44TH ASECAP STUDY & INFORMATION DAYS 2016

How to gradually shift from traditional ITS towards Autonomous Driving: GNSS as the core technology

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Intercontinental Hotel
25 May 2016

www.asecapdays.com

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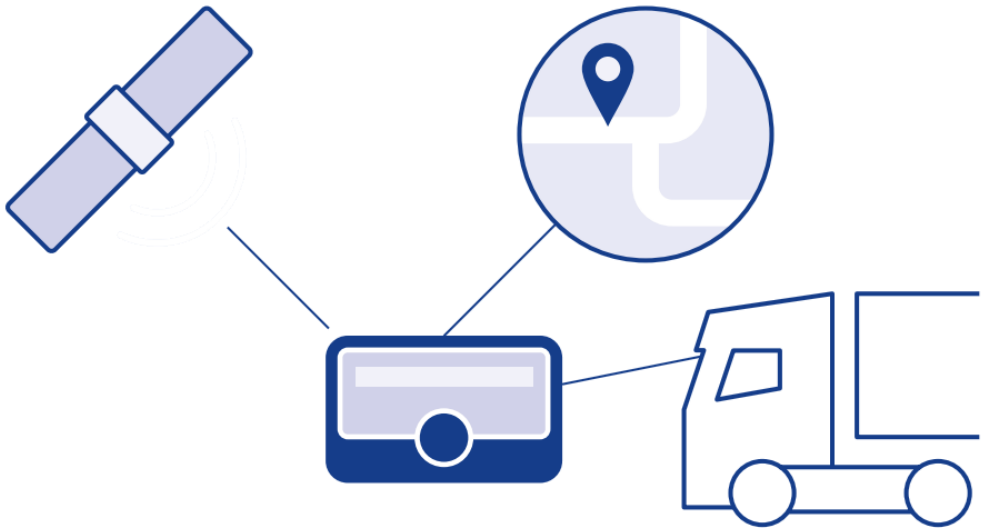
Why GNSS for Road User Charging?



FLEXIBILITY

Rapid changes can be implemented

EXTENSIBILITY

Example of a network extension in 3 months

REVENUE POTENTIAL

SP can include several VAS to their offer

ENVIRONMENT (AND COST)

Around 80% less roadside infrastructure

TRAFFIC MANAGEMENT

Dynamically influence traffic behavior

LOW TRANSACTION COSTS

Data traffic costs already @ approx. 2€/month

Why Autonomous Vehicles?

Safety
- Today over 90% of accidents involve driver error
- Significant reduction accidents on the roads

Reduced congestion
- Increased roadway capacity without impacting safety
- Machines can help maintain much shorter minimum distances between vehicles compared to human drivers

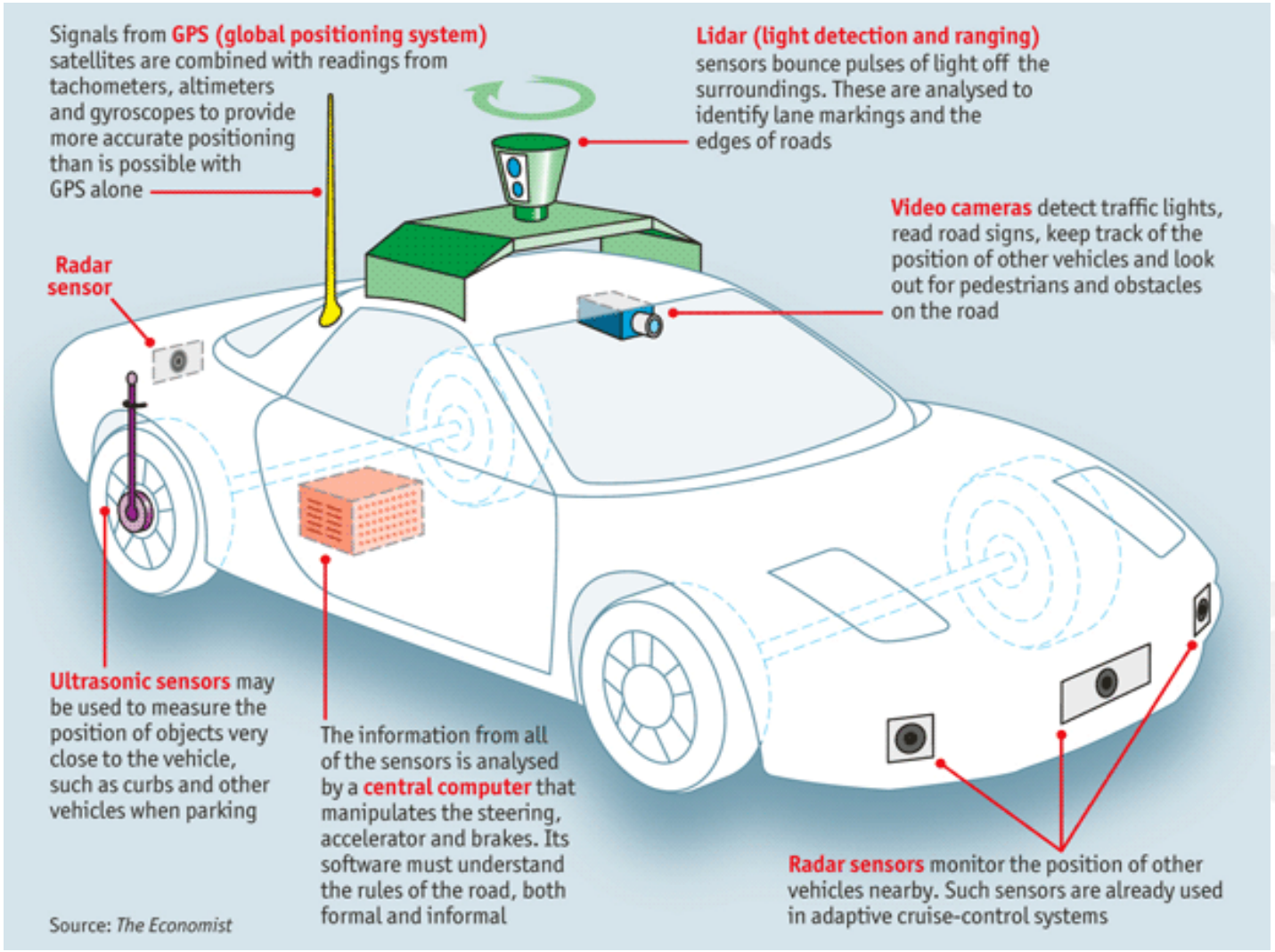
Eco-friendly
- Reduction of fuel consumption & CO2 emission

Efficient and less expensive
- Optimization of fuel/electricity together with time savings will compensate the investment

Demographic change
- Support unconfident drivers
- Enhance mobility for elderly people

Similarities with GNSS benefits in RUC

… we share the complementarity and interoperability of automotive technologies



… we share the complementarity and interoperability of automotive technologies

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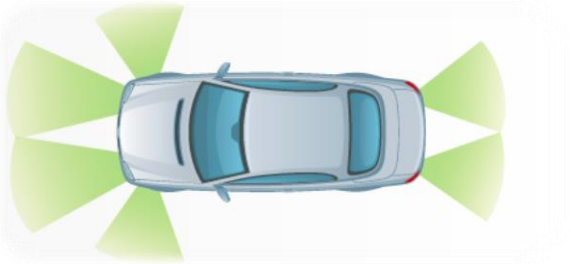
SENSOR BASED VS. CONNECTION BASED VS. CONVERGED SOLUTION

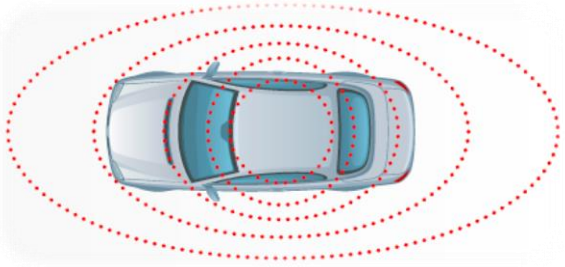
Sensor-Based Solution Only



- **Cannot sufficiently mimic human senses**
- **Not cost-effective** for mass market adoption
- **Lack of adequate 360º mapping** of environment in urban grids

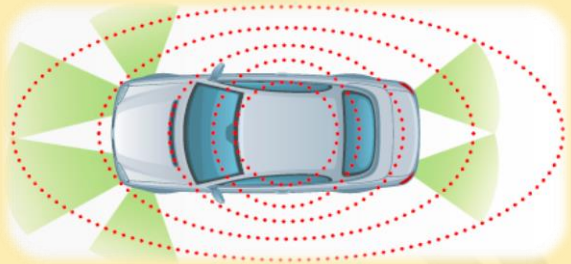
Source: KPMG Self-driving cars: The next revolution

Connected Vehicle Solution Only



- **DSRC does not currently work with pedestrians, bicyclists, etc.**
- DSRC-based V2I (Vehicle-to-Infrastructure communication) might **require significant infrastructure investment**
- V2V (Vehicle-to-Vehicle communication) **requires high market penetration** to deliver value reliably

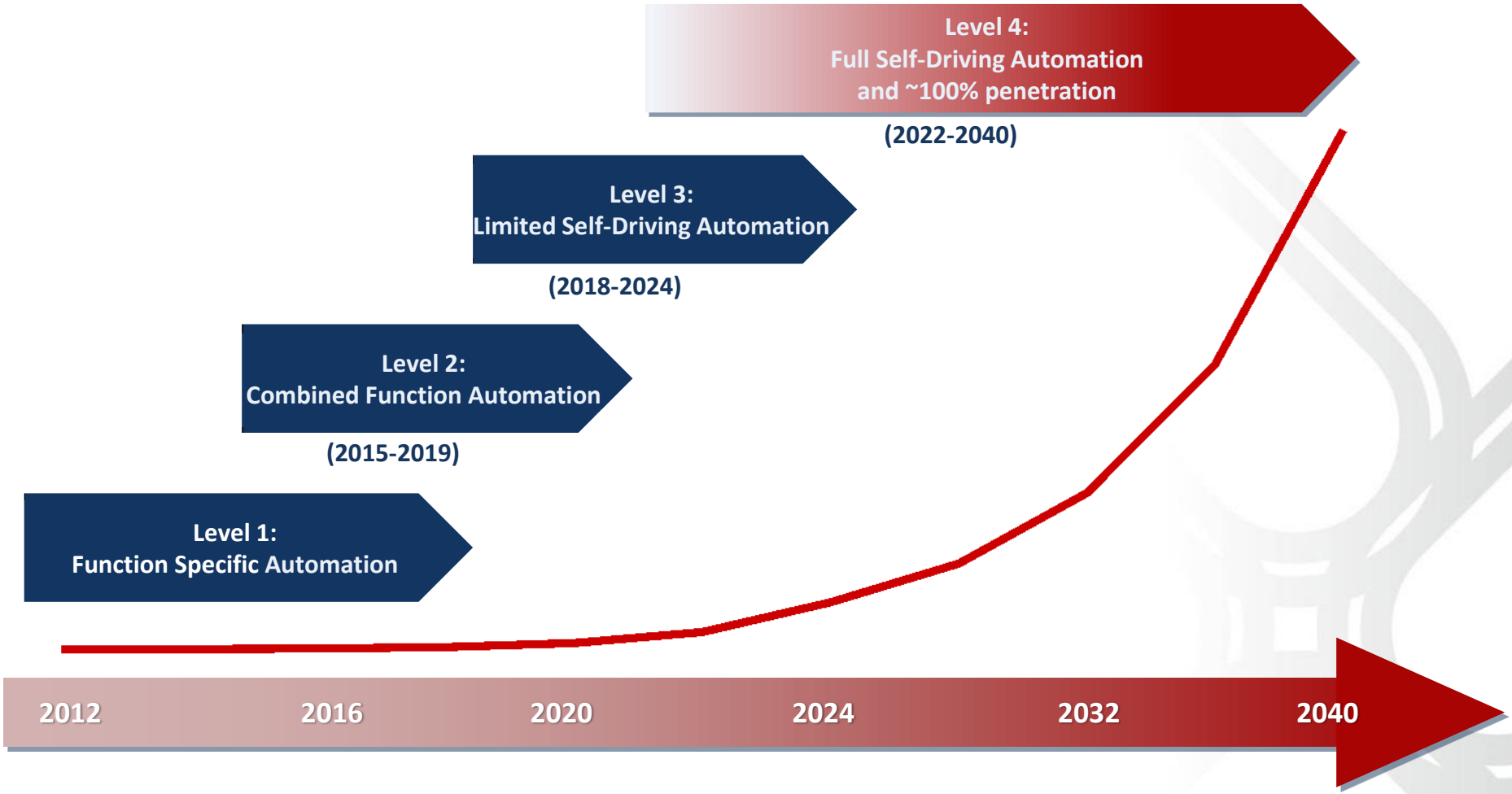
Converged Solution



- **Facilitate adequate mimic of human senses**
- Convergence will **provide the necessary level of functional redundancy**

Converged solution reduces need for both expensive mix of sensors and infrastructure investments. Accurate and reliable GNSS will contribute to drastically reduce the cost!

While automation is already a reality today, full self driving automation will come after 2020



Source: Autonomous vehicle adoption path by NHTSA; Autonomous Vehicle Implementation Predictions – Implications for Transport Planning Todd Alexander Litman © 2013-15; Self-Driving the New Industry Paradigm – Morgan Stanley

Personal Rapid Transit - podcars

Infrastructure	Do not need infrastructure to operate (e.g. pavement streets in segregated areas)
Circulation	Like a bus, they follow a route, which can be dynamically modified to account for higher demand in specific spots
Capacity	Up to 15 passengers per vehicle[2]

Examples *(*)*

- **AKKA:** Enhanced vehicle-location capability with simultaneous localisation and mapping and robust GNSS systems
- **EASY MILE:** Hybrid sensing approach combining localisation through vision, laser and differential GNSS.

(*) Navigation solution developed in TAXISAT project, funded by the GSA under the FP7 programme

Survey on GNSS in Personal Rapid Transit

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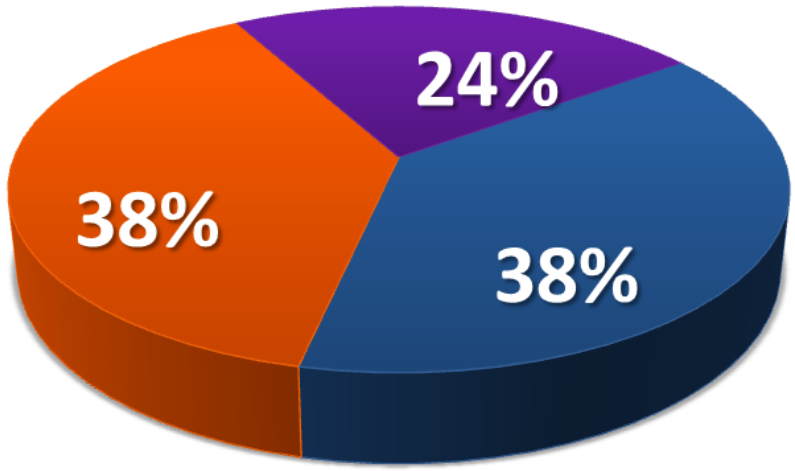
Sample: 13 main worldwide manufacturers

Company	Location	Usage of GNSS
AKKA	**France**	**Yes**
NAVYA	**France**	**Yes**
EasyMile	**France**	**Yes**
ZMP	**Japan**	**Yes**
Vectus Intelligent Transport	**Korea**	**Yes**
Intamin Transportation	Switzerland	**TBC**
Taxi2000 (Skyweb Express)	USA	**TBC**
WGH Ltd.	UK	**TBC**
2GetThere	The Netherlands	No
Boeing	USA	No
RDM Group	UK	No
Ultra Global PRT	UK	No
ModuTram	Mexico	No



Survey on GNSS in traditional Car Makers

Share of produced vehicles worldwide (2013)	Car Manufacturer Group
13.49%	Volkswagen
12.47%	Toyota
10.06%	Hyundai
9.81%	General Motors
6.21%	Honda
5.96%	Nissan
4.83%	Ford
3.56%	Groupe PSA
3.42%	Renault
3.15%	Fiat Chrysler Automobiles
2.92%	BMW
2.38%	Daimler
1.55%	Tata
1.41%	Geely
0.03%	Tesla

14 groups → 80% of the produced vehicles worldwide

Source: OICA, International Organization of Motor Vehicle Manufacturers

Source: Business Insider

Early results of the survey on Galileo utilisation in Autonomous Driving tests

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Car Brand	Commercial Name	Galileo
Audi	Piloted Driving	TBC
BMW	Active Assist	TBC
Chevrolet	---	TBC
Chrysler (*)	(With Google)	TBC
Citroen and Peugeot	Highway Chauffer	TBC
Fiat	---	GALILEO
Ford	---	TBC
Honda	Automated Drive	TBC
Hyundai	---	GALILEO
Jaguar Land Rover	---	TBC
Kia	Drive Safe	GALILEO
Mercedez Benz	---	TBC
Nissan	Intelligent Driving	TBC
Renault	Next Two	TBC
Tesla (**)	Autopilot	TBC
Toyota and Lexus	---	TBC
Volkswagen	---	TBC
Volvo (***)	Drive Me/Intellisafe Autopilot	GALILEO

GNSS is the preferred technology

All 14 car maker groups are developing Autonomous Driving pilots with GNSS

4 brands already confirmed readiness for Galileo

(*) Recent partnership between Google and FCA (Chrysler)
(**) Commercially available: Model S latest software upgrade includes autonomous driving functions
(***) Tests with volunteer customers starting in 2017 in Sweden and UK

For traditional car makers, robust GNSS is a complement to Connected Cars functions

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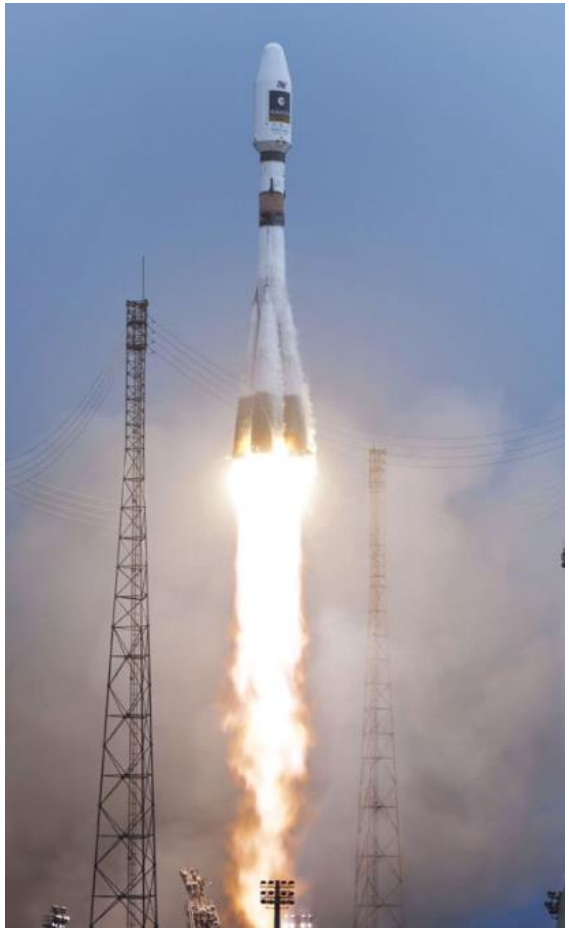
Connected cars are likely to include the following capabilities:

- ✓ Integration with home networks*
- ✓ Data exchange with insurers, manufacturers and third parties*
- ✓ Diagnostics and vehicle health reports
- ✓ Improved navigation and positioning*
- ✓ In-vehicle WiFi hotspot
- ✓ Payment integration*
- ✓ Streaming of music and Video on Demand
- ✓ Localised information and advertising*
- ✓ Police warnings and location*
- ✓ Car-to-car gaming
- ✓ Real time traffic and incident alerts*
- ✓ Assisted and automated driving*

** GNSS supported*

Galileo is becoming a reality



- **14 satellites** have been launched, till now:
  - ✓ Half of them were launched in 2015
  - ✓ First position fix made in March 2013
  - ✓ Recovery plan designed for 2 satellites with no-nominal orbit
  - ✓ 2 new satellites launched on the 24 May!
- **16 additional satellites** already in production
- **Initial operational services declaration** in October 2016

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