available, but at a commercially unviable price point of tens of thousands of Euros per vehicle.**

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# Easy-OBU will apply new technologies and scientific methods to radically cut the cost of the localization information improvement

## User focused design and ...

- one simple OBU that does not need anything but a power cord to connect with the car
- standard location information (GPS and EGNOS) when GPS is available
- improved location information for loss-of-signal situations when GPS is unavailable

**&**

## ... the technology behind

- motion sensors integrated into the OBU (gyroscope, accelerometer)
- Application of non-causal filtering that delivers great location information improvement even in combination with low-cost sensors
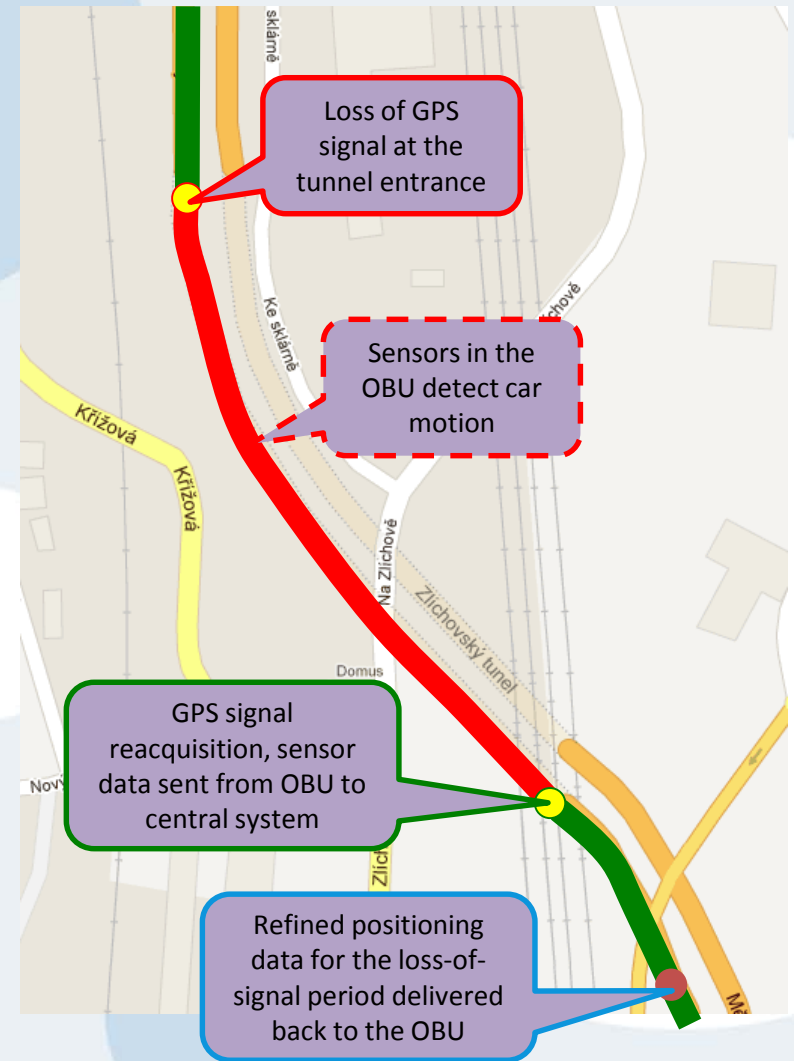- Open interfaces for integration

**Simple, cost effective and commercially attractive solution for location information improvement able to compensate 95% of signal outages and ready for integration into various ecosystems**
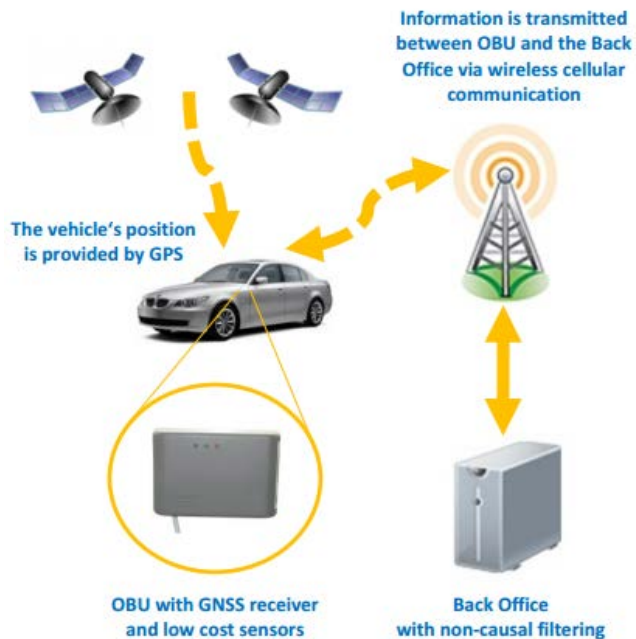
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# Easy-OBU can offer location precision improvement to applications that do not insist on real time availability of the location information

**The only limitation of Easy-OBU (and a "price" paid for the low cost of the unit) is availability of the refined positioning data only after a short delay.**

**Easy-OBU is suitable only for applications that do not necessarily require the improved location information in real time:**

- Shortly after leaving the tunnel, but not during the signal loss in the tunnel

- Examples of such applications may include:

  - Fee collection (tolling, parking etc.)

  - Car Sharing pay-per-use models

  - Route controlling (e.g. hazardous goods transport monitoring

  - Fleet monitoring with analytics that requires a more precise location information

  - Insurance



Loss of GPS signal at the tunnel entrance

Sensors in the OBU detect car motion

GPS signal reacquisition, sensor data sent from OBU to central system

Refined positioning data for the loss-of-signal period delivered back to the OBU

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Information is transmitted between OBU and the Back Office via wireless cellular communication

The vehicle's position is provided by GPS

OBU with GNSS receiver and low cost sensors
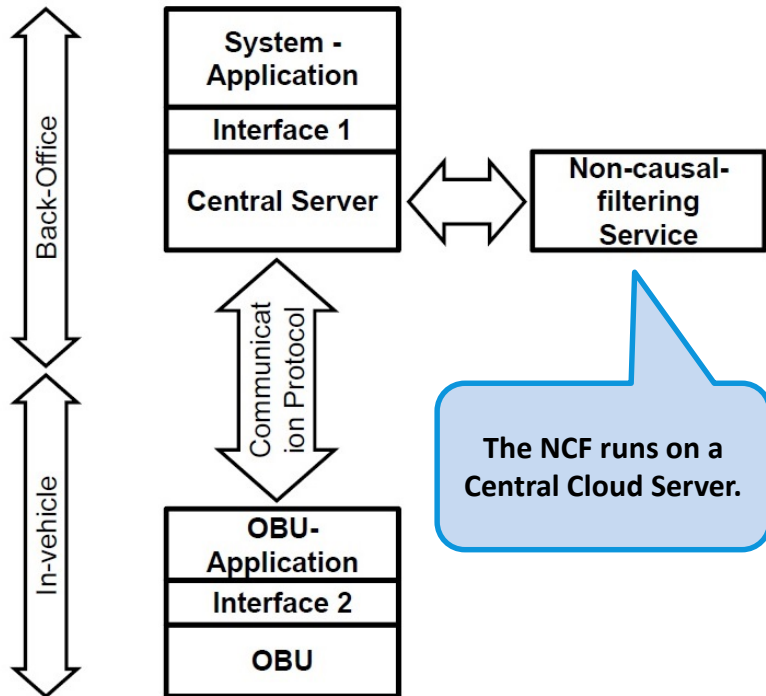
Back Office with non-causal filtering

# Major impact of Easy-OBU is robust position estimation also in situation with GNSS outages due to the novel filtering approach.
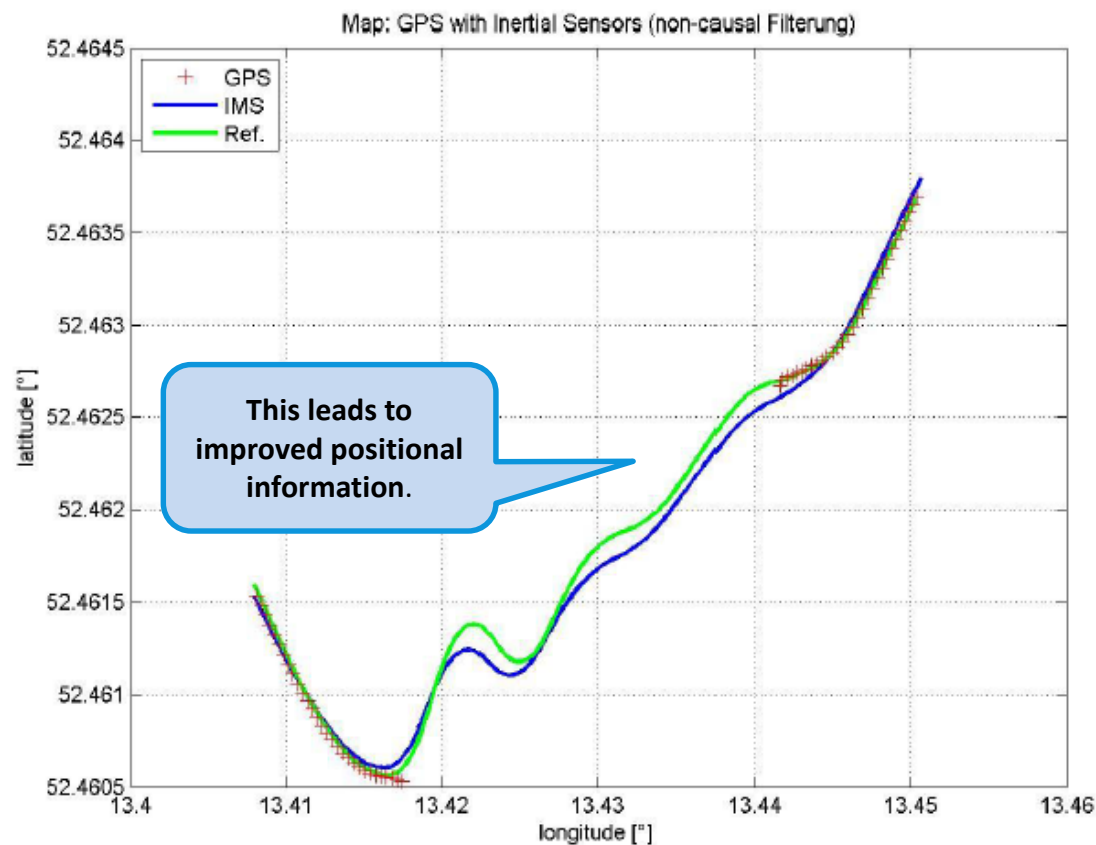
## Basic components of Easy-OBU system:
- ✓ On Board Unit
- ✓ Central Server
- ✓ Non-Causal Filtering

## The System Architecture enables the most economic solution.



Back-Office

In-vehicle

System - Application

Interface 1

Central Server

Non-causal-filtering Service

Communication Protocol

OBU-Application

Interface 2

OBU

The NCF runs on a Central Cloud Server.

- ➢ the non-causal filter algorithms shall be located in **the central server**
- ➢ OBU contains **cheap internal sensors – gyroscope and accelerometer**
- ➢ the Easy-OBU system provides **two open interfaces**: Interface 1 and Interface 2
  - • Interface 1 - development of different applications based on the available data in the back-office.
  - • Interface 2 - the design and development of different OBU types according to the requirements of the different use cases.

# The innovative NON-CAUSAL FILTERING approach will cover GNSS outage and provide the necessary data.



Map: GPS with Inertial Sensors (non-causal Filterung)

Legend:
- GPS (+)
- IMS
- Ref.

This leads to improved positional information.

## The non-causal filtering…

… has the capability to work **without costly side effects**

… needs **„less real time"** capability (retrospective robustness)

… bridges the times of GNSS outages with **1 Hz update** rate, but with a short time delay

… is based on **using low-cost sensors**

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# Tunnel sections are the most common examples of GNSS outages.



Position-Error during GPS-Outage
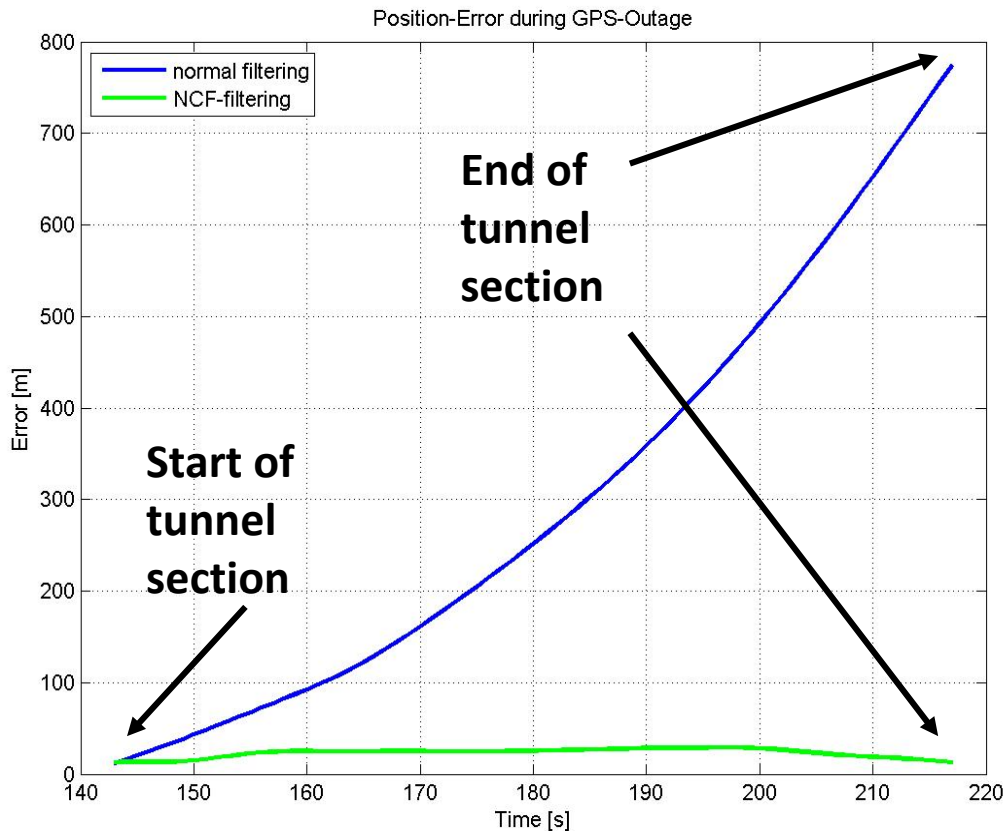
**Thanks to the NCF algorithm the error is NOT rising with extending the gap of time outage.**

✓ the gap has been bridged with **much smaller position-error**

✓ the maximum error of NCF stays **below 30 meters**, which states **a reduction of over 95%** of the error reached by classical filtering algorithms

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# ITS&S

## Czech National ITS Association



- Founded in 2000 as ITS&S Czech Republic
- +80 Czech and Slovak companies & institutions on board
- Member of the Network of ITS National Associations
- Discussion partner to public sector
- Partnership with other Czech professional associations active in transport

http://www.sdt.cz/

# Thank you very much for your attention!

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