

# AN ADVANCED WINTER ROAD MAINTENANCE APPLICATION

**FABRIZIO DOMINICI**

**ISTITUTO SUPERIORE  
MARIO BOELLA**



Innovation Center



Trento, 05/02/2015



Who we are?

# ISTITUTO SUPERIORE MARIO BOELLA



ISMB is a non-profit Research & Innovation Center founded by **Compagnia di San Paolo** and Politecnico di Torino. It counts more than 130 researchers, expressing high competences on the **ICT domain** and their related applications working on **R&D projects**. The main goal is to create **value-driven and socially relevant technological & process innovations** in close collaboration with industry and institutions.



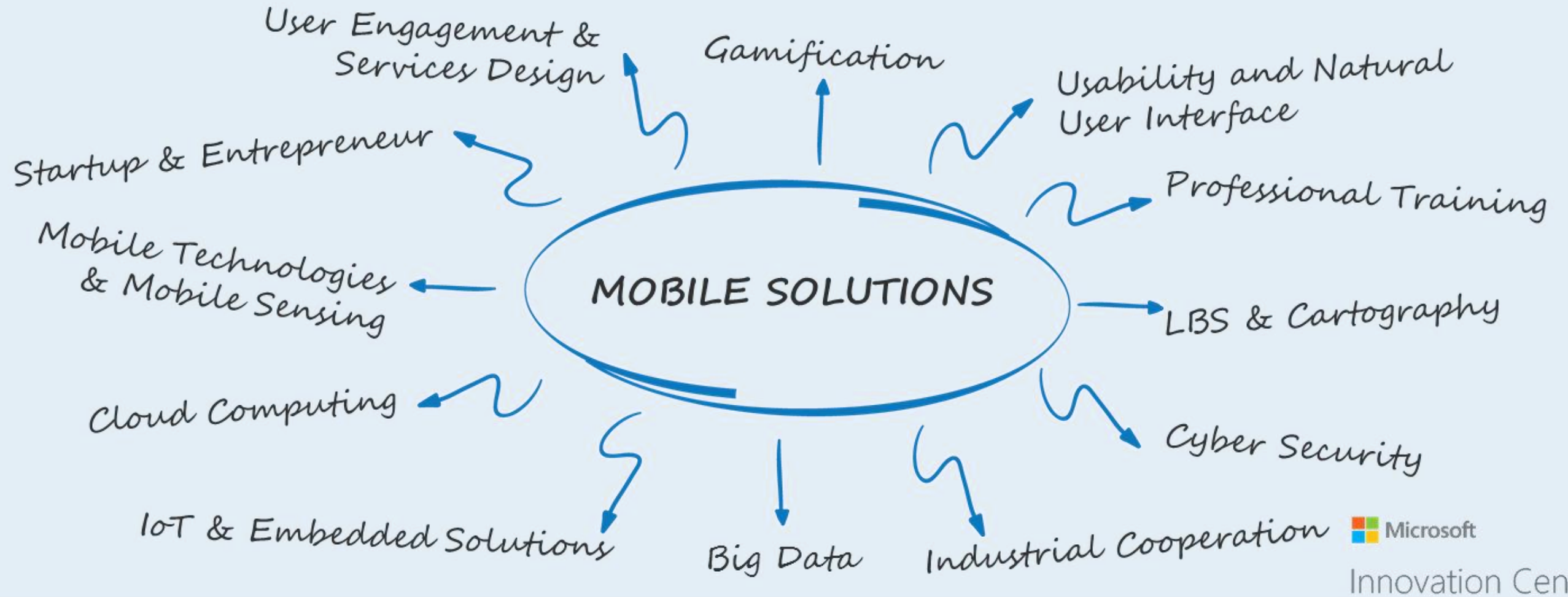
**POLITECNICO  
DI TORINO**

# MOBILE SOLUTIONS AREA

The research area works in the domain of **Mobile Solutions** and the emerging paradigms of **Big Data**, aiming to support the **innovation of products and processes** realizing **end to end solutions**. In particular, the area is focused on the research and development on **Smart Device** applications connected to back-ends based on **Cloud Computing** technology to provide added value services by means of a smart data management



# MOBILE SOLUTIONS AREA



# An Advanced Winter Road Maintenance Application



Innovation Center



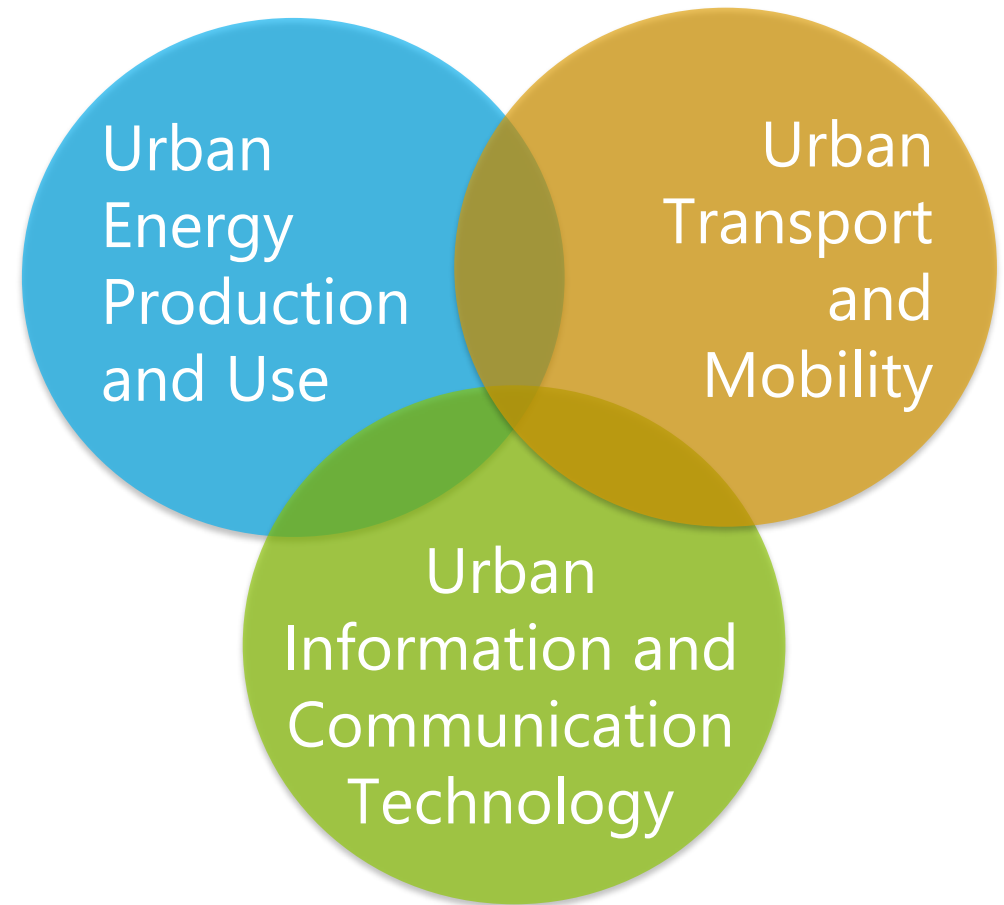


# A DEFINITION OF A SMART-CITY

**Cities** are the place of the world where the bulk of the **consumption of energy and non-renewable resources is concentrated.**

This implies that the innovations which must guide us towards a new model of **sustainable development** should be experimented first of all within cities, where they may cause more benefits.

A Smart City is a city where research and innovation aim toward the target of triple sustainability: **social, economic** and **environmental.**



# ROAD WINTER MAINTENANCE IN A SMART CITY

The **winter maintenance innovation** and its project aims at helping to reach all the three sides of the sustainability triangle.





# THE INNOVATION ROADMAP

Ecosat10: the new **embedded product** available and ready for the next innovation step



**Advanced navigation** concepts and applied research for a competitive advantage

Definition of the innovation of product and process, Requirements sketch out and PoC realization

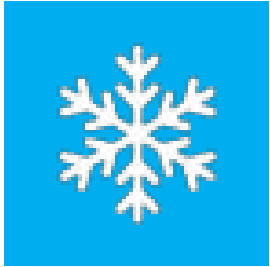


State of the art analysis, process evaluation, technology assessment

Introduction of the **cloud computing** concept following the intelligent system paradigm, focus on data aggregation and a smart-centralized control of the on field resources



# BRINGING SALT SPREADING TO THE CLOUD



Roads have to be maintained open and safe, even in the worst winter conditions



Improved road security, intelligent device management and spreading operations certification



PAs and road managers needs to reduce costs without reducing the quality of the service



Environmental preservation thanks to the general salt usage reduction



Operations can be automated and improved by means of an advanced use of ICT technologies

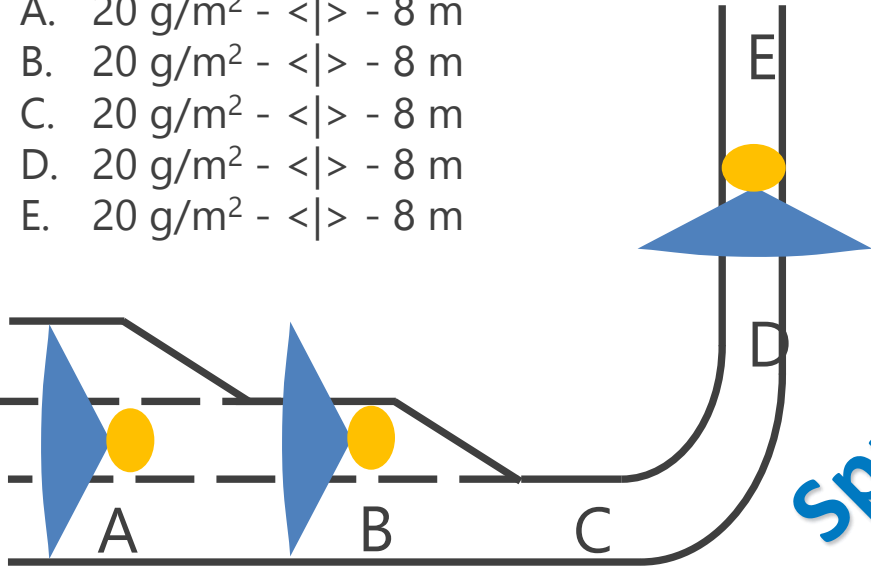


Data collection and analysis on cloud services, assistance to forecasting and decision making

# THE AUTOMATIC SPREADING CONCEPT

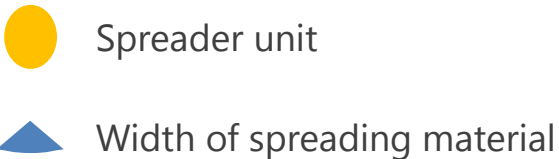
## Wrong Spreading Fixed geo-salting treatment

- A. 20 g/m<sup>2</sup> - <|> - 8 m
- B. 20 g/m<sup>2</sup> - <|> - 8 m
- C. 20 g/m<sup>2</sup> - <|> - 8 m
- D. 20 g/m<sup>2</sup> - <|> - 8 m
- E. 20 g/m<sup>2</sup> - <|> - 8 m



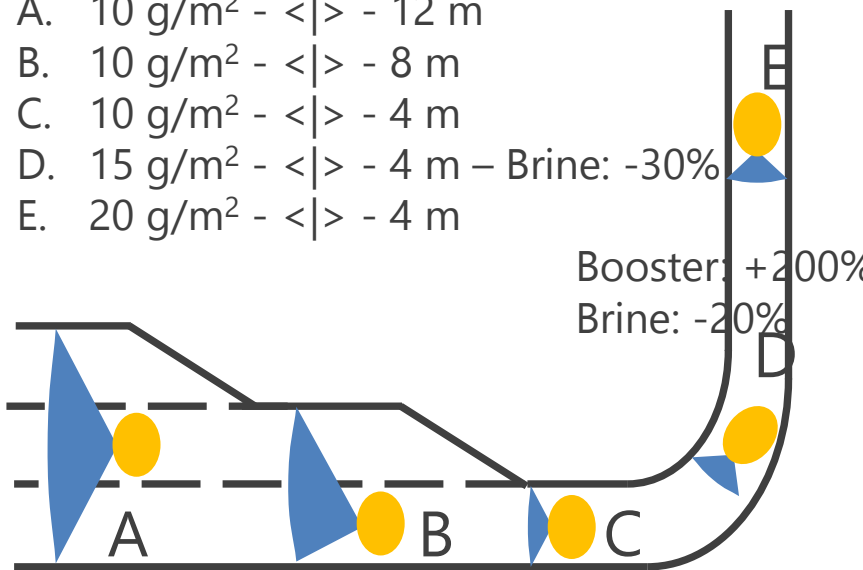
- A. 3 lanes (12 m)
- B. 2 lanes (8 m)
- C. 1 lane (4 m)
- D. Porus asphalt
- E. Bridge: 1 lane (4 m)

Spread the right quantity  
at the right time  
in the right position



## Right Spreading Green geo-salting treatment

- A. 10 g/m<sup>2</sup> - <|> - 12 m
- B. 10 g/m<sup>2</sup> - <|> - 8 m
- C. 10 g/m<sup>2</sup> - <|> - 4 m
- D. 15 g/m<sup>2</sup> - <|> - 4 m – Brine: -30%
- E. 20 g/m<sup>2</sup> - <|> - 4 m



- A. 3 lanes (12 m)
- B. 2 lanes (8 m)
- C. 1 lane (4 m)
- D. Porus asphalt
- E. Bridge: 1 lane (4 m)

# Internal NavCOM Unit (GNSS + IMU + 3G)

RTCM  
Augmentation

GMS Network



Maps view

Audio-Video Alerts

CEN-TC337  
EN15430-1  
Serial Interface

Ext SatCOM  
Interface

Data  
Download

Spreading Parameters

Spreader Functionalities

Snowplough  
Controls



Dedicated CAN Bus line for plough and spreading

Plough Power Pack

Spreader Power Pack

**ON BOARD UNITS**



- GNSS and IMU integration
- Position performance enhancement by means of EDAS augmentation
- Compliances with CEN standards

- Data transfer from the WSM to the OBUs for pre-route and on-route information
- Telemetry and Missions management
- Augmentation provisioning

- Corrections over RTCM protocol

**Winter Services Middleware (WSM)**

OBU's Management Interface 

- Augmentation Provisioning
- On-route Services
- Pre-route Services
- ...
- ...
- Telemetry and Tracking

Data Processing

Data Integration and Analysis

Data Provisioning Interface  
(i.e. for a decision support)

**USERS INTERFACE**

Road Management Systems  
(i.e. Highway Systems)

**SPACE ASSETS AND SERVICES**

**Satellite Navigation Augmentation**

Local Area Systems (DGPS Network)

Wide Area Systems (EGNOS/EDAS)

**Earth Observations**

Weather Forecasts and Snow Information

Road Weather Information

Digital Information (i.e. road boundaries, bus stops)

**THIRD PARTY SYSTEMS**

Traffic Information (from road systems)

Road Database

Geo information (e.g. aerial images)



# THE EARTH OBSERVATION ROLE



Road Polygon



Road Centerline



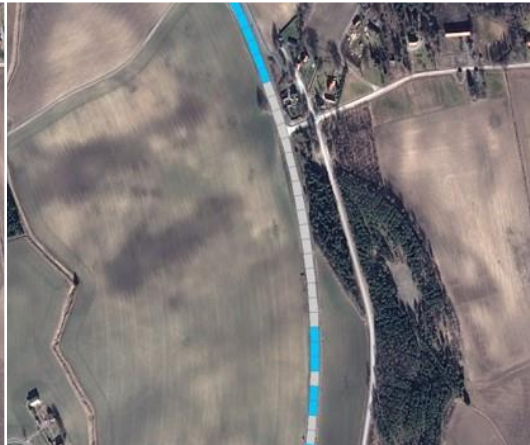
Road Boundary



Road Features



Road Segments  
(Width)



Road Segments  
(Snow)

**Very High  
Resolution Images**  
Very high details  
Resolution: 0.3-1 m  
High Cost (around  
10 E/Km<sup>2</sup>)



**High Resolution  
Images**  
Good level of  
details  
Resolution: 1-20 m  
Lower costs (around  
2-4 E/Km<sup>2</sup>)



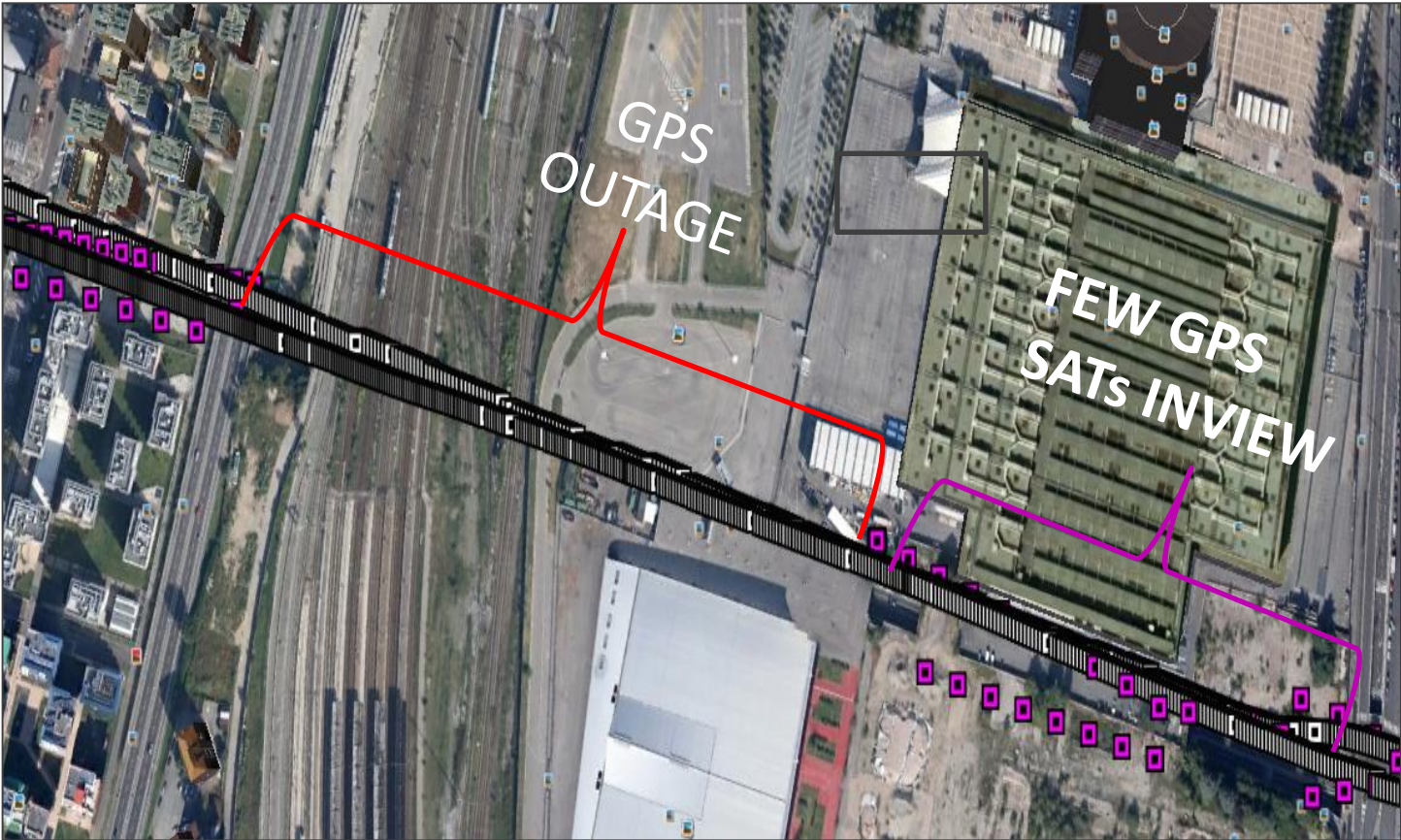


# THE ROBUST POSITIONING

URBAN CANYON



UNDER A TUNNEL



- GPS ONLY
- GPS/INS

# THE PROOF OF CONCEPT RUNNING IN THE NORTH

December 2014

January 2015

February 2015

March 2015

PoC Design

PoC Technical Verification

PoC User Validation  
(test fields in Sweden)

Phase 0

Phase 1

Phase 2

Västerås (SWEDEN)

Demo  
(in Norway)

POC STARTED!!!





# ADDED VALUES FROM THE SYSTEM



Test results:  
- 20% salt usage



Flexible and  
secure  
service



Data mining  
in cloud



Trusted  
positioning



Environmental  
impact reduction

