The Road to Safer, Cleaner and More Efficient Transportation in Future Smart Cities

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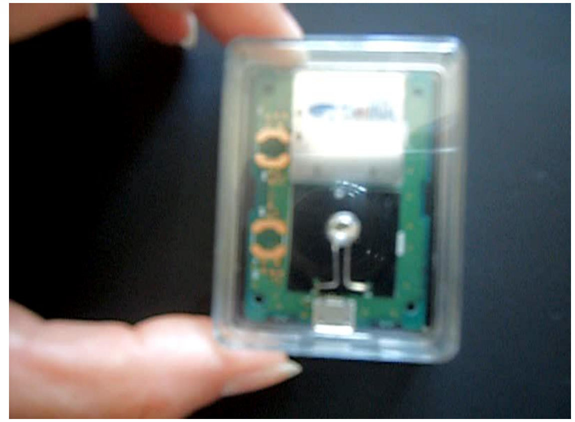
Smart Anything Everywhere (Anytime)

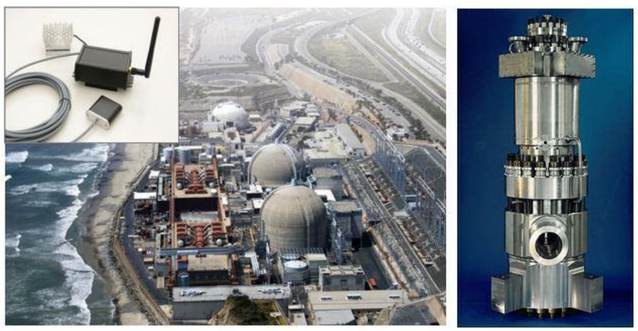
Smart Applications

Formula 1 Monitoring

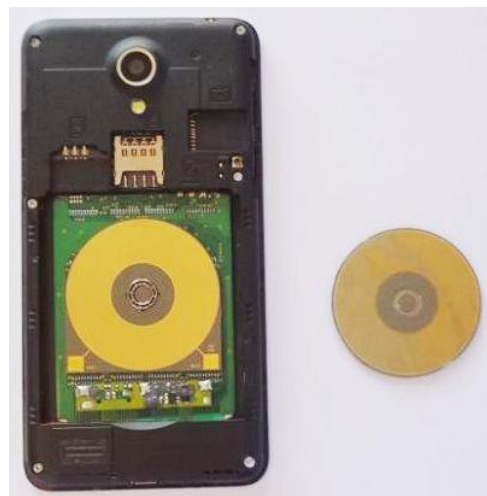


Micro-generator

Autonomous Vehicles

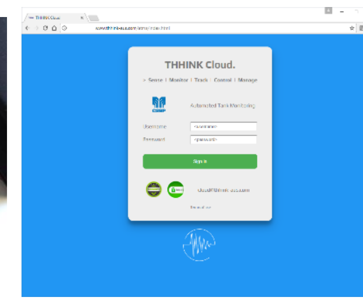


Nuclear Monitoring

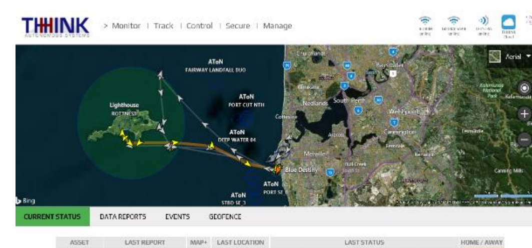


Self-Powered Phone

Satellite Comms.



Remote Monitoring



THHINK Cloud

For a New Technology to be Successful Three Things Need to Come Together

Problem or Customer Demand

Technology Development

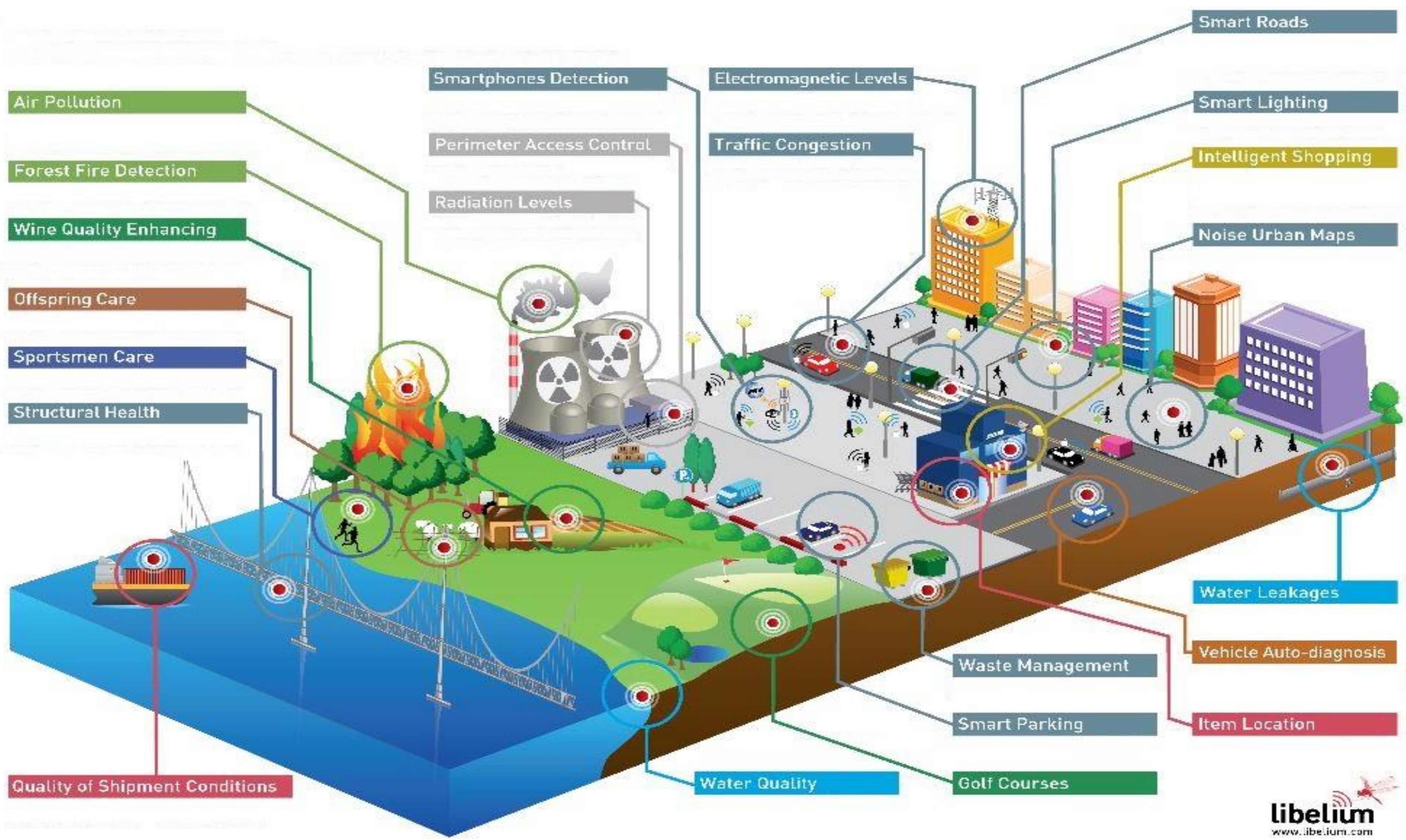
Barriers – Acceptance, Privacy, Legal, etc.

Roll Out of Technology

Hyper Connected Society Vision

Silicon Labs.

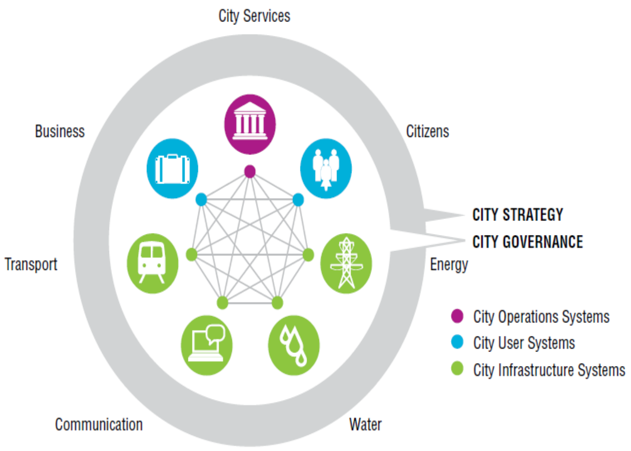
Hyperconnectivity is the increasing digital interconnection of people – and things – anytime and anywhere. By 2020 there will be 50 billion networked devices. This level of connectivity will have profound social, political and economic consequences.



- Market prediction $4billion by 2020 (Frost and Sullivan)
- Problem 90% of applications not possible if need to change batteries

Urbanisation - Smart Cities

- Increased urbanisation combined with increased instrumentation and interconnection
- 100 years ago less than 20 cities had populations of more than 1 million people. Now there are 450
- As they get larger they gain greater economic, political and technological power becoming the hubs of a globally integrated, services-based society.



Source: IBM Center for Economic Development analysis.

“Sometimes Autonomous” Vehicles

Chaotic Traffic

Traffic Jams

Traffic Concerns in 1890's!

- In the 1890s the **key environmental concern was horse manure**. London had 11,000 cabs and several thousand buses, each using 12 horses per day - more than 50,000 horses in public transport alone. Each horse produces 15-35 lbs of manure per day; New York had 2.5 million lbs per day to shift, leading a *New York Times* editorial to comment in 1894, "how much pleasanter the streets of a great city would be if the horse was an extinct animal".
- **'Crossing sweepers' were employed to clear paths through the dung**, which was either sludge in wet weather or a fine powder which blew about in the dry. The piles of manure produced huge numbers of flies, which spread typhoid fever and other diseases; it's estimated that three billion flies hatched in horse manure per day in US cities in 1900, and in New York, **20,000 deaths per year were blamed on manure**.
- Each horse produced about two pints of urine daily; 40,000 gallons per day in New York.
- They were incredibly noisy (**iron shoes on cobbles made conversation impossible** on busy streets),
- They were more dangerous than modern traffic: horses kick, bite and bolt; the **fatality rate was 75% higher per capita than today**
- Dead horses. The average streetcar horse had a life expectancy of about three years. **In 1880, New York cleared 15,000 carcasses from its streets, 41 per day.** Dead horses were unwieldy, and street cleaners often waited several days for the corpses to putrefy so they could more easily be sawed into pieces.

Congestion Today

- The annual costs of congestion in terms of time and fuel are estimated at $100 billion in the US and £8 billion in the UK and are predicted to double within 15 years.
- In 2010, a traffic jam in China which was originally caused by roadworks and high demand and exacerbated by broken down vehicles and people leaving their cars, stretched for more than **100km** on a major national highway leading from Beijing. Drivers were managing as little as <u>one kilometre per day</u>. **They passed the time with games of chess and cards by the roadside.**
- Traffic jams are so bad in China there's now a service that allows someone else to sit in a traffic jam for you. You call the company and motorcycle arrives with two people. One stays with your car and you leave on the back of the bike.

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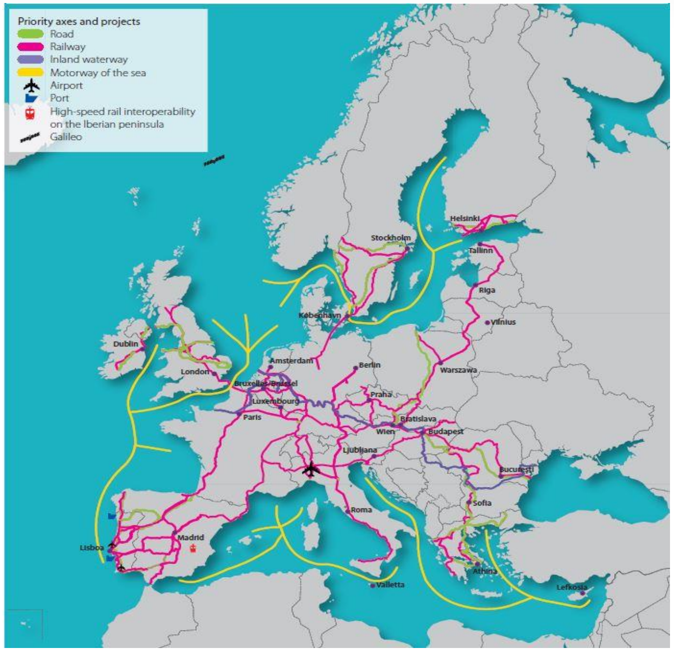
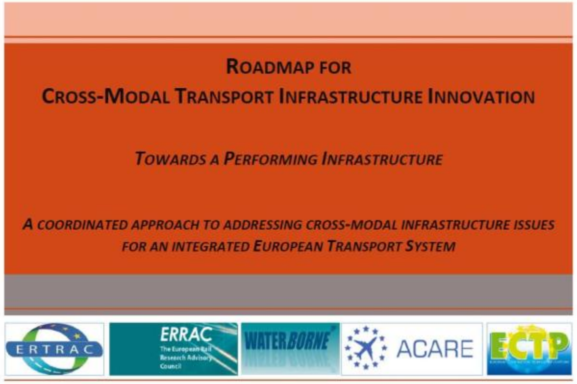
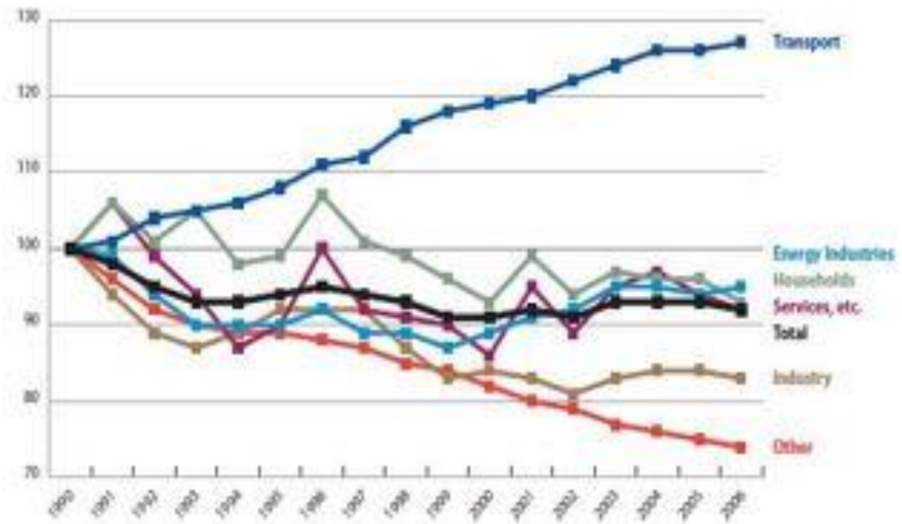
Keeping Europe Moving





- The sustainable transport initiative covers road, rail and marine transport and has identified key routes
- Highlights dramatic increase in both freight 35% and passenger transport 20% between 1995 and 2006
  - Improve capacity, efficiency and reduce cost
  - Maintain continuous operation and provide resilience to disruption and failures
  - Reduce emissions

Safety and Emissions



There is a car accident in Barcelona every 19 seconds!

Safety

- Infrastructure needs to support continuing increase in demand – safety reduce fatalities by 50%
- With the increasing numbers of vehicles being operated the probability of accidents and fatalities becomes a significant issue. US/EU have set aggressive targets (e.g. halving on roads) for reducing loss of life and limb.

Emissions

- Emissions are a key issue – Transport accounts for ¼ of all emissions. Consumer demand and government regulation are driving the transportation sectors to use less energy overall, emit fewer harmful. CO2 emissions targets are spelled out in the Copenhagen accord of 2009, with the EU offering to increase its emissions reduction to 30% (from 1990 levels) by 2020.
- To achieve this operators are now turning to Systems of Systems thinking to optimise the use of assets to minimise fuel costs and emissions
- Move to Electric vehicles (makes sense if not reliant on coal produced electricity)

EU Directive

European Parliament and Council introduced the Directive 2010/40/EU in July 2010 on the framework for the deployment of Intelligent Transport Systems (ITS) in the field of road transport and for interfaces with other modes of transport. The European Commission's aim is to accelerate and coordinate the deployment of ITS applications on the Trans European Road Network (TERN) across Member States in a consistent and harmonised way.

ERTRAC Strategic Research Agenda for Road Transport

Covers

- Mobility, transport and infrastructure, safety and security, environment, energy and resources and design and production

Research Topics

- Traffic management related research topics proposed included integration of vehicle and infrastructure systems, traffic management using ITS, data collection and processing, business models, optimisation of road space to ensure that vehicles (particularly HGVs) adopt routing systems that minimise adverse impacts, systems fro segregating traffic with dedicated infrastructure and prioritised traffic management and methods to assist the booking of optimised slots for freight vehicles

Policy background: Environmental, social and global trends

The White Paper on Transport, the Lisbon Strategy and Trans-European Networks

Traffic congestion on major overland road and rail corridors and in urban areas, the need to improve the balance between different transport modes, and the needs to improve safety and mitigate the impact of transport on the environment are some of the key challenges set out in the European Commission's White Paper on Transport **"European Transport Policy for 2010: time to decide"** (CEC, 2001). Traffic management and control are key tools with which to address these problems, alongside infrastructure investments, transport pricing, regulatory and fiscal measures and smart transport applications.

More recently, the renewed **Lisbon Strategy** (CEC, 2005) highlighted the need to develop and improve economic and resource efficiency. This will enable a reduction in transport costs. Objectives of the Lisbon Strategy with relevance to traffic management include improved utilisation of existing networks, tackling congestion and increasing accessibility, developing urban transport opportunities, developing charging policies, increasing synergies between modes and improving logistics.

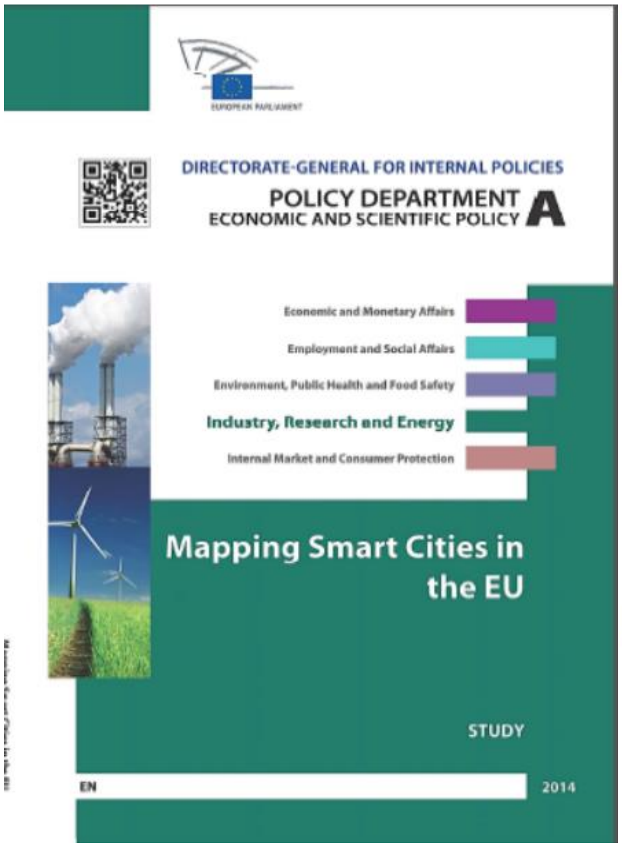
According to **"Keep Europe moving - Sustainable mobility for our continent"** (CEC, 2006), the mid-term review of the 2001 White Paper on Transport, there is no reason in the long run why sophisticated communication, navigation and automation should be restricted to aircraft and not be available to land transport modes, in particular road transport. The review expects that new technologies will provide new services to citizens and allow improved real-time management of traffic movements and infrastructure capacity use, as well as the tracing and tracking of transport flows. In addition to providing benefits for transport operators and users, new systems can provide public administrations with rapid and detailed information on infrastructure maintenance and renovation needs. Traffic management applications can increase the efficiency of networks, reduce the need to build new infrastructure, enhance driving and travelling comfort and also help to increase safety and security, as well as tackling wasteful and socially harmful transport patterns in the interests of environmental and social sustainability.

Approaching the end of the 10-year period of the 2001 White Paper on Transport, it is time to define a vision for the future of transport and mobility, preparing the ground for later policy developments. A reflection process identified six main trends that will shape the future of transport policy over the coming decades: aging, migration and internal mobility, environmental challenges, the availability of energy resources, urbanisation and globalisation. Accelerating the introduction of innovative technologies and the full integration of the different transport modes is crucial to meeting those challenges (CEC, 2009).

EU policy is to promote integrated traffic management and control on the **Trans-European Networks (TEN-T)**, which cover all transport modes, to enable them to fulfil their function of offering high-quality core networks and corridors linking all countries and regions of Europe. This includes Air Traffic Management and waterborne applications, outside the scope of this Policy Brochure, as well as open access and interoperability of rail systems, infrastructure and rolling stock, and integration of road traffic management and related services such as traveller information, payment and ticketing systems.

White Paper

Mapping Smart Cities in EU

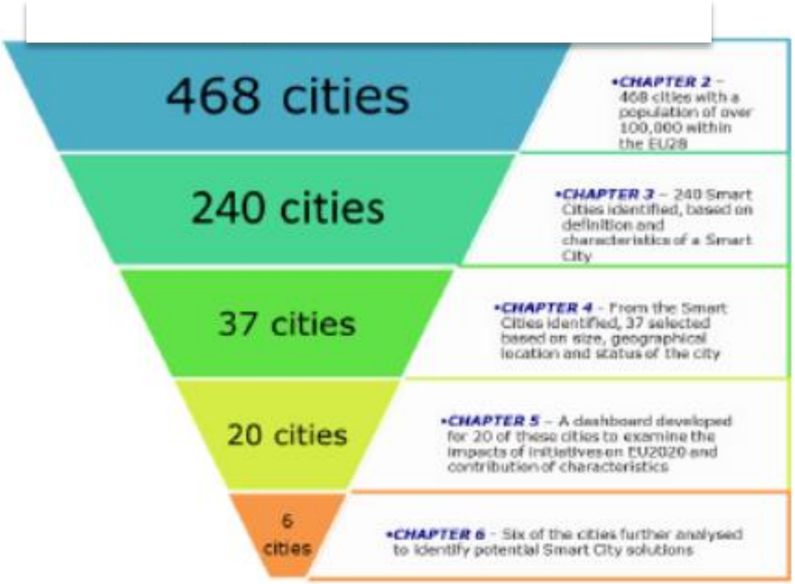


Recommendation	Intended for
Understanding Smart Cities: research and evaluation	
Detailed panel of longitudinal case studies with city-level funding and outcome data	DGCNECT, DG JRC
Standardised evaluation and assessment methods to measure success at internal, city and European level for impact assessment and benchmarking	The European Commission (EC) and Impact Assessment Board (IAB)
Develop methods and structures for a needs assay of the city's performance against relevant targets and presentation scorecards	Collective effort led by existing Smart City clusters[1]
Designing Smart City initiatives and strategies	
Mandate specialised impact assessment guidelines for Smart City strategies and initiatives to include: SMART objectives, issues of timing and uncertainty, and assessment of experimental variation	Funding bodies,[2] IAB, Smart City clusters
Promote local modularity for early-stage initiatives	Funding bodies, Smart City clusters; additional specific funding from EC, local government stakeholders
Facilitate exit and change of participation during the latter stages of an initiative	Funding bodies, Smart City clusters, local government stakeholders
Structural conditionality in funding for Smart City initiatives	Funding bodies
Specific design procedure for structuring Smart City initiative components	IAB, Smart City clusters, local government stakeholders (as monitoring hosts)
Smart City governance	
European-level Smart City platform with brokerage or intermediary functions	EC
Privileged or low-cost access to existing infrastructures	Local government stakeholders, infrastructure operators, national regulatory agencies
Mandatory multi-stakeholder governance with lay users represented and on integrated project teams	Funding bodies and government authorities and participants
Encourage industry-led public-private partnership consortia	Funding bodies and government authorities and participants

Recommendation	Intended for
Supporting the development of Smart Cities	
Use demand-side measures to stimulate demand for city-based 'Smart solutions'	Member State and local government procurement agencies, Horizon 2020, service users, standards bodies, national regulatory agencies
Selective use of regulatory forbearance and/or pro-competitive sourcing	Procurement agencies, national regulatory agencies, European Parliament
From Smart Cities to a Smarter Europe: replication, scaling and ecosystem seeding	
Periodic assessment of scalability potential and identification of instruments and activities to optimise pan-European dissemination of good practices and solutions	EC (platform), IAB (guidelines), local authority participants
Include Smart Cities as a future internet public-private partnership (PPP) use case or involve Smart City stakeholders in large-scale pilots, standards bodies, etc.	Future Internet Public-Private Partnership (FI-PPP), Horizon 2020, EC (supporting standards body engagement with additional specific funding)
Expand support for Smart Cities and Communities - European Innovation Partnership	EC
Additional resources for Smart City translation and transfer	EC, Member States
Create and encourage Smart City-specific new intellectual property ownership rights and contract forms	EC, Council, Parliament; possible WIPO

Very large number of projects around Europe!

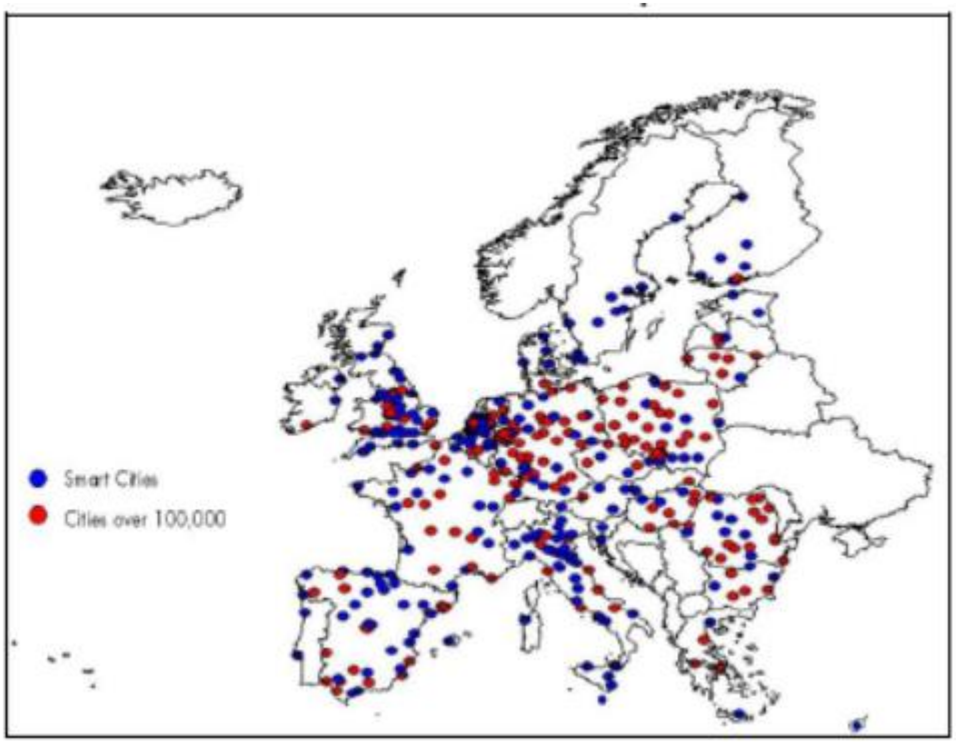
Key Findings



KEY FINDINGS

- In 2011, 240 of the 468 EU-28 cities with at least 100,000 inhabitants (51% of the total) had at least one Smart City characteristic and can therefore be classed as Smart Cities.
- There are more small Smart Cities than large ones, but there are Smart Cities in all size categories and in most EU-28 countries.
- **The highest absolute number of Smart Cities are found in the UK, Spain and Italy; the countries with the highest proportion of Smart Cities are Italy, Austria, Denmark, Norway, Sweden, Estonia and Slovenia.**
- **Most Smart City initiatives are still in the early phases of development**, but the larger cities tend to be the most mature (with at least one fully launched or implemented initiative).
- **The most common of the six characteristics** defined in Chapter 2 are those associated with pan-European public goods problems – **Smart Environment and Smart Mobility, present in 33% and 21% of initiatives respectively. Each of the other four characteristics (governance, economy, people and living) is addressed in approximately 10% of the Smart Cities**, reflecting specific local strengths or weaknesses.
- City size is clearly positively correlated with the number of characteristics sought through Smart City initiatives; Smart Cities with only one characteristic tend to have between 100,000 and 200,000 inhabitants.
- Smart Living initiatives are found throughout the EU-28; initiatives focusing on other characteristics are less evenly distributed.
- Smart Governance projects are seen mainly in Northern Europe (e.g. France, Spain, Germany, Sweden and the UK) and Italy.
- Smart Mobility initiatives are relatively well represented in non-Nordic Northern Europe, Spain, Hungary, Romania and Italy, but underrepresented in Nordic Member States.
- Some characteristics are likely to be found in combination with others, such as Smart People and Smart Living.

Smart Cities in Europe (28)

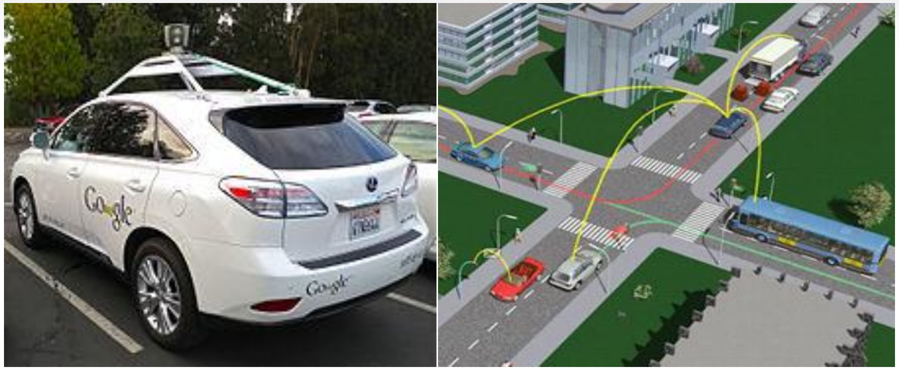


	Smart Neighbour hoods	Testbed micro infrastructures	Intelligent traffic systems	Resource management systems	Participation platforms
	10	7	11	14	8
Smart Environment	+++	+++	++	+++	+
Smart Mobility	++	++	+++		+
Smart Governance				++	+++
Smart Economy	++	++		++	++
Smart Living	++			+	+
Smart People	++			+	++

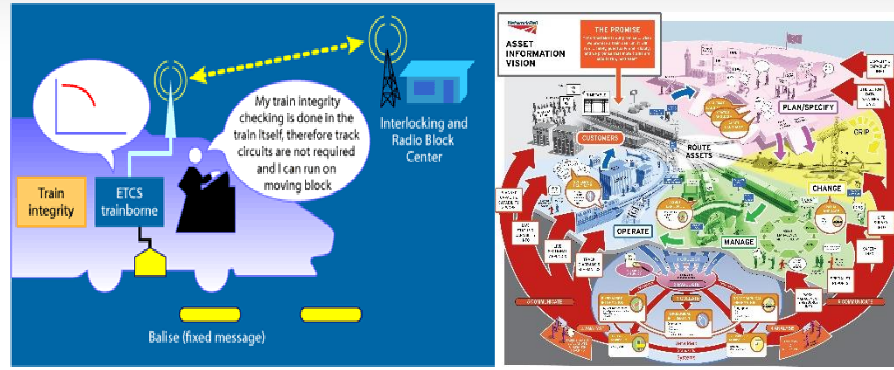
50 Smart City Projects

UK, Spain and Italy, have the largest number of Smart Cities – more than 30 each

Trends in Transportation

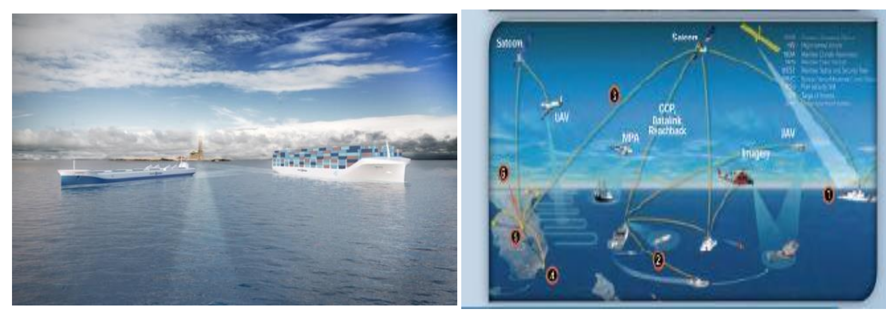


Autonomous Cars
Optimised Traffic Flow
Health Monitoring



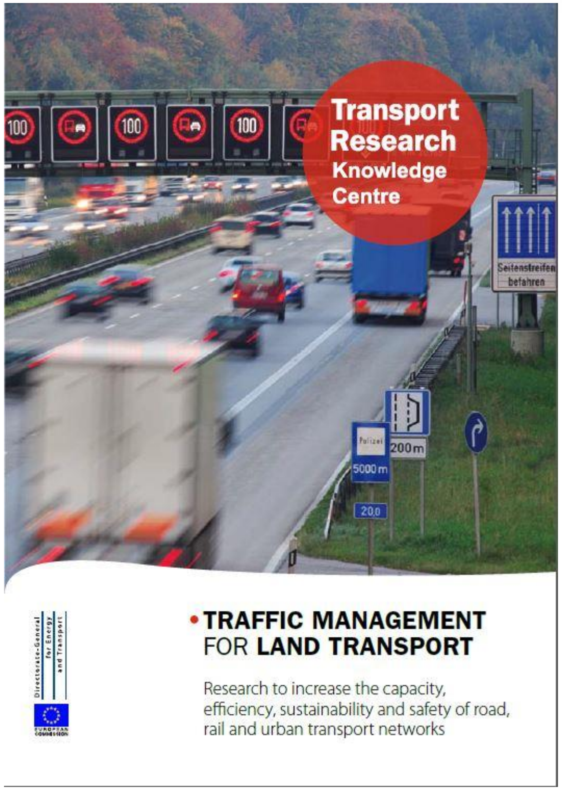
Autonomous Trains – ERTMS
Optimised Operations
Health Monitoring

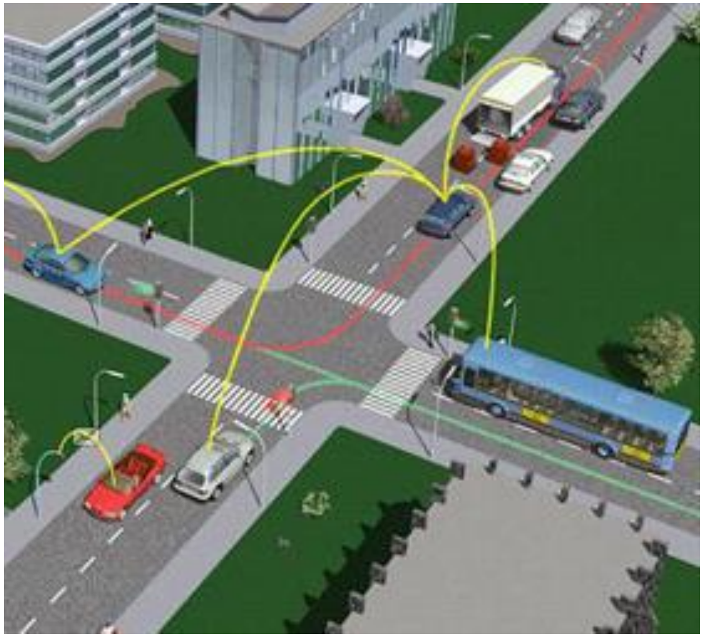
Autonomous Aircraft
SESAR – 4D Traffic Management
Health Monitoring



Autonomous Ships
Traffic Management
Health Monitoring/Surveillance

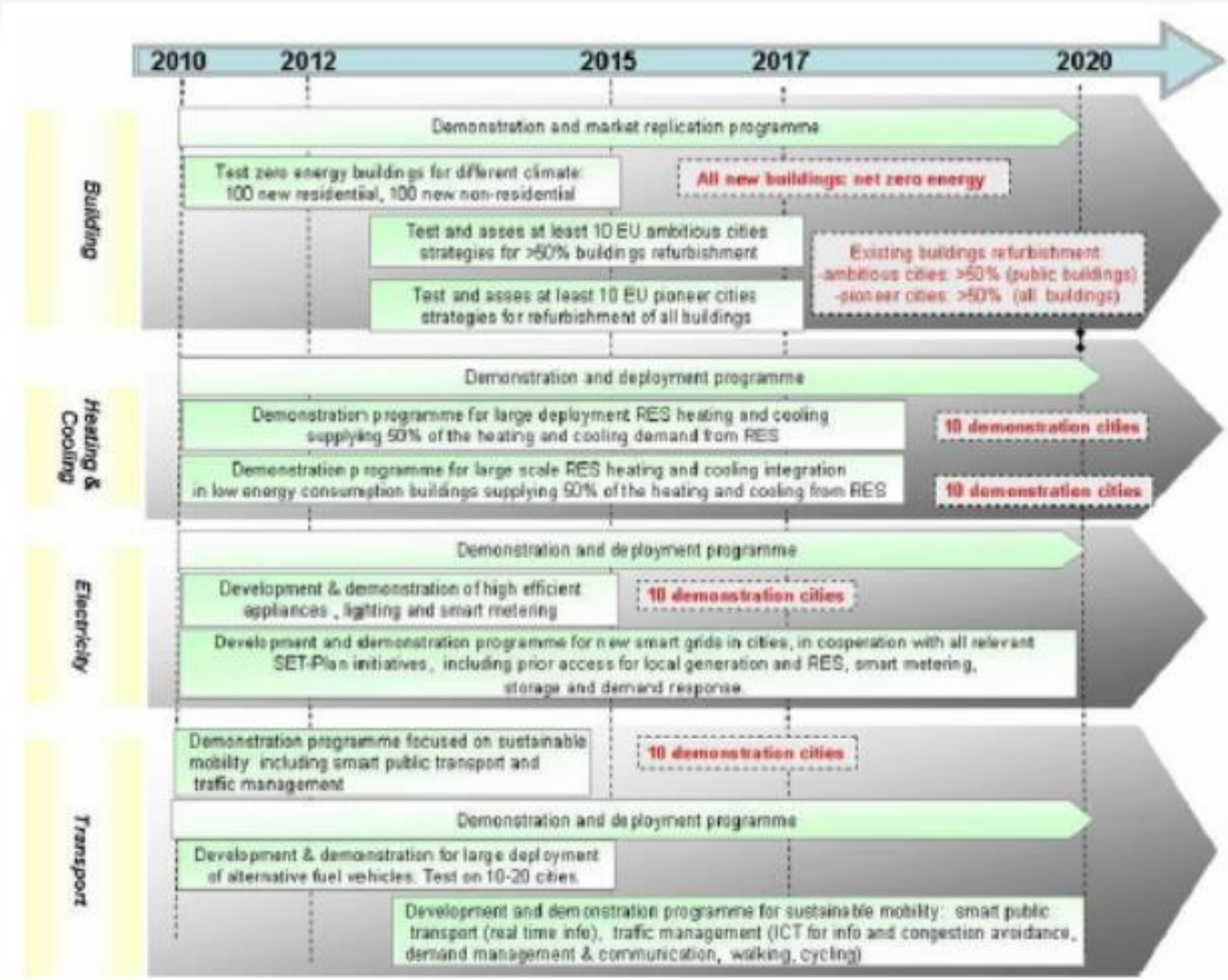
Traffic Flow Control and Integration with Infrastructure





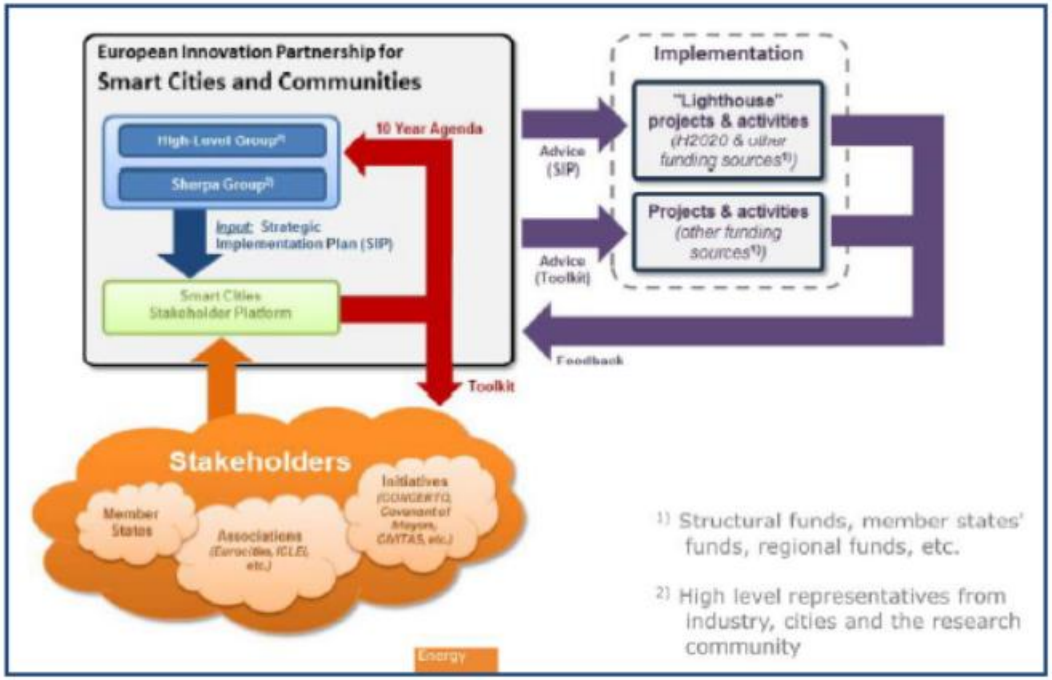
- The global car fleet is predicted to double from currently 800 million vehicles to over 1.6 billion vehicles by 2030
- Without integration of information and flow control systems, severe congestion
- Markets and Markets predicts that the global traffic management market is expected to grow from USD 4.12 Billion in 2015 to USD 17.64 Billion by 2020
- **Need large-scale demonstrations**

Smart Cities Technology Roadmap



Source:http://setis.ec.europa.eu/implementation/tech
nology-roadmap/european-initiative-on-smart-cities

European Innovation Partnership for Smart Cities and Communities



High Level Group and the Smart Cities Stakeholder Platform, which aim to implement a Strategic Action Plan and to promote Smart City concepts on a wider scale.

The High Level Group

A "High Level Group" as the first pillar of the EIP-SCC, consists of CEOs from research-intensive industries, city mayors, regulatory authorities and public financing institutions. It was established to support the implementation of the EIP-SCC. It is responsible (together with a "Sherpa Group") for the Strategic Implementation Plan (SIP), which helps define how concepts to promoting Smart Cities are put into practice. It also looks at how the European Commission can support these measures during the next Research Framework Programme – Horizon 2020.

EU Smart Cities Stakeholder Platform[1]

The EU Smart Cities Stakeholder Platform is the second governance body of the Smart Cities and Communities European Innovation Partnership (EIP-SCC).It was initiated by the European Commission with the dual aim of

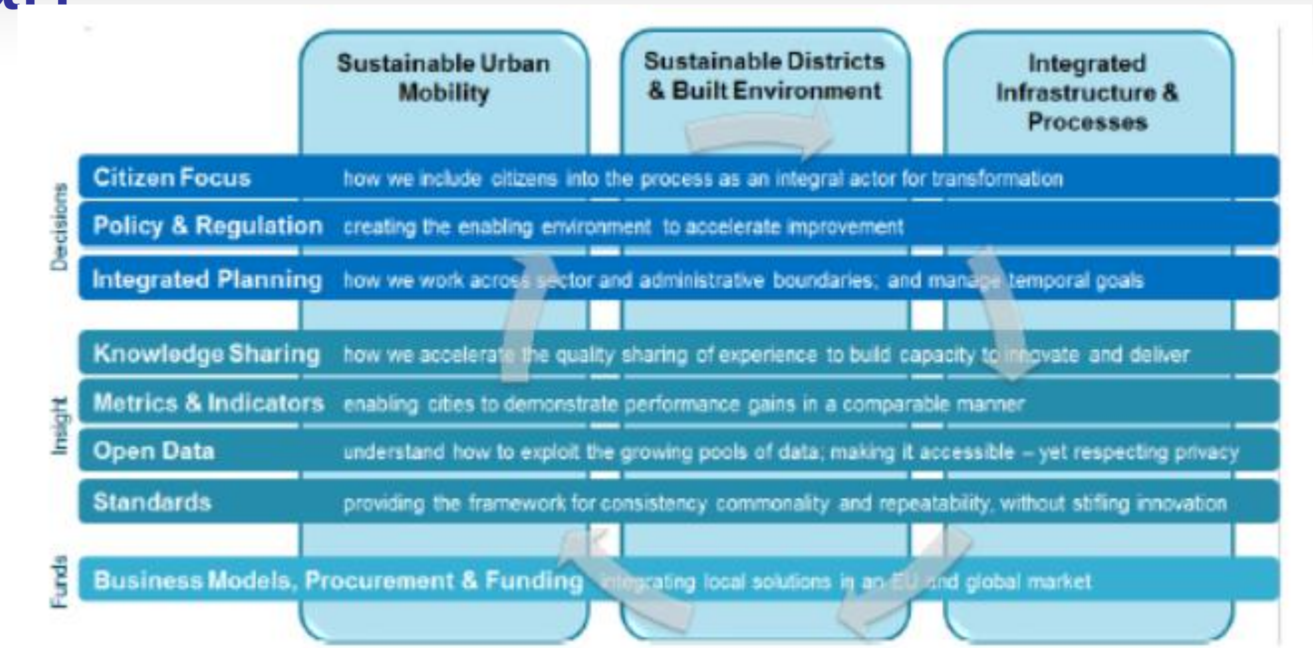
- identifying and spreading relevant information on technology solutions and needs required by practitioners; and
- providing information for policy support to the High Level Group and the European Commission.

It is both a web-based and physical Platform open to anyone who registers on it. Backbone is the contributions by stakeholders in a bottom-up way, owned by the stakeholders. The Platform will bring city authorities, industry, NGOs and civil society together. It will accompany the implementation of the lighthouse projects and monitor overall implementation of the Innovation partnership. It will organise activities so that experience and knowledge from lighthouse projects will be shared.

The Smart Cities and Communities European Innovation Partnership is not a single initiative but part of a broader effort by the EC to foster a new approach to EU research and innovation. To date five European Innovation Partnerships have been launched.

€ 81 Million of EU funds have been earmarked, covering two sectors: transport and energy.

Plan



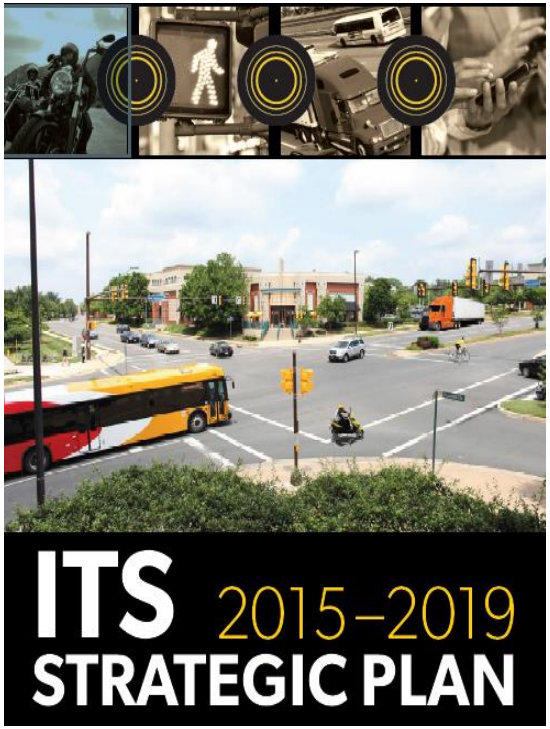
- European Innovation Partnership on Smart Cities and Communities Operational Implementation Plan: First Public Draft Sherpa Group Feb 2014.
- Also a programme for smaller cities Small Giants – less than 250,000 inhabitants

Intelligent Transport Systems Joint Program Office (US)

- The ITS Joint Program Office (ITS JPO), within the Office of the Assistance Secretary for Research and Technology (OST-R), is charged with executing Subtitle C- Intelligent Transportation System Research of Public Law 109-59 Safe Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users, enacted August 10, 2005, which requires the Department to:

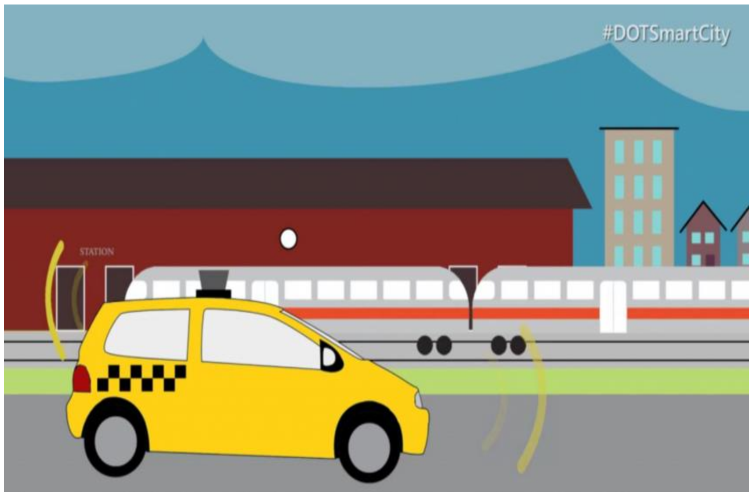
  “Conduct an ongoing intelligent transportation system program to research, develop, and operationally test intelligent transportation systems and to provide technical assistance in the nationwide application of those systems as a component of the surface transportation systems of the United States”

- Works with the Federal Highway Administration, Federal Motor Carrier Safety Administration, Federal Railroad Administration, Federal Transit Administration, Maritime Administration, and the National Highway Traffic Safety Administration to plan, program, and execute the ITS Research Program
- The focus of the program is on **vehicle-to-vehicle and vehicle-to-infrastructure connectivity** through the application of advanced wireless technologies.
- The ITS Research Program develops and tests the underlying technology and applications

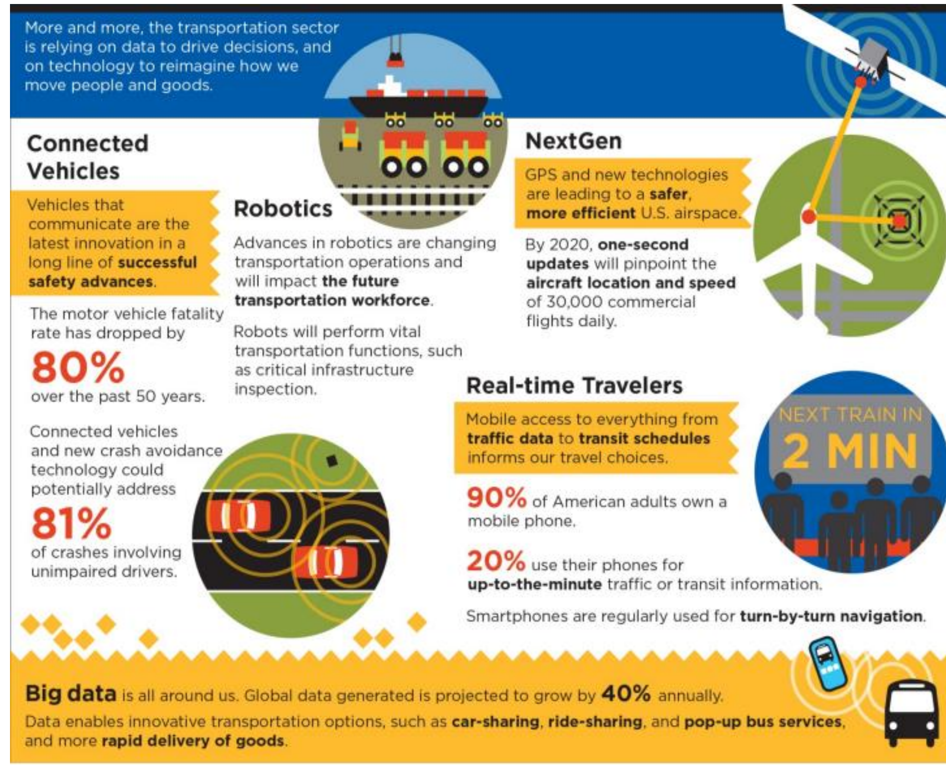


THHINK

Smart City Challenge and Beyond Traffic

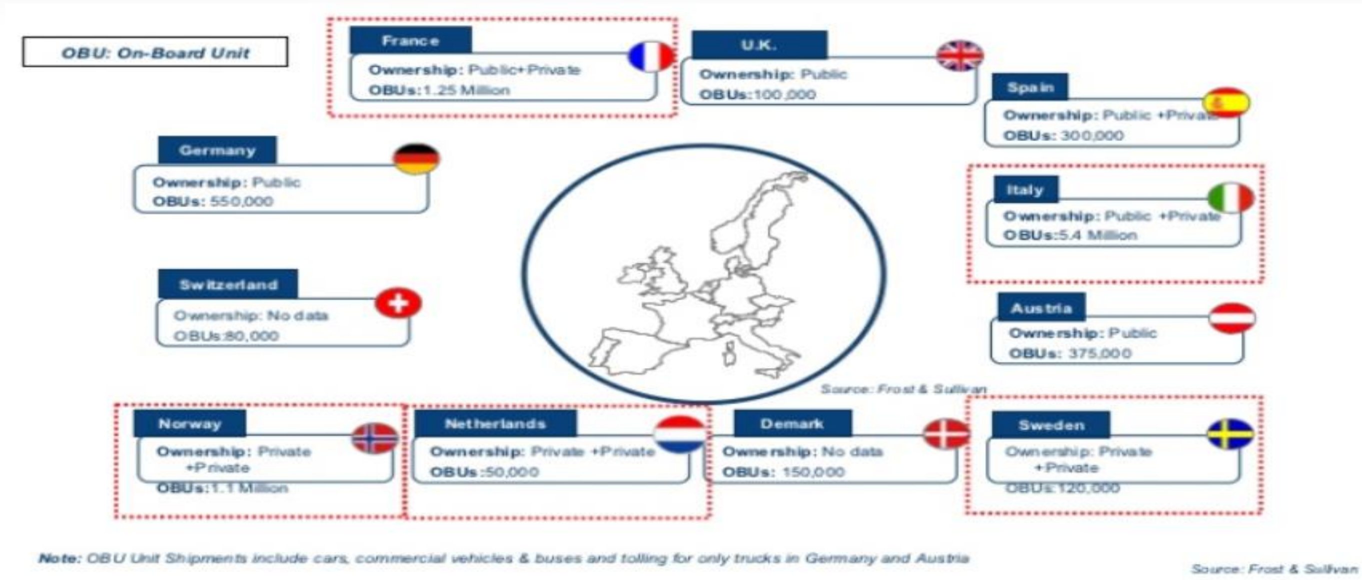


The United States Department of Transportation (DOT) has launched a Smart City Challenge. This is targeted at mid-sized American cities (200,000 and 850,000 residents). The DOT will award the winning city with $50 million of funding to implement proposed ideas and create a model for other cities to follow.



Forward-looking analysis from the U.S. Department of Transportation outlining the expected trends in the transportation system over the next three decades

Car-2-Car Communications in Europe



- Industry has been working for 10-15 years already on car-to-infrastructure and car-to-car communications
- A critical issue is the quality of the standard. This needs to work in all the member states and also worldwide, covering Europe, America, Japan, and China.
- A study by Frost and Sullivan identified that for vehicle-to-vehicle and vehicle-to-infrastructure communications countries with significant private ownership of road infrastructure are more likely to invest in cooperative systems infrastructure. These countries are highlighted with red boxes

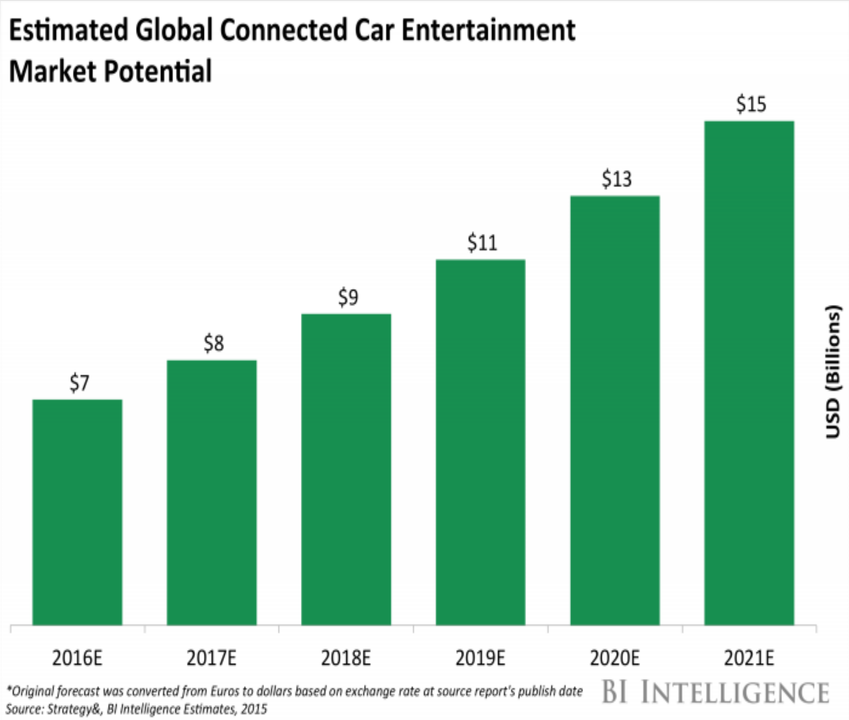
Infotainment

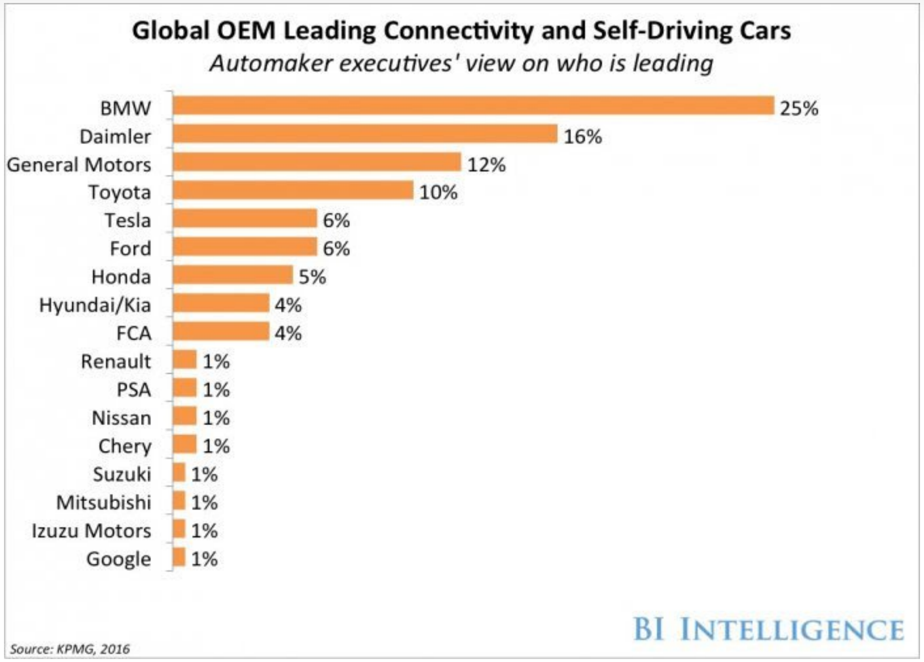
- Two types of connection
  - Embedded connection cars use a built-in antenna and chipset
  - Tethered connections use hardware to allow drivers to connect to their cars via their smartphones
- The ability to integrate Apps into cars is becoming commonplace in today's vehicles. Google Maps and other navigation tools are replacing built-in GPS systems in many cars. Music Apps replace the need for a traditional radio or music player

Advantages

- Internet connectivity in vehicles allows car companies to release software updates in real time (extremely important during a recall)
- Automotive companies can use data from the car to analyse performance and obtain valuable data on how drivers use their cars
- Automotive companies can find even more ways to cross-sell their products and services to customers

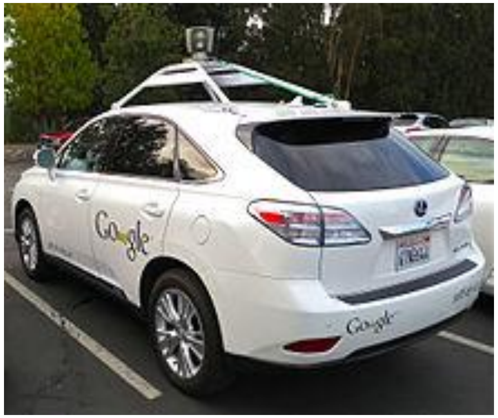
Infotainment Market



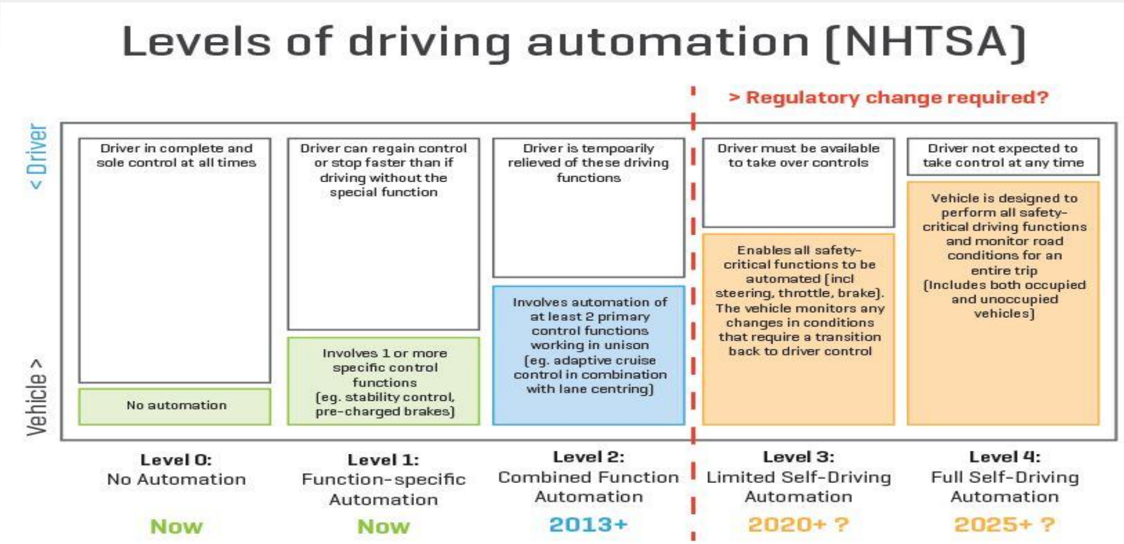


- Driven by the Internet of Things the “Connected Car” is seen as a major business opportunity
- BI Intelligence predicts that 94 million connected cars will be shipped in 2021 (82% will be connected)
- Compound annual growth rate of 35% from 21 million connected cars in 2016
- 381 million connected cars to be on the road by 2020, up from 36 million in 2015
- Connected cars will generate $8.1 trillion between 2015 and 2020
- Although the car companies are providing the connection interface in the car it is other companies that provide data services that are driving this change. AT&T added 2.7 million connected cars in the U.S. in the first three quarters of 2015. Major players such as Microsoft, Apple, Pandora, Sprint, Google, etc., all see the opportunity for getting their platforms onto connected cars.

Autonomous Vehicles



Autonomous Cars



Source: NHTSA (Modified)

Different levels of autonomy

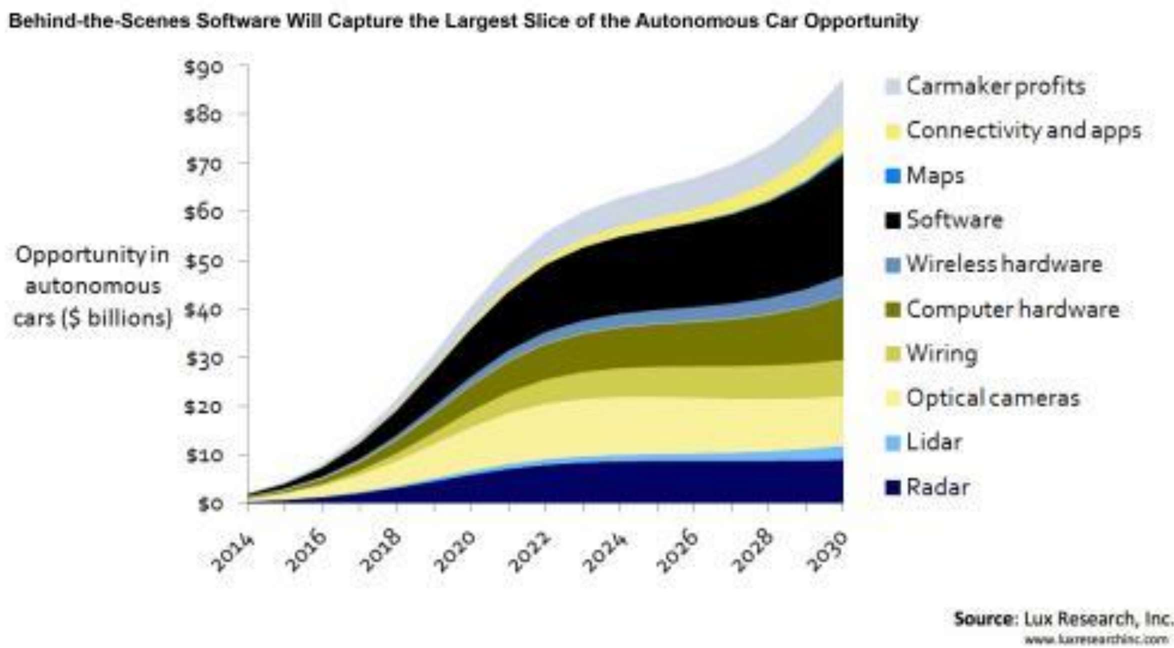
Traffic Ahead

Many carmakers are developing prototype vehicles that are capable of driving autonomously in certain situations. The technology is likely to hit the road around 2020.

	BMW	Mercedes-Benz	Nissan	Google	General Motors
VEHICLE	5 Series (modified)	S 500 Intelligent Drive Research Vehicle	Leaf EV (modified)	Prius and Lexus (modified)	Cadillac SRX (modified)
KEY TECHNOLOGIES	• Video camera tracks lane markings and reads road signs • Radar sensors detect objects ahead • Side laser scanners • Ultrasonic sensors • Differential GPS • Very accurate map	• Stereo camera sees objects ahead in 3-D • Additional cameras read road signs and detect traffic lights • Short- and long-range radar • Infrared camera • Ultrasonic sensors	• Front and side radar • Camera • Front, rear, and side laser scanners • Four wide-angle cameras show the driver the car's surroundings	• LIDAR on the roof detects objects around the car in 3-D • Camera helps detect objects • Front and side radar • Inertial measuring unit tracks position • Wheel encoder tracks movement • Very accurate map	• Several laser sensors • Radar • Differential GPS • Cameras • Very accurate map

Different levels of technology

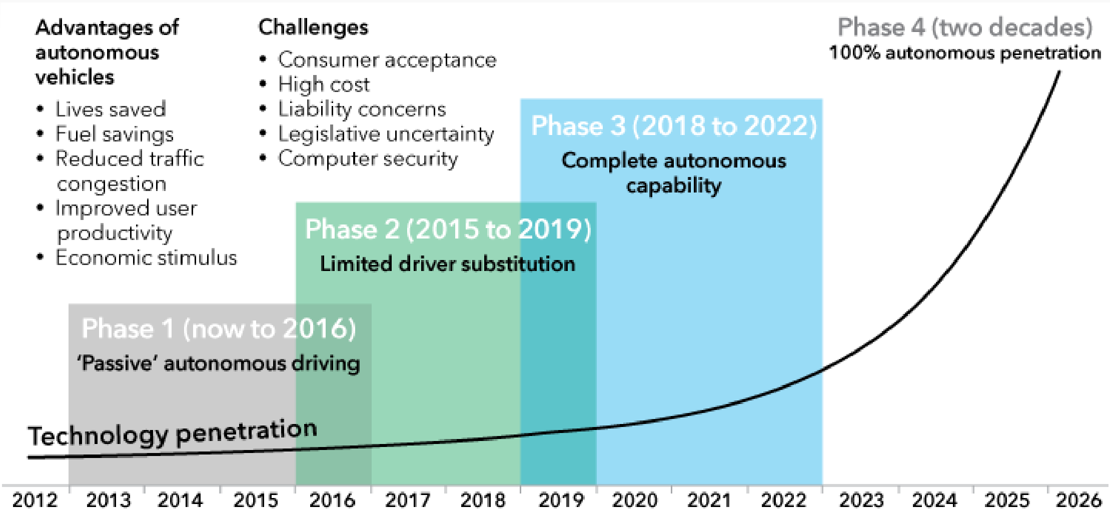
Predicted Opportunities



- Software industry will be main benefactor in a move to autonomy
- Lux Research predicts that the market for self-driving cars will be $87 Billion by 2030 (however in their prediction no cars are expected to be fully autonomous to Level 4 by this date)
- 92% of vehicles will have simple Level 2 driver assist features such as adaptive cruise control, lane departure warning and collision avoidance braking
- Level 3 cars using high resolution maps are expected to gain an 8% share of the market

Trust!

Barriers

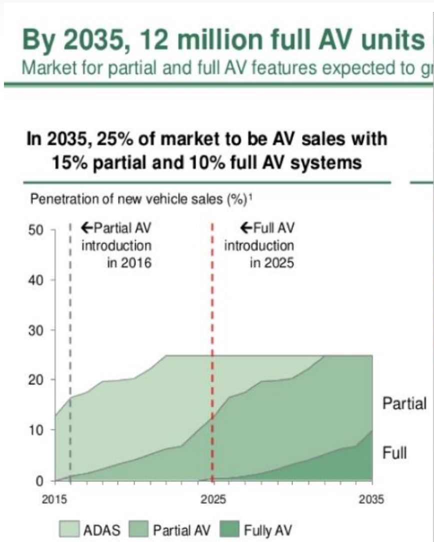


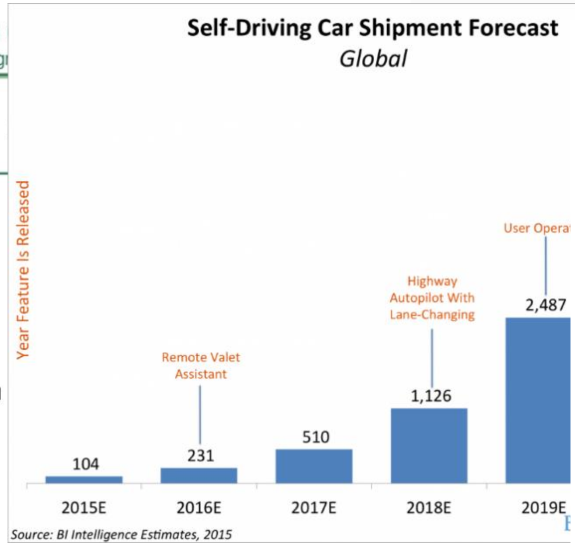
- Autonomous driving is seen as an important technology to make road traffic more secure and more efficient
- The majority of the work is currently concentrated on technical solutions, e.g. processor architectures, sensor technologies, and data processing algorithms
- The key challenge here is to make the technologies cheap enough for mass usage. The systems used on the Google Car, for instance, to make it fully autonomous currently cost $150,000.
- More of a concern, however, is how will autonomous vehicles actually behave when mixed with more traditional vehicles, especially under fault conditions. Designers will not be able to anticipate all possible eventualities and put in place necessary and sufficient mitigations as the scope of the system is effectively unbounded and the number of eventualities is very large.
- As a consequence, there is a need for intensive real-time monitoring of the performance of the systems to spot potential issues arising before they develop into accidents. This leads to other potential barriers such as the loss of driver's privacy.

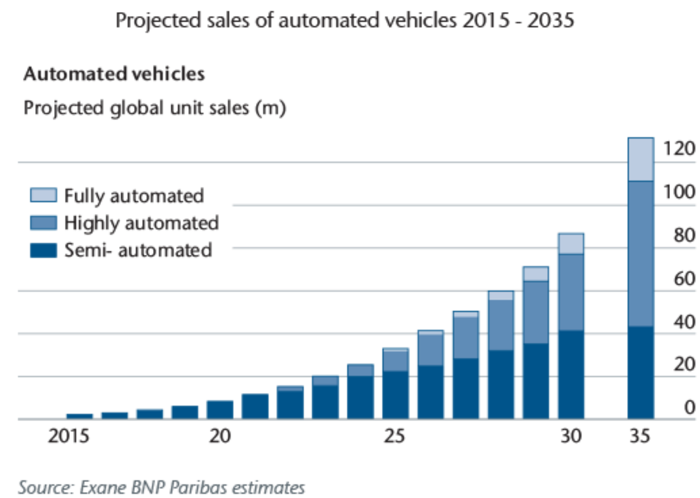
Staged Uptake

- The introduction of autonomous cars will happen in phases as the technology develops and users develop trust. The uptake of fully autonomous cars is only just beginning and is likely to be slow.
- BCG surveyed 1,500 U.S. drivers as well as interviewing executives of some leading car making companies. The study revealed that :
  - 55% of the respondents would like to buy a fully autonomous car within 5 years
  - 44% would consider to do so within a 10-year time
  - 20% would pay an extra $5,000 for highway and urban autopilot features
- The attractions for potential customers are the ability to perform self-driving in itself, increased safety and resulting lower insurance and fuel costs.
- BCG predicts that self-driving cars with highway and traffic jam autopilot modes are most likely to be adopted first with urban autopilot mode cars being adopted by 2022, with large scale uptake of fully driverless cars no earlier than 2025. By this time, the global market will be worth around $42 billion.
- Japan and Western Europe are predicted to be the fastest adopters of intelligent self-driving cars, followed by the U.S. and China.

Staged Introduction

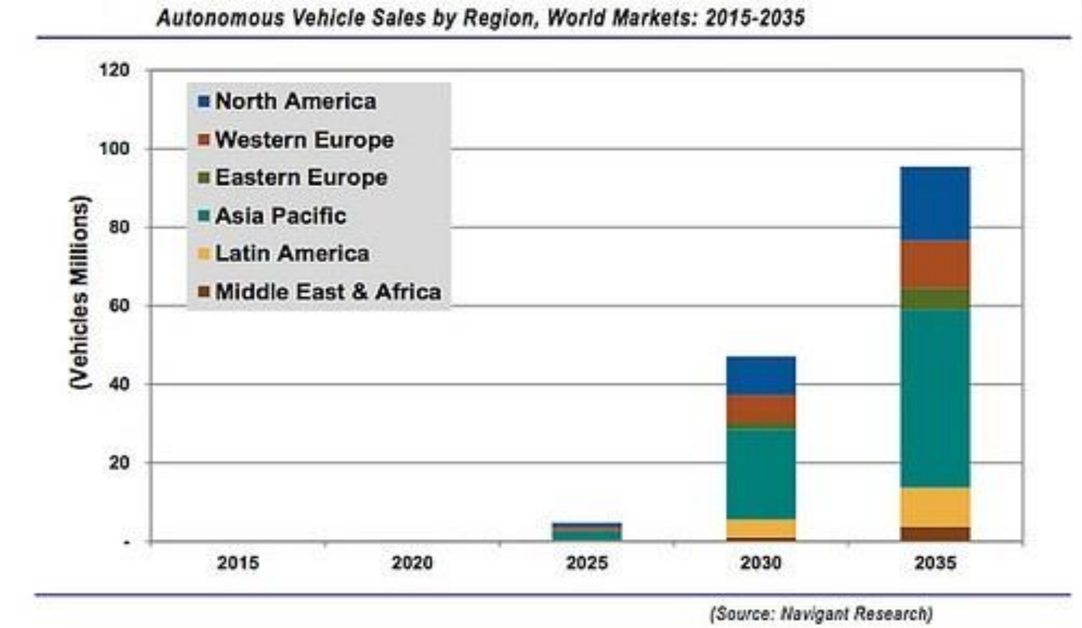






- Not all cars will be fully autonomous in the future and looking at the global market there will be a mix of vehicles on the road with Advanced Driver Assist Systems (ADAS), partial autonomy and full autonomy.
- BNP Paribas predicts a change in the sales of cars with the area of highly autonomous cars being dominant by 2035 with fewer fully autonomous cars. This is predicted based on the rapid advancement of technology and investment from automakers, such as Daimler, GM, BMW and Volkswagen.
- This leads to a global market prediction of $42 Billion in 2025 and $77 Billion market in 2035

Worldwide Market



- Navigant Research indicate that the future market will be dominated by the Asia Pacific region with roughly equal numbers of cars being sold in Europe and North America. Worldwide the total number of autonomous car sales was considered to be about 95 million.
- Lux Research has more optimistic figures. This identified that the uptake of autonomous cars will be led by the United States and Europe but China will rapidly grow and claim a 35% share of the 120 million cars expected to be sold in 2030.
- The revenues from this are expected to be $24 Billion against a $21 Billion US market and a $20 Billion European market.
- The biggest opportunities for companies are in the software sector as this will be a differentiator and also key to safety. This is expected to grow from $0.5 Billion today to $10 Billion in 2020 and $25 Billion in 2030. Here it is expected that Google and IBM will be major players.

Car Sharing and Mobility Integrators

- Car ownership is predicted to decrease in the future with more and more people using mobility solutions and services - market opportunity for Mobility Integrators
- Uber (founded 2009) has revolutionised the taxi industry operating worldwide with an estimated worth of $62.5 billion. The biggest expense for Uber is in paying drivers so the use of self-driving cars would be a major saving for the company. According to the German publication “Manager Magazin” Uber has ordered at least 100,000 Mercedes S-Class cars from Daimler’s Mercedes Benz.
- GM has bought a $500 million stake in Lyft a rival to Uber in the US and also bought Cruise Automation for $1 billion which has key self-driving technology.
- The provision of mobility services and “ride-sharing” is a natural fit for self-driving cars. Ride-sharing has taken off in urban areas where personal vehicle ownership is not a high priority. Consumers prefer efficient and safe services that can be delivered on demand rather than owning their own cars. This removes the hassle of driving which may not be possible if combined with social drinking. Also by not being the owner of the vehicle the responsibility for maintaining and insuring the car is taken away.
- CEO of Tesla, Elon Musk, has also highlighted plans to implement car sharing for their vehicles which would allow Tesla owners to earn money by lending out their cars.

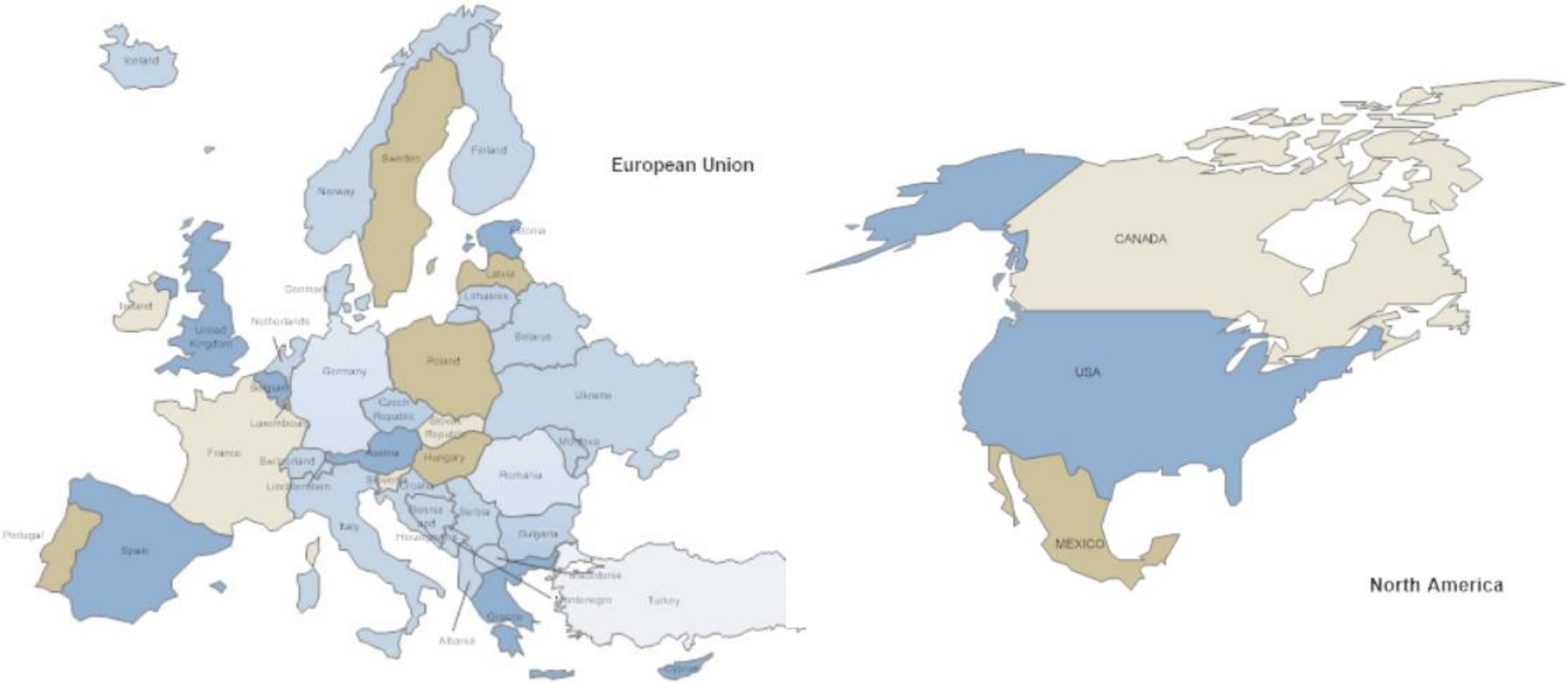
THHINK

Ability to Share Data - Open Data Readiness

Country	Rank	Readiness Sub-Index	Implementation Sub-Index	Impact Sub-Index	ODB Overall
United Kingdom	1	100.00	100.00	79.91	100.00
United States	2	95.26	86.67	100.00	93.38
Sweden	3	95.20	83.14	71.95	85.75
New Zealand	4	81.88	65.49	89.81	74.34
Norway	5	91.88	70.98	46.15	71.86
Denmark	5	83.54	70.20	55.73	71.78
Australia	7	87.88	64.71	51.19	67.68
Canada	8	79.11	63.92	51.59	65.87
Germany	9	74.50	63.14	53.61	65.01
France	10	79.39	64.31	39.07	63.92
Netherlands	10	85.92	67.06	21.42	63.86
Korea (Rep. of)	12	77.19	54.90	24.56	54.21
Iceland	13	62.99	52.94	26.45	51.01
Estonia	14	72.38	49.41	24.00	49.45
Finland	14	91.19	41.18	40.87	49.44
Japan	14	76.99	47.06	27.94	49.17
Spain	17	67.48	49.41	21.13	48.19
Austria	18	68.56	39.22	48.62	46.03
Israel	18	61.82	45.88	25.36	45.58
Italy	20	50.39	42.75	45.69	45.30
Russia	20	54.43	40.39	48.86	44.79
Switzerland	22	65.11	41.57	26.80	43.24
Czech Republic	22	61.83	40.00	35.36	43.18
Kenya	22	49.70	45.88	21.55	43.06
Mexico	25	49.10	45.49	8.37	40.30
Chile	25	65.70	39.22	18.27	40.11
Portugal	27	60.38	38.04	19.25	38.63
Brazil	28	66.03	32.16	27.87	36.83
Singapore	29	70.28	35.29	8.97	36.29
Ireland	29	61.61	32.55	23.82	35.76
Thailand	31	38.09	39.22	14.88	35.33
Argentina	31	40.08	30.47	17.29	35.00
Belgium	31	72.01	28.63	25.64	34.80
India	34	57.36	33.73	9.87	33.38

Open Data Barometer 2013 Global Report

Privacy



- Europe – big problem - different attitudes to privacy across member states
- Difficult to roll out technologies across Europe

- US – easier to roll out technologies
- Driven by business

Differences

European Data Protection Directive (Directive 95/46/EC) protects an individual with respect to processing of personal data and on the free movement of such data**. 7 Key principles**

- Notice—data subjects should be given notice when their data is being collected;
- Purpose—data should only be used for the purpose stated and not for any other purposes;
- Consent—data should not be disclosed without the data subject's consent;
- Security—collected data should be kept secure from any potential abuses;
- Disclosure—data subjects should be informed as to who is collecting their data;
- Access—data subjects should be allowed to access their data and make corrections to any inaccurate data; and
- Accountability—data subjects should have a method available to them to hold data collectors accountable for not following the above principles.

Right to personal autonomy:

- The First Amendment protects the privacy of beliefs
- The Third Amendment protects the privacy of the home against the use of it for housing soldiers
- The Fourth Amendment protects privacy against unreasonable searches
- The Fifth Amendment protects against self-incrimination, which in turn protects the privacy of personal information
- The Ninth Amendment says that the "enumeration in the Constitution of certain rights shall not be construed to deny or disparage other rights retained by the people." This has been interpreted as justification for broadly reading the Bill of Rights to protect privacy in ways not specifically provided in the first eight amendments.

However, the right to privacy is most often cited in the Due Process Clause of the 14th Amendment, which states:
No state shall make or enforce any law which shall abridge the privileges or immunities of citizens of the United States; nor shall any state deprive any person of life, liberty, or property, without due process of law; nor deny to any person within its jurisdiction the equal protection of the laws.

- **"Safe Harbor Privacy Principles"** have been defined with the aim of enabling some US companies to comply with privacy laws that protect European Union and Swiss citizens. According to the principles US companies who store customer data may self-certify that they adhere to 7 key principles that comply with the EU Data Protection Directive and with Swiss requirements.

- The European Commission and the United States agreed on a new framework for transatlantic data flows on 2nd February 2016, known as the **"EU-US Privacy Shield".**

Common Technologies and Issues

Industrial Drivers and Societal Needs

Smart Cities

Smart Energy

Smart Transportation

Technologies Internet of Things | Big Data | Cloud Computing | Cyber Physical Systems | Wireless Standards, e.g. 5G

Policy Issues Cyber Security | Privacy | Confidentiality | Safety | Ethics | Interoperability/Standards | Internet Governance

Key Messages for Road Ahead

- Talk “jam packed” and “moved along smartly”
- Global car fleet is predicted to double to 1.6 billion vehicles by 2030
- Markets and Markets predicts global traffic management market will grow from $4.12 Billion to $17.64 Billion by 2020
- Self-driving car market will grow from $42 Billion in 2025 to $77 Billion by 2035

Problem or Customer Demand

Traffic Jams, Safety, Connected Car, Car Ownership -> Mobility

Technology Development

Sensors developing rapidly – cost is barrier
Need a global communication standard
Safety-critical software for autonomy
Security

Barriers – Acceptance, Privacy, Legal, etc.

Trust, privacy, liability, ethical issues (who to save)

Roll out of Technology (Next 10 years)

More Likely