Jupiter

GNSS Training for ITS Developers

Exploitation of EGNOS and EDAS for road applications

European Global Navigation Satellite Systems Agency

HORIZON 2020

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Exploitation of EGNOS and EDAS for road applications

- Road Traffic Management – Main Issues
- EGNOS/EDAS and Road User Charging
- Increasing Road Safety
- Improving Fleet Management and public transport
- EGNOS/EDAS for driver assistance

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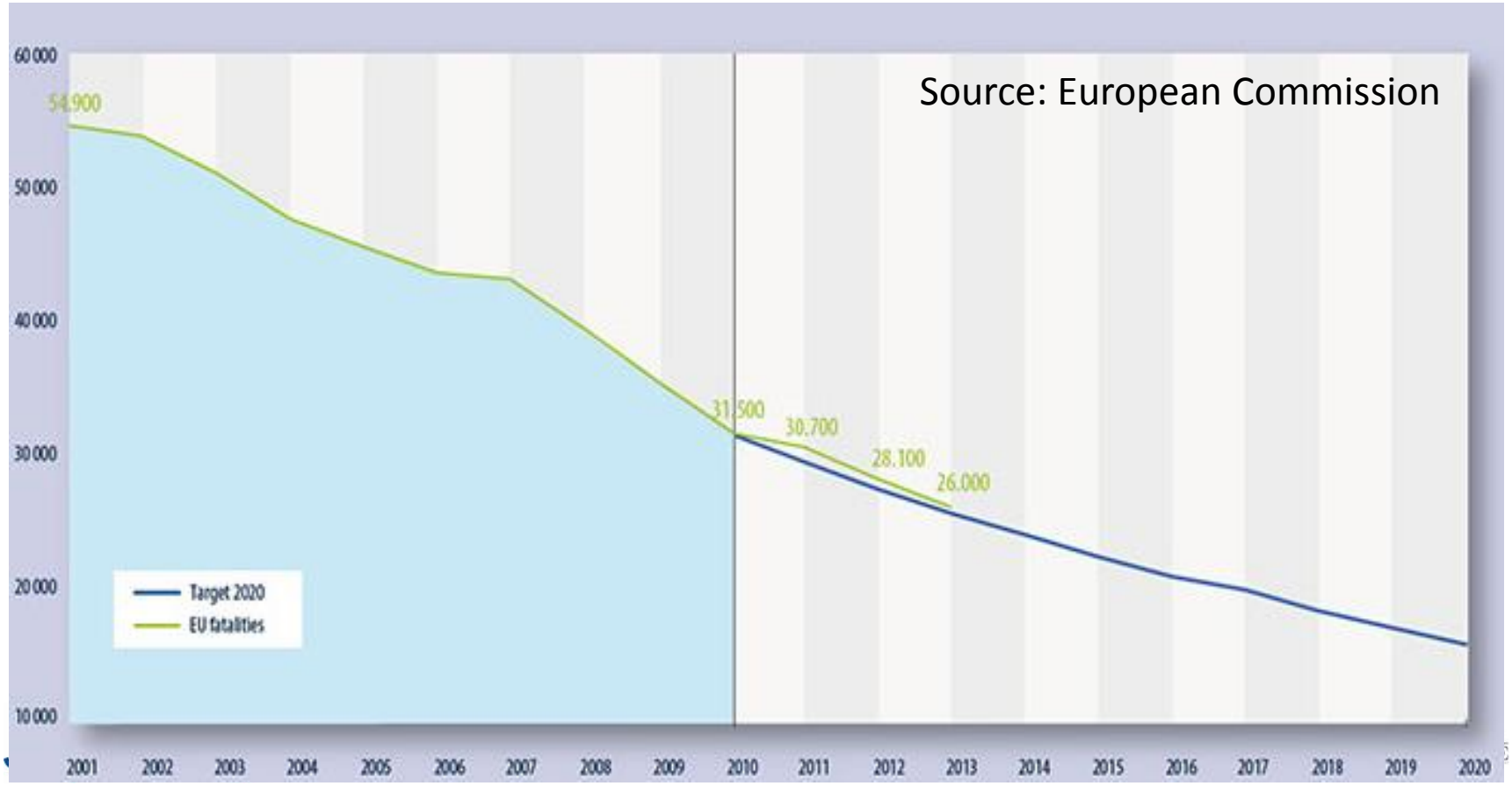
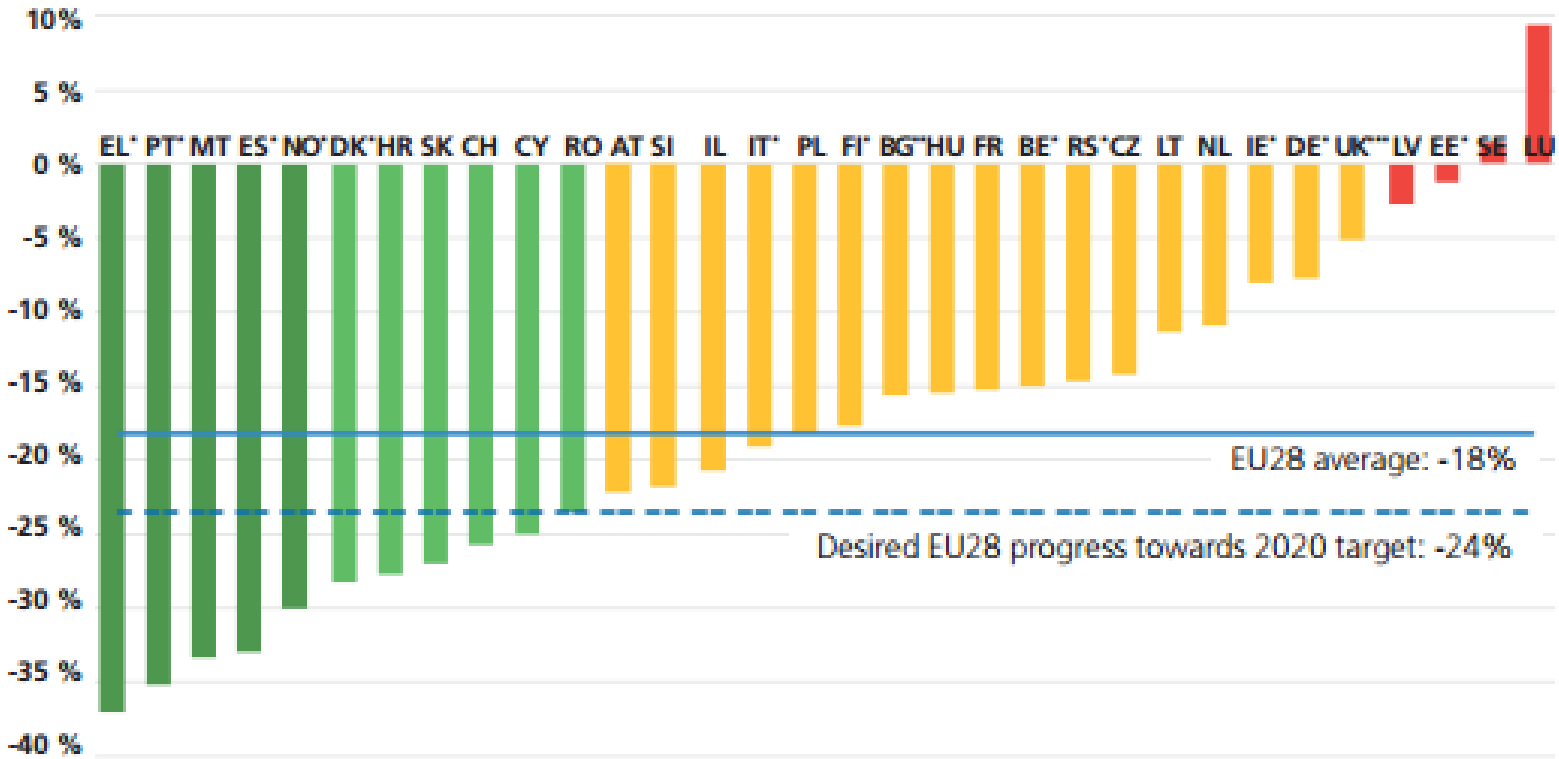
Issue 1: Road Safety - Status

25845 people died on the roads of the European Union in 2014.



Issue 1 – Road Safety - Status

Percentage change in road deaths between 2010 and 2014 (Source: ETSC – June 2015)



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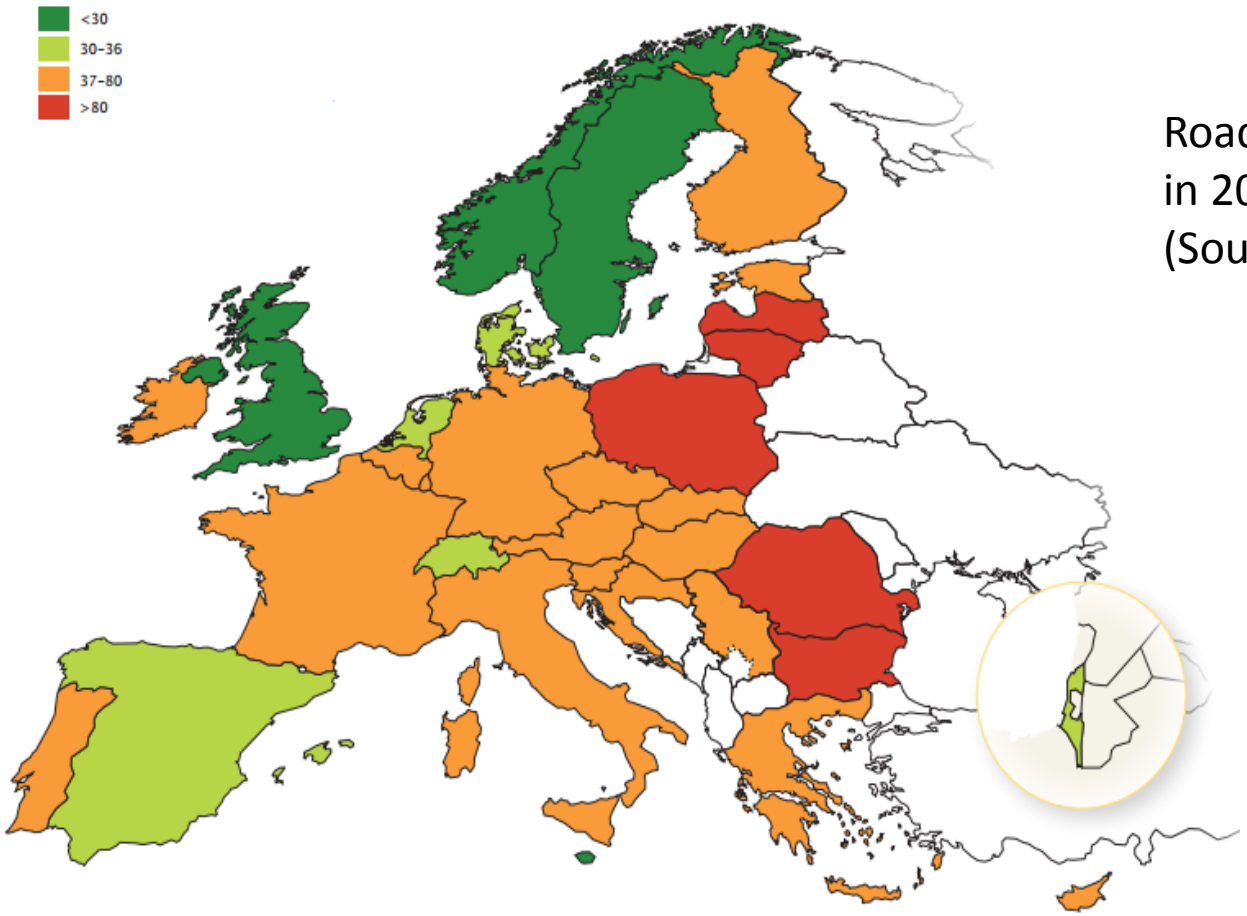


Road death per million inhabitants in 2014
(Source ETSC)

Issue 2: Pollution - Status

Air pollution:

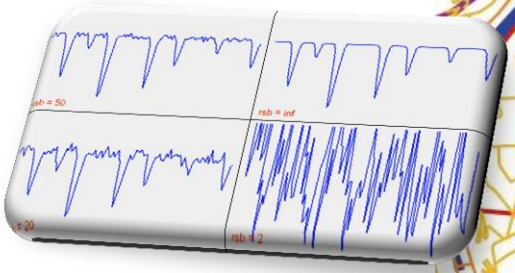
- Transport is one of the main sources of air pollution, for which evidence on direct effects on mortality as well as on respiratory and cardiovascular disease is firmly established.
- About 100 000 premature adult deaths attributable to air pollution occur each year in the WHO European Region. Emissions from road traffic account for a significant share of this burden.
- Some 40 million people in the 115 largest cities in the European Union (EU) are exposed to air exceeding WHO air quality guideline values for at least one pollutant.

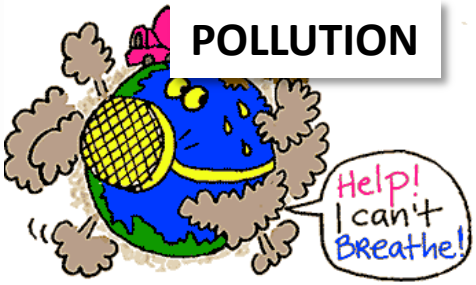
Source: WHO, June 2015

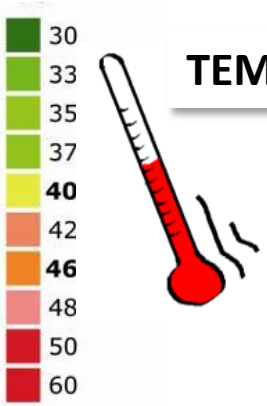
Issue 2: Pollution – Most Polluted Cities

Number of days of PM_{10} exceedances of EU limit value of 50 ug/m³ (daily mean)		Number of days of O_3 exceedances of EU target value of 120 ug/m³ (maximum daily 8 hours mean)		NO_2 annual mean concentrations in ug/m³ (the EU limit value is 40 ug/m³)	
Plovdiv, Bulgaria	208	Turin, Italy	77	Brescia, Italy	62
Pleven, Bulgaria	185	Campobasso, Italy	74	Turin, Italy	60
Sofia, Bulgaria	176	Bologna, Italy	72	Brasov, Romania	58
Krakow, Poland	152	Bergamo, Italy	69	Modena, Italy	50
Timisoara, Romania	136	Athens, Greece	68	Milan, Italy	49
Rybnik, Poland	122	Novara, Italy	65	Trieste, Italy	48
Nowy Sacz, Poland	116	Cremona, Italy	64	Rome, Italy	43
Craiova, Romania	112	Brescia, Italy	64	Athens, Greece	42
Zabrze, Poland	108	Milan, Italy	62	Padua, Italy	41
Turin, Italy	106	Reggio nell Emilia, Italy	61	Genoa, Italy	41

Issue 2: Pollution - Measurments







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Telespazio
A Finmeccanica/Thales Company
GUIDE

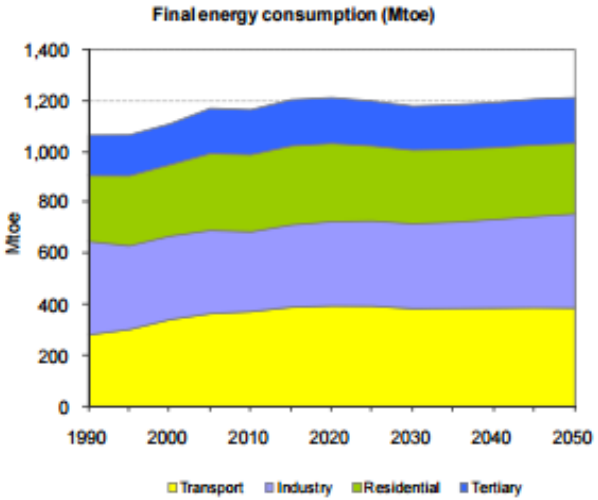
Issue 2: Pollution – CO_2 emission

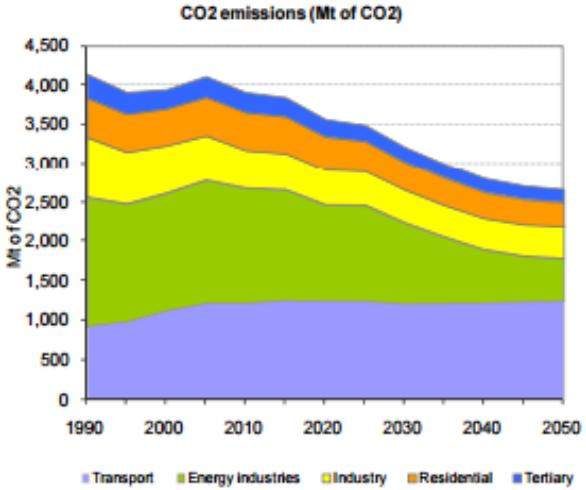
Carbon Emission:

- Transport = fastest growing source of carbon emission (largest contributor to greenhouse effect and climate change)
- +20% net increase of greenhouse-gas emission in 10 years (source: WHO, June 2015)
- Indirect effects, such as the wide range anticipated from climate change, are becoming increasingly evident.

Issue 2: Pollution - Forecasts

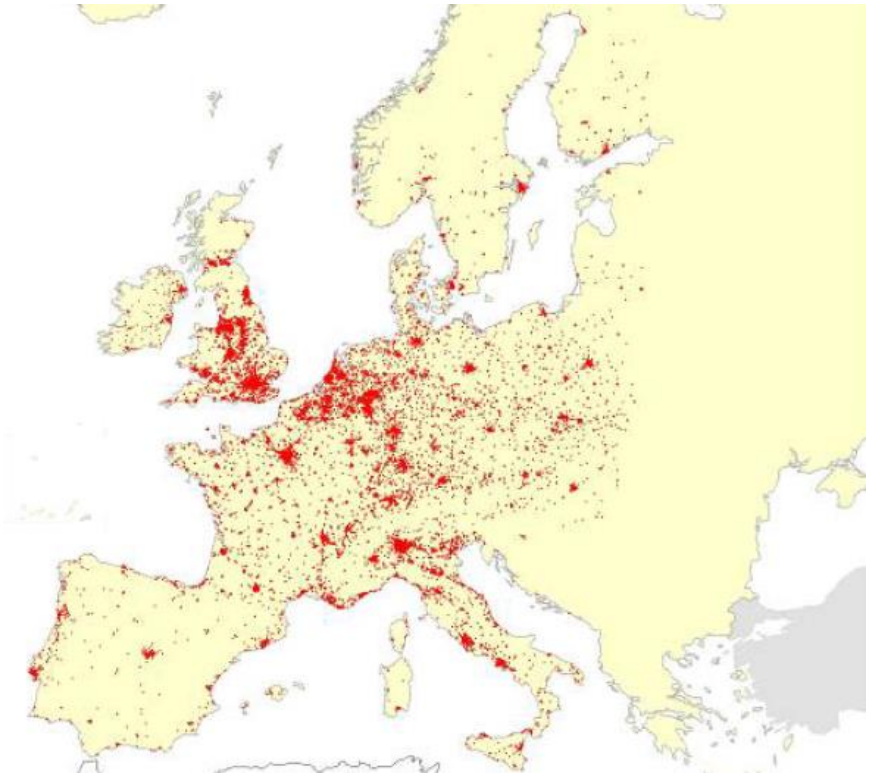
- Transport accounts for over 30% of final energy consumption and about one fourth of CO2 emissions
- CO2 emissions from transport are projected to be 1% below their 2005 level by 2030 and roughly stabilise afterwards
- The share of CO2 emissions from transport would continue increasing, to 38% of the total by 2030 and almost 50% by 2050





(Source: PRIMES)

Issue 3: Congestion - Status



- Over the past 30 years, the number of car in EU doubled and the distances covered tripled.
- 10% of EU roads are congested on daily basis.
- Most congested countries (source: INRIX – June 2015):
  - Belgium
  - UK
  - The Netherlands

The most congested local road links in Europe.
Source: Transtools 2010

Issue 3: Congestion - Status

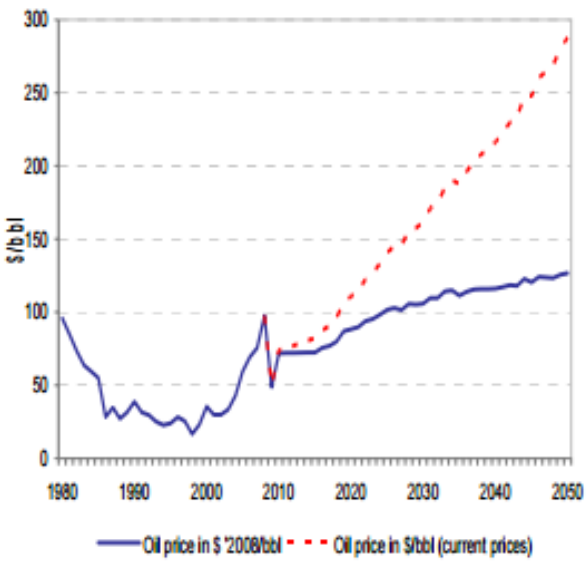
Congestion Classification: Average Delay per km during one hour peak period (Source: Transtools 2010)

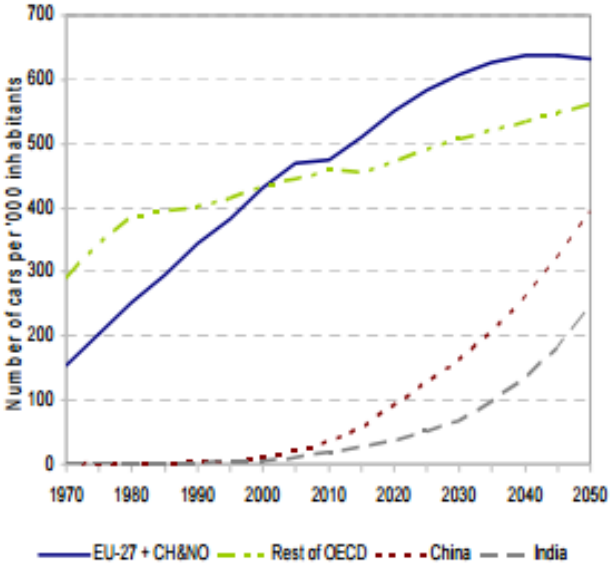
	Average delay per km (seconds)				
	1 to 5	5 to 10	10 to 20	Higher than 20	Higher than 10
United Kingdom	48.2%	25.7%	11.1%	8.8%	19.9%
Belgium	42.7%	35.1%	12.6%	6.4%	19.1%
Netherlands	46.3%	32.0%	11.6%	6.4%	18.0%
Luxembourg	44.5%	36.2%	9.6%	5.8%	15.3%
Germany	46.7%	36.8%	9.5%	4.3%	13.8%
Italy	50.7%	25.2%	7.9%	4.7%	12.6%
Hungary	65.7%	19.0%	7.3%	4.1%	11.4%
Poland	60.8%	21.7%	6.4%	4.5%	10.9%
Slovakia	57.8%	26.6%	7.6%	2.6%	10.2%
Ireland	61.8%	18.7%	5.2%	4.1%	9.3%
Czech Republic	52.8%	28.0%	6.3%	2.5%	8.8%
Austria	55.7%	28.4%	5.8%	2.7%	8.5%
France	61.1%	19.4%	5.3%	2.7%	7.9%
Portugal	57.3%	21.0%	5.5%	2.3%	7.9%
Denmark	62.8%	20.9%	5.2%	2.3%	7.5%
Sweden	70.7%	13.6%	3.5%	1.5%	5.0%
Spain	68.2%	16.8%	3.7%	1.2%	4.9%
Lithuania	78.6%	9.4%	1.9%	1.7%	3.6%
Estonia	74.4%	8.3%	1.9%	1.2%	3.2%
Finland	74.8%	13.4%	2.1%	0.8%	2.9%

Issue 3: Congestion - Cost

	Annual cost of congestion (€ billion)	Cost of congestion as % of GDP 2009
Austria	1.8	0.6%
Belgium	3.4	1.0%
Czech Republic	0.8	0.6%
Germany	24.2	1.0%
Denmark	1.5	0.7%
Spain	5.5	0.5%
Estonia	0.1	0.8%
Finland	1.4	0.8%
France	16.5	0.9%
United Kingdom	24.5	1.6%
Hungary	0.7	0.8%
Ireland	1.8	1.1%
Italy	14.6	1.0%
Lithuania	0.5	1.7%
Luxembourg	0.3	0.7%
Netherlands	4.7	0.8%
Poland	4.8	1.6%
Portugal	1.2	0.7%
Slovakia	0.3	0.5%
Sweden	2.6	0.9%
Total EU (available countries)	**111.3**	**1.0%**

Oil price evolution



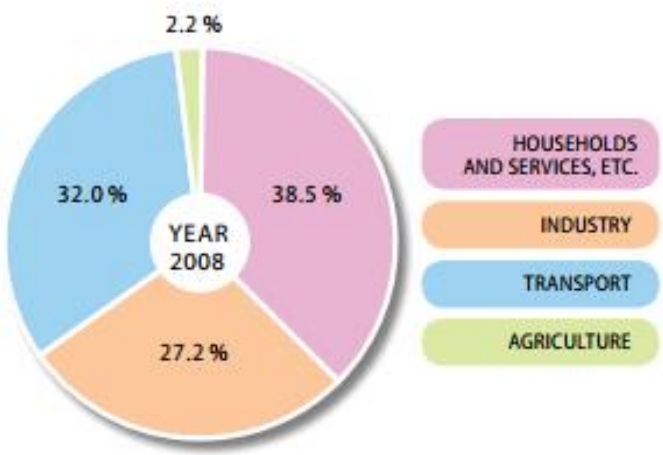


(Source: Prometheus, National Technical University of Athens)

Mean Cost: 1% of the Growth Domestic Product – 111.3 B€

Issue 4 – Fleet Management -Status

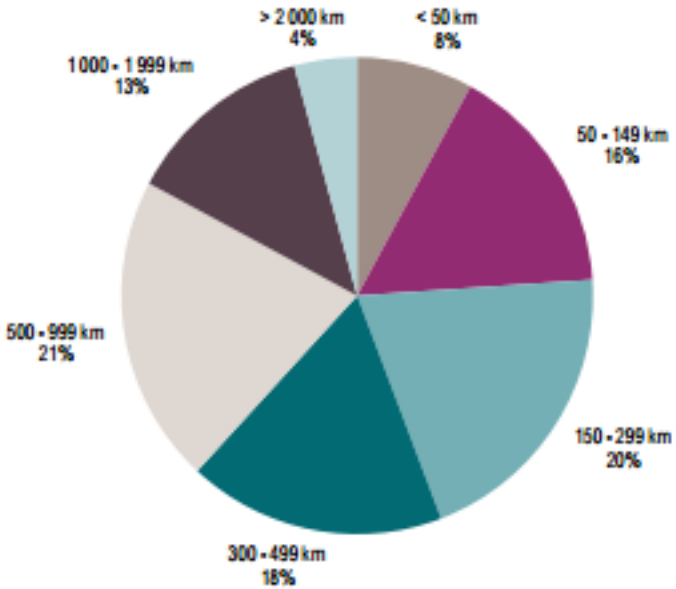
- Main issues:
  - 1/5 of trucks travelling around Europe are carrying nothing.
  - 20% of all truck journeys in the EU are run empty.

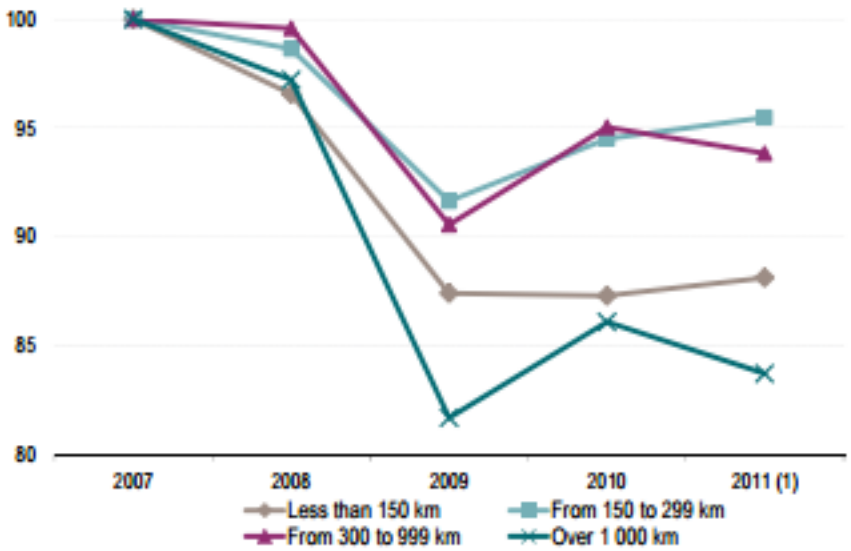


Final Energy Consumption
(source: European Union,2011)

Waste of Fuel and money
Push Up carbon emission and air pollution

Issue 4 – Fleet Management -Distance





Road freight transport by distance class – Source : Eurostat, 2011

Road Traffic Management - Challenges (1/2)

- The main objective of road application are:
  - Safety Improvement:
    - situational awareness through vehicle-to-vehicle and vehicle-to-infrastructure communications, enhancing the safety and comfort of the driver.
    - Improvement of emergency assistance
    - Insurance telematics: increase the fairness of motor insurance for both insurers and subscribers.
  - Carbon emission reduction
    - Better usage of roads and vehicule thanks to Road User Charging

Road Application Challenges (2/2)

- Regulation
  - Better road traffic monitoring through collection of location data from vehicles through PNDs, IVS and mobile devices.
- Fleet Management
  - Better management through OBU.
  - Digital Tachograph for better control and Safety
  - Fuel and Maintenance Management
- Innovation
  - Connected Vehicles
  - Autonomous driving

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EGNOS/EDAS Added Values

- **Better Accuracy**
  - To localize vehicles and accidents (in particular in urban areas)
- **Better Reliability**
  - To trust the positionning and use it in complex systems
- **Integrity**
  - To detect problems quickly

Reducing Pollution

- EGNOS/EDAS simplifies Road User Charging (RUC) system:
  - Definition: Systems where the driver pays directly for use of a particular roadway or road network in a particular city, region or nation.
  - Objective:
    - To reduce pollution (limitation of roads usage)
    - To reduce rush hour peak and congestion
    - To finance roads infrastuctures
    - To reduce noises dued to traffic

RUC Existing projects in Europe

- Existing projects:

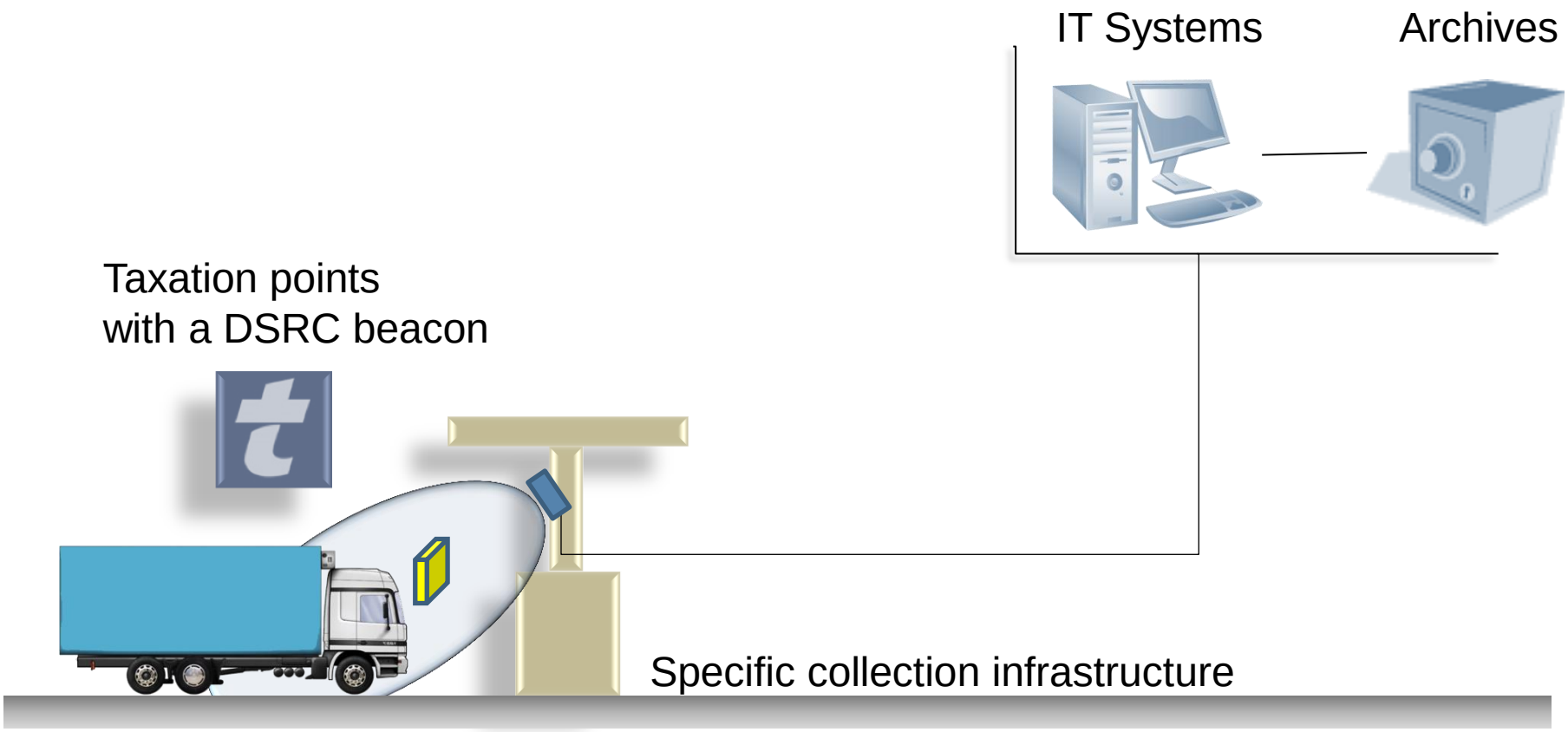
Germany

Czech Republic

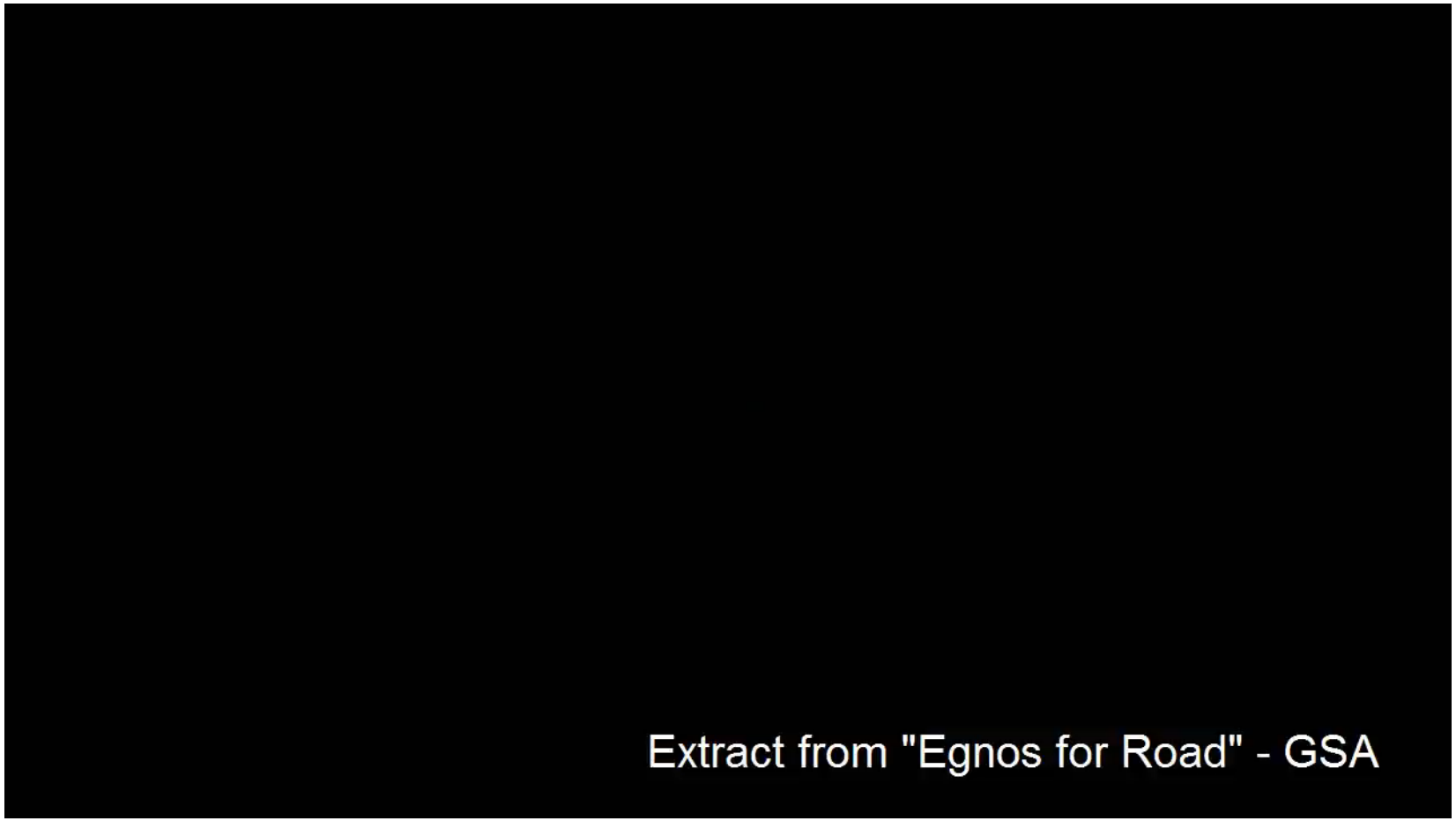
Belgium

Hungary

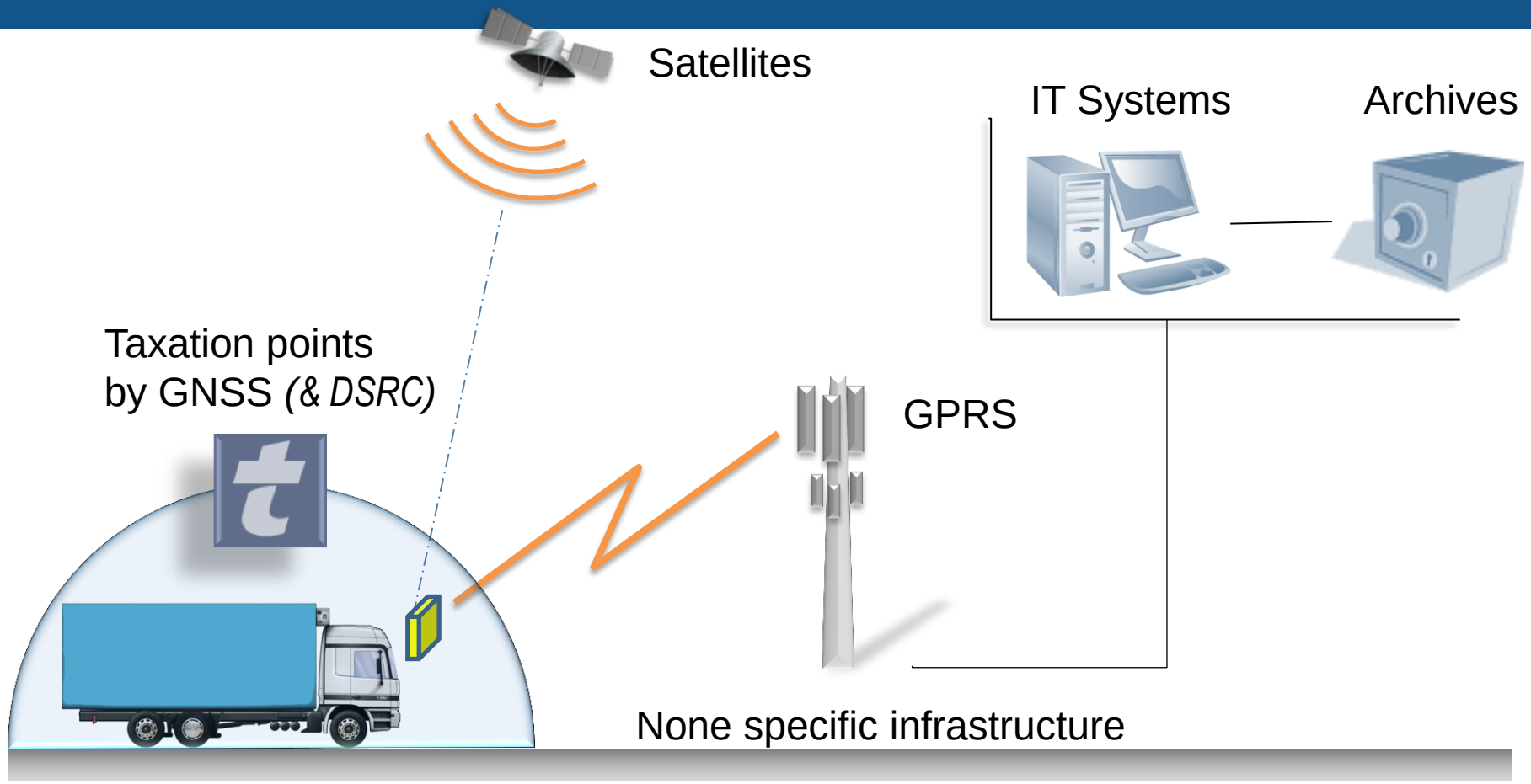
Operating principle with DSRC tag



EGNOS for Road User Charging - Principles

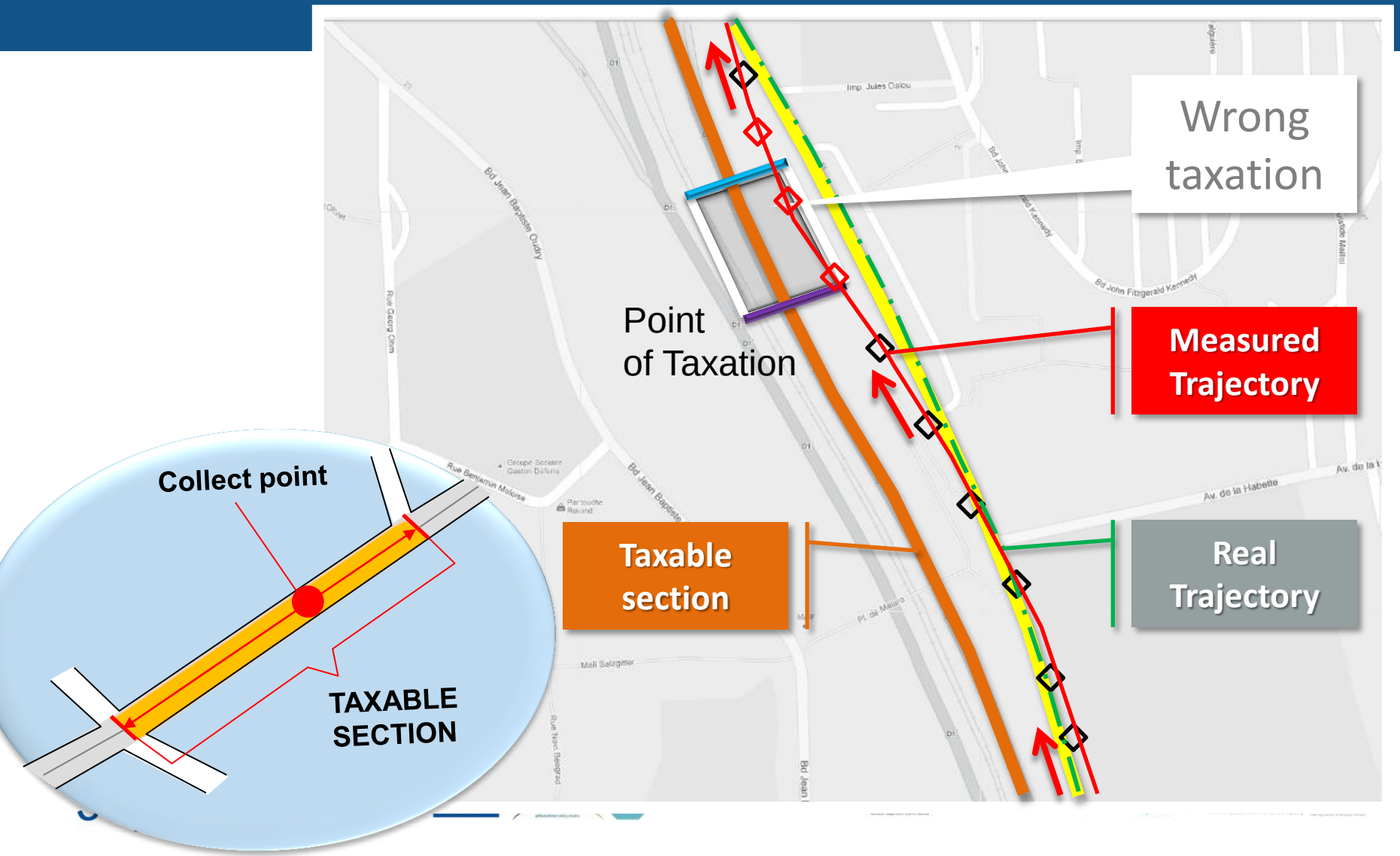


Operation principle with satellite

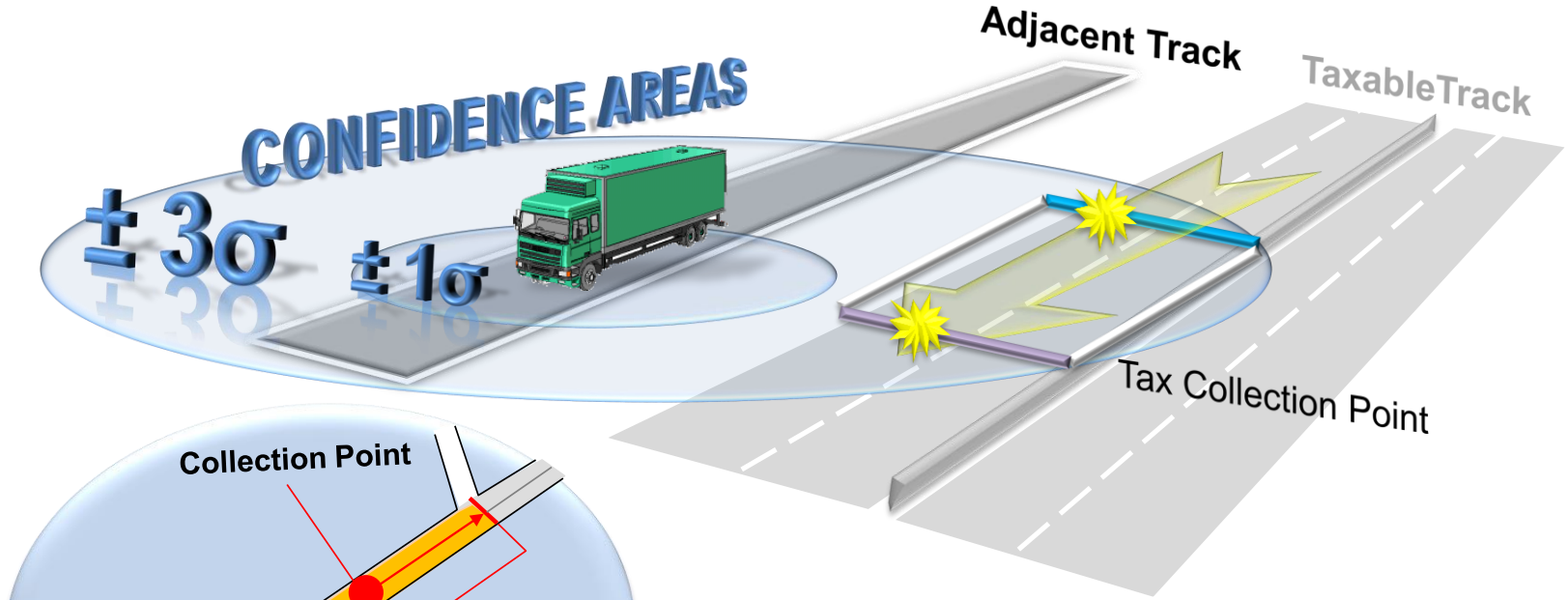


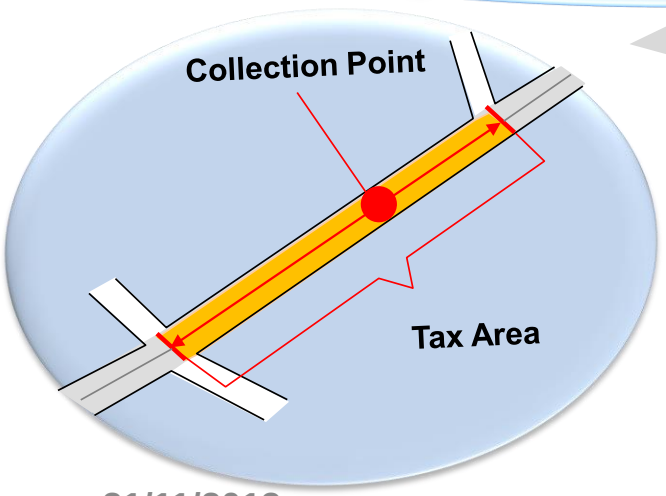
Truck with a GNSS receiver (& DSRC)

Points of taxation



RUC Performance



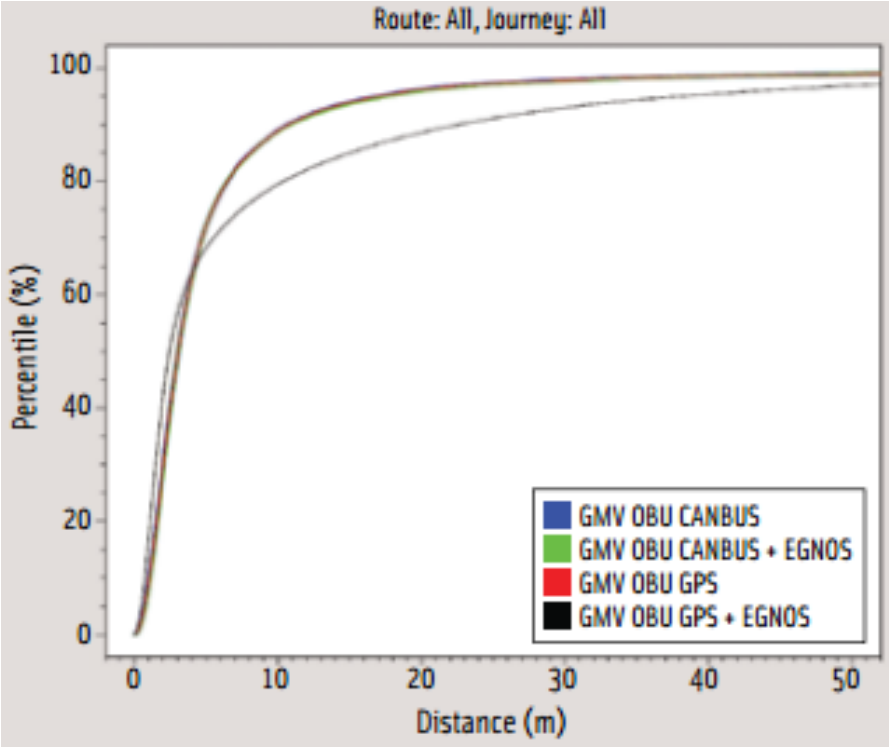


EGNOS/EDAS reduces:

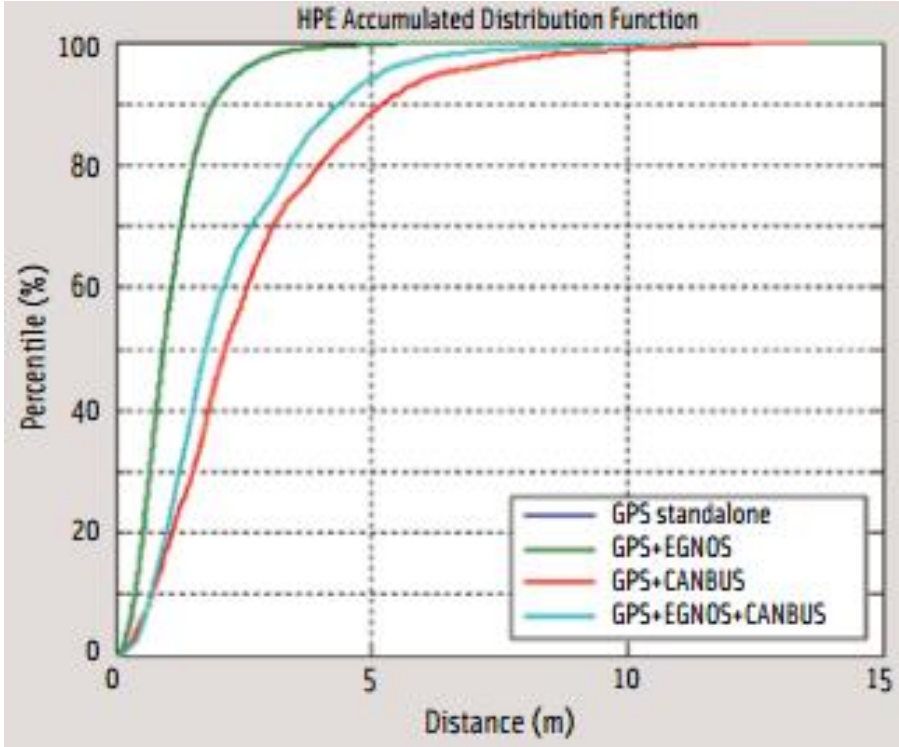
- Infrastructure
- Incorrect charging

and increase trust in the system.

EGNOS Performance



Absolute positionning error (All configuration)



Absolute positionning error (Motorway Only)

Source : Inside GNSS, April 2011

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Safety Improvement – Example of Applications

EGNOS/EDAS provide better positionning to improve:

eCALLING

To know where the accident is.

ADAS – Advanced Driver Assistance Systems

To avoid collisions

PPUI - Pay-Per-Use Insurance

To localize vehicule

Jupiter aerospace valley ERTICO TOPOS Czech Republic Ministry of Transport PildoLabs move smart ISMB Capital High Tech ThalesAlenia Space Telespazio GUIDE

Example of ADAS: ERSEC Project (FP7)

- Collision Avoidance System Project leaded by EICAS
- Automatically deviates the vehicule trajectory just before an impending crash.
- Objective: Accuracy on the order of 0.1 meter at a sampling rate of 100 Hz.
- Intelligent datafusion of the EGNOS/GNSS sensor positioning measurement, the Road-GIS digital local map data and the measurement data obtained from an instrument set installed on board of the vehicle, including vehicle dynamic sensors and environmental sensors.
- More information : http://www.ersecproject.eu/

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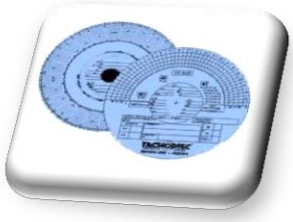
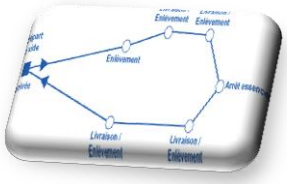
Fleet Management Improvement



DIGITAL TACHOGRAPH – DT

To providing reliable data to any ITS application



ROUTING

To optimize truck journeys

PREVENTIVE MAINTENANCE

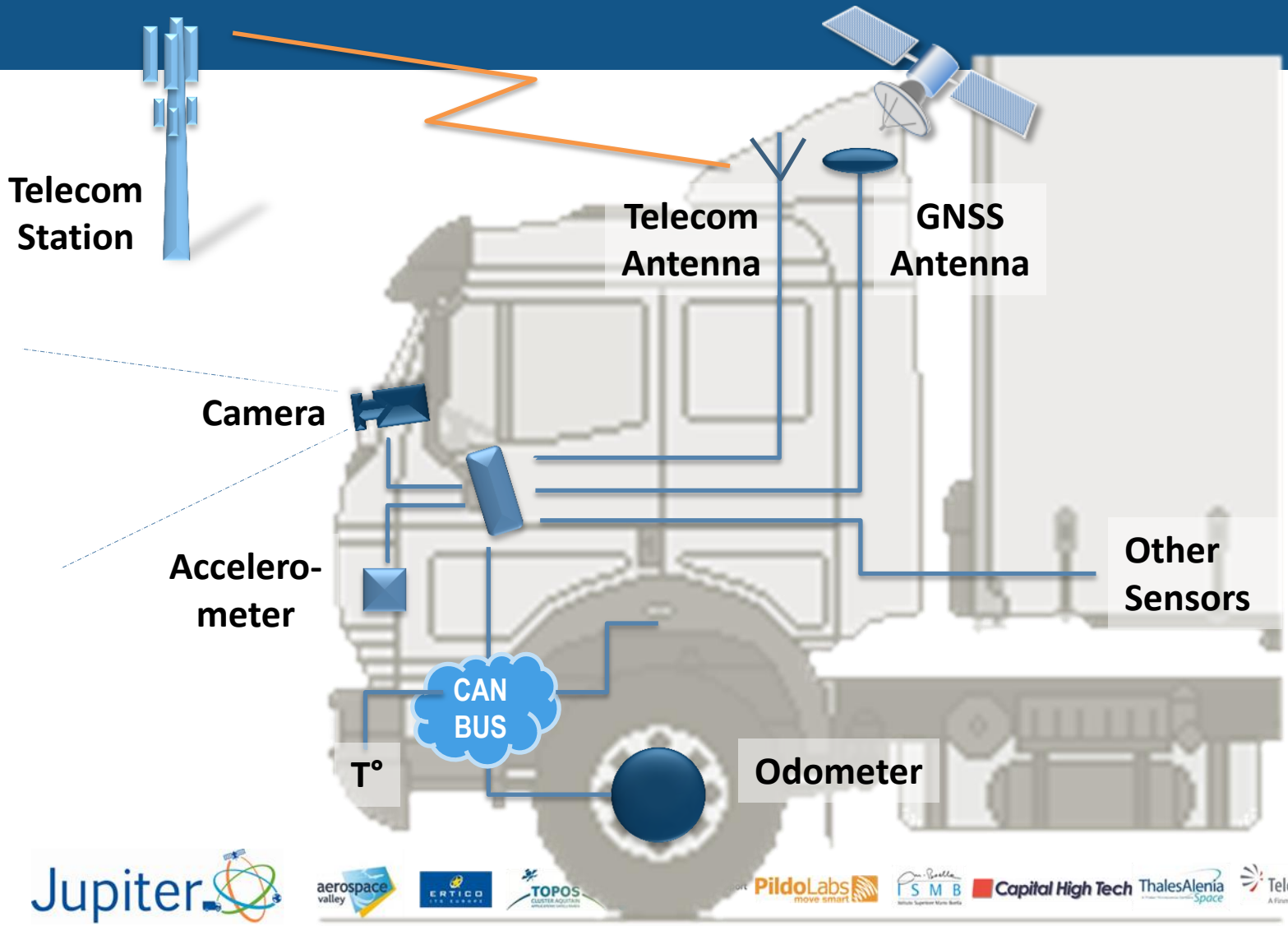
To prevent breakdown by analysing truck usages

FUEL MANAGEMENT

Example of Project : TACOT

- FP7 project granted in 2012 (End of Project: January 2014)
- TACOT: Trusted Multi Application Receiver for Trucks
- This project aimed to prepare the introduction and promote the use of EGNOS and Galileo in the road transportation industry through the realisation of a Trusted GNSS function to be used by the Digital Tachographs (DT)
- PVT reliability rely on multi sensor:
  - EGNOS/GALIELO, GPS and GLONASS
  - On Board Sensors (odometer, secure clock)
  - Other Sensors (time sources, accelerometer)

Architecture Overview



Fleet Management Improvement

LIVESTOCK

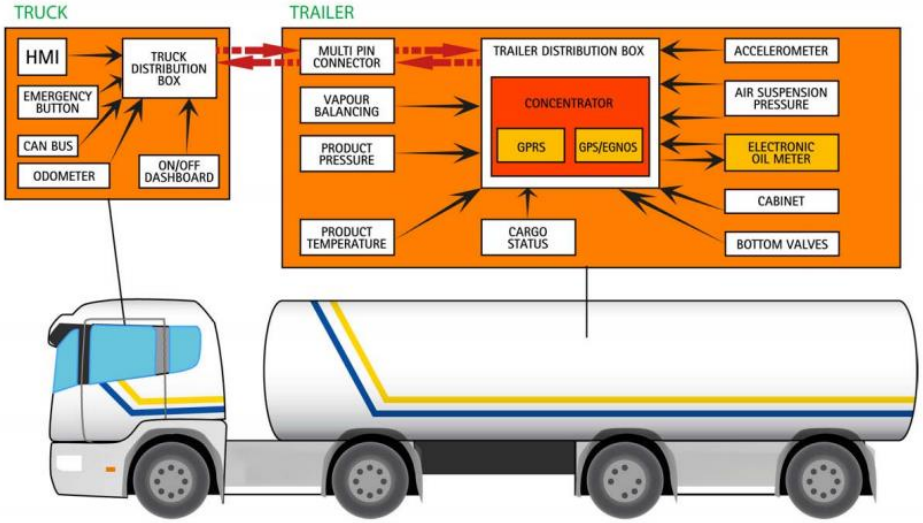
DANGEROUS GOODS

PERISHABLE GOODS

Eg. Cold Chain

SCUTUM

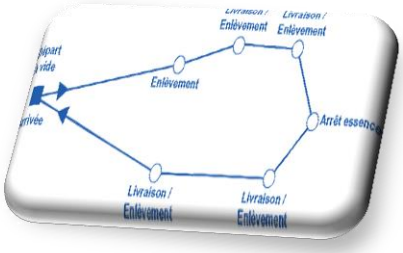
- **SeCUring the EU GNSS adopTion in the dangeroUs Material transport:** European best practice for the operational adoption of commercial services based on EGNOS.
- Wide adoption of EGNOS in Europe for tracking & tracing of dangerous goods transported by road.
- 300 ENI trucks are equipped with GPS/EGNOS (OS and CS) tracking & tracing devices.



Reduce Congestion by traffic management

PERSONAL NAVIGATION DEVICE (PDA)

ROAD TRAFFIC MONITORING



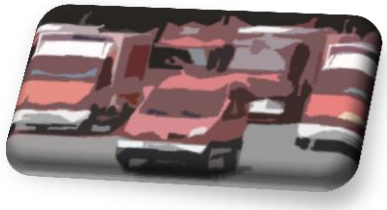
ROUTING

Pay-Per-Use Insurance

- The costs of the insurance depends on the driven distance, the place, the time of driving and the behaviour of the driver.
- Objective: to differentiate and reward "safe" drivers, giving them lower premiums and/or a no-claims bonus.
- Some systems use GNSS signal (e.g. Metromile in US).
- Privacy concerns hinder the development of such systems.

Reduce Congestion by public transport management

PUBLIC TRANSPORTS



EMERGENCY VEHICLES

WASTE COLLECTION VEHICULES

STREET SWEEPERS

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Innovation

- Connected Vehicle:
  - Objective: to provide situational awareness through vehicle-to-vehicle and vehicle-to-infrastructure communications, enhancing the safety and comfort of the driver.

Innovation

- Autonomous Driving:
  - Objective: replace the driver to reduce traffic accident, improve traffic flow and driver comfort.
  - Coupling of several sensors allowing to identify the optimal path of action.
  - EGNOS/EDAS provides accurate and reliable position and speed.

Existing Technologies

Mercedes S-Class Sedan

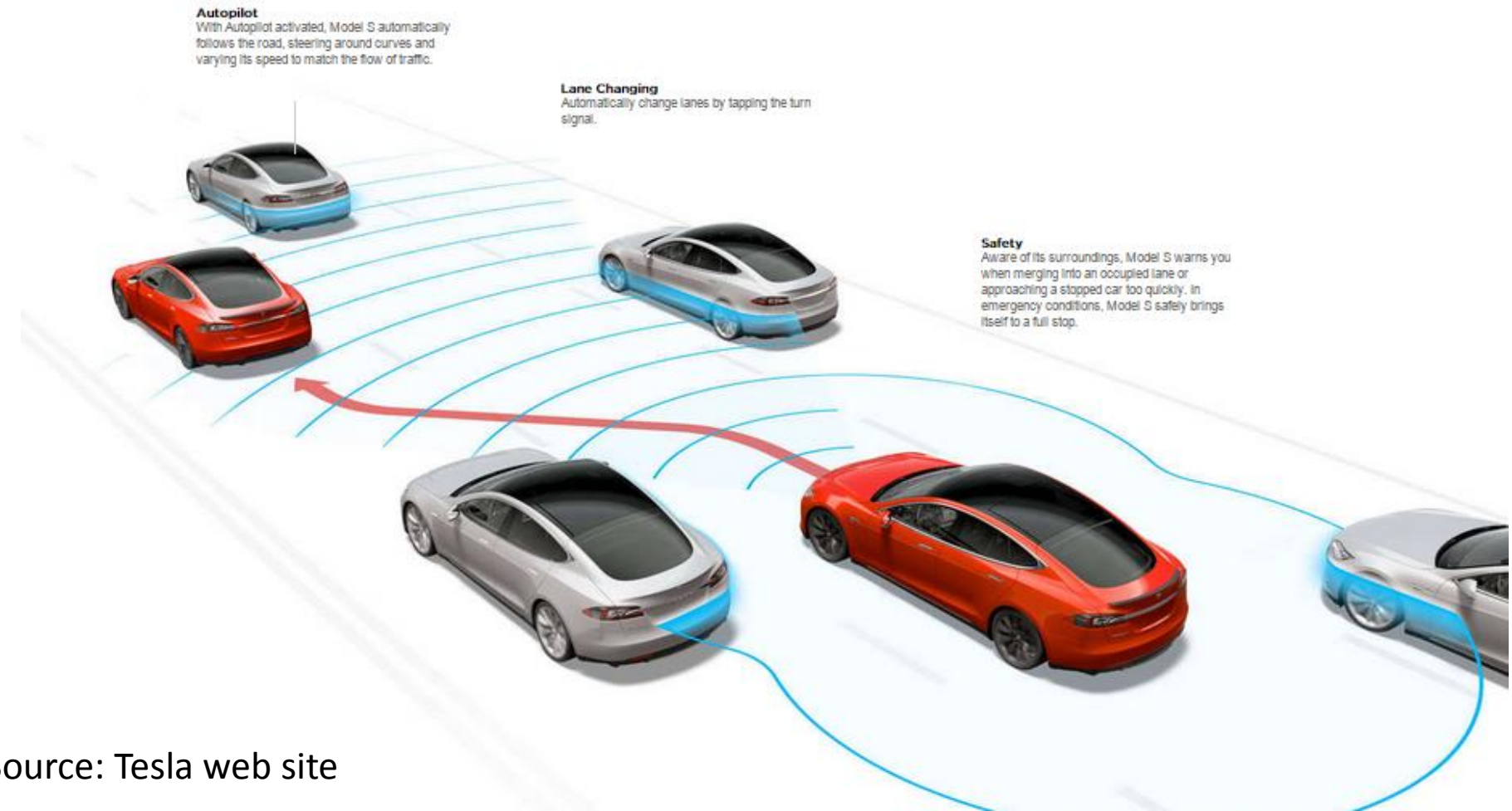
- Active Lane Keeping Assist
- Active Blind Spot Assist
- BAS PLUS
- Pre-Safe Pedestrian Recognition
- Intelligent Drive

Audi Q7

- Presense City
- Exit warning assist
- Adaptive cruise control with Stop & Go and Traffic Jam assist

Existing Technologies

- Tesla Model S - Autopilot



Source: Tesla web site

R&D Systems

Google Self-Driving Car

- HW: LIDAR, Cameras, Radar, Odometers and GPS.
- Used preprocessed journeys data

New Cadillac

- To be released in 2017
- Advanced cruised control on highways

EGNOS – Driver Assistance

Conclusions

- Intelligent transport systems for road transport represent an important segment of the GNSS market.
- EGNOS/EDAS signals allows to enhance existing application and to create new application to settle down the main issues dealing with road management.

- Using GALILEO signals, the performance of new application will be even higher.