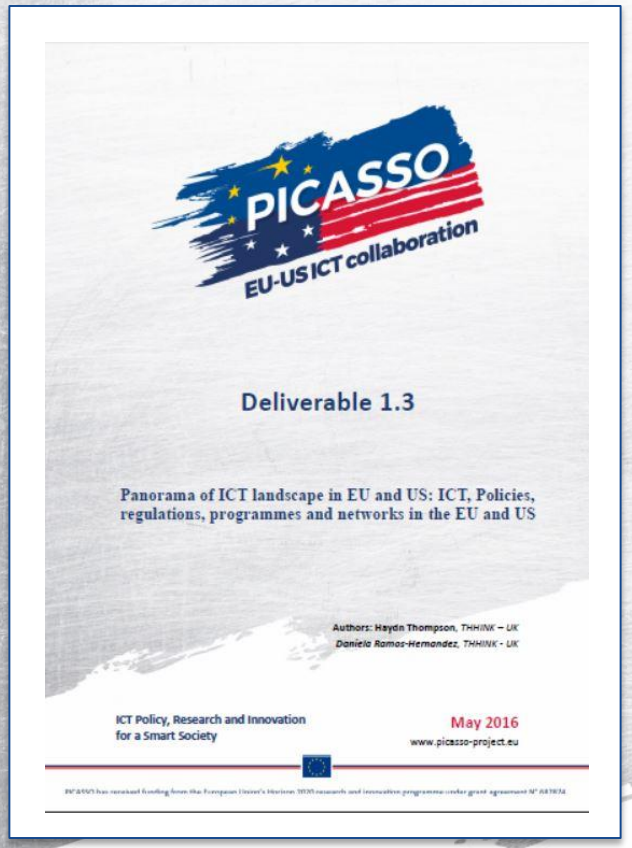


Panorama of ICT landscape in the EU and US

ICT Policies, regulations, programmes and networks in the EU and US

Professor Haydn Thompson

ICT Policy, Research and Innovation for a Smart Society

www.picasso-project.eu

PICASSO has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 687874.

PICASSO

Industrial Drivers and Societal Needs

Smart Cities

Smart Energy

Smart Transportation

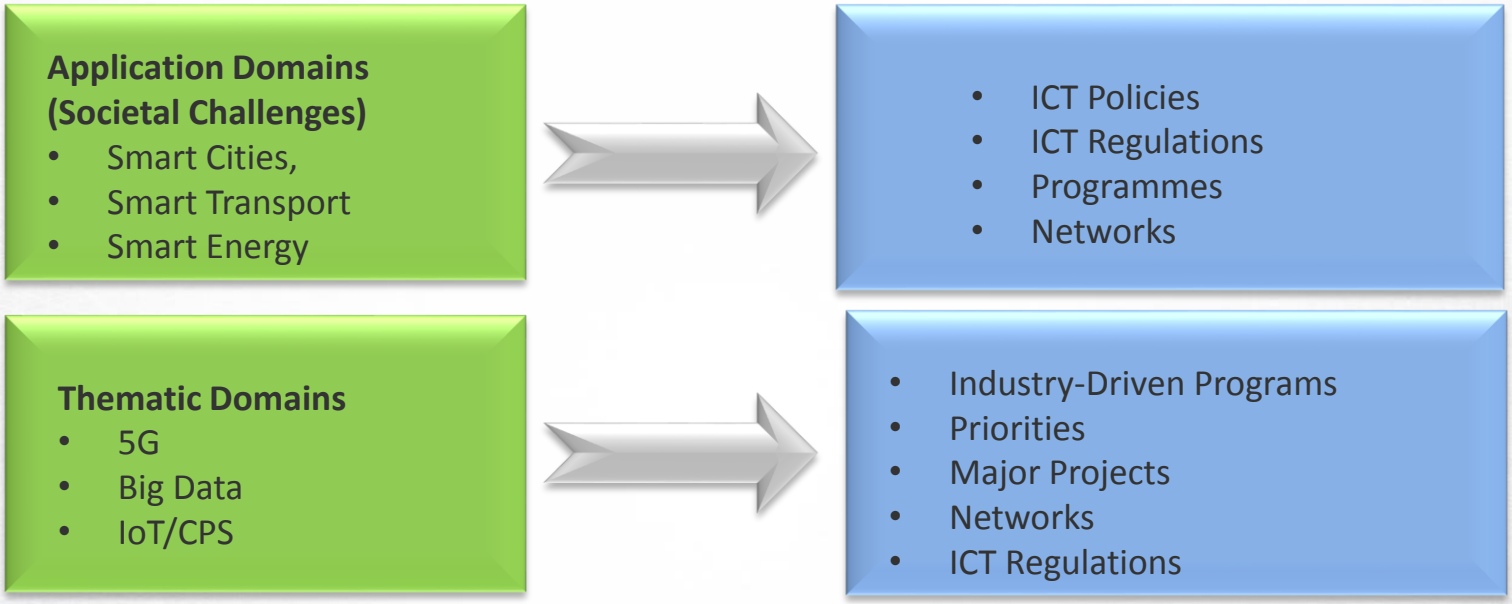
Technologies Internet of Things | Big Data | Cloud Computing | Cyber Physical Systems | Wireless Standards, e.g. 5G

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

PICASSO EU-US ICT collaboration

THINK WIRELESS TECHNOLOGIES LTD

Panorama of ICT landscape in EU and US: ICT Policies, regulations, programmes and networks in EU and US



It is clear that there are many opportunities for joint collaborations between the EU and US. The report proposes:

- 15 areas where it may be possible to collaborate on research and policy
- 16 areas where there is an opportunity to work together on regulations
- 9 areas where it would be beneficial to work together on standards

PICASSO EU-US ICT collaboration

THINK WIRELESS TECHNOLOGIES LTD

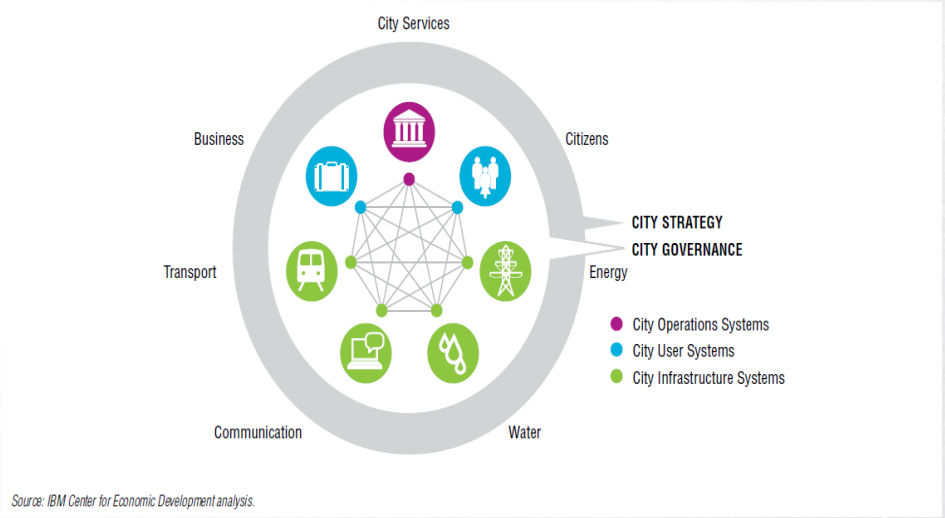
Potential Collaboration Areas

Potential Areas for Collaboration Smart Cities	
Research/Policy	Integration of mixed-criticality systems – combining the CPS and IoT worlds
Research/Policy	Cyber-Security – bringing together expertise in Europe, e.g. Estonia, The Internet of Things Security Foundation (IoTSF) UK and the National Cyber-security Center of Excellence
Research/Policy	Demonstration at scale and replication of solutions
Research/Policy	Anonymising data, encryption and processing in encrypted domains
Regulation	Regulation in the area of privacy and in allowing sharing of data to provide services
Regulation	Changes to allow new methods of certifying systems for safety
Standards	Development of Smart City Standards to provide guidance and best practice on implementation of smart functionalities
Standards	Interoperability, e.g. smart city standards targeted at mobility, transportation, M2M, energy efficiency, security and Smart Sustainable Cities.
Potential Areas for Collaboration Smart Energy	
Research/Policy	There are many synergies in research and policy in the areas of smart metering, energy efficient neighbour hoods, smart city energy management, low carbon economy and renewable energy. There may well be opportunities for joint research.
Research/Policy	In the area of cyber-security closer ties should be encouraged between the European Commission multi-stakeholder expert group on cyber-security and NISTs Smart Grid Interoperability Panel (SGIP) Cyber-security Committee (SGCC). Here there are critical lessons to be learned from the experience of Estonia and from the US guidelines, e.g. NISTIR 7628.
Regulation	Sharing of best practice regulation for smart metering and tariffs to manage system load capacity (off-peak/on-peak schemes).
Regulation	Introduction of harmonised regulation to allow stakeholders to make grid investments in EU and US
Standards	Currently standards for interoperability are being driven by the European Commission and EFTA, e.g. the Smart Grid Mandate M/490 which was accepted by CEN, CENELEC and ETSI. EISA in the US has asked NIST and FERC to facilitate the development and adoption of interoperability standards. Here there may be opportunities to harmonise standards development.
Potential Areas for Collaboration Smart Transportation	
Automotive Sector	
Research/Policy	There are many similarities in policy in the EU and US driven by climate change and increased urbanisation. There are opportunities to collaborate on Intelligent Transport Systems, autonomous cars, electric cars and alternative fuels.
Regulations	As the automotive market is global there are opportunities to harmonise regulations that promote adoption of green technologies, e.g. electric cars and reductions in fuel consumption and emissions.
Regulations	There is a need to address barriers to the adoption of autonomous cars at a global level. This requires regulation on safety, liability and also privacy.
Standardisation	Wireless standards are needed for ITS, for car-to-car and car-to-infrastructure communication. These need to be world-wide as the marketplace for automotive is global.
Rail Sector	
Research/Policy	There are opportunities for joint research on providing high availability in rail networks, maintenance approaches, emissions reductions and approaches to increasing capacity
Regulation	Automatic train control systems are already a reality in Europe and will be in place across Europe by 2023. Opportunities within the US may also be considered but regulation is required to support this.
Aerospace Sector	
Research/Policy	There are many research projects both industrial and academic exploring the use of autonomous aircraft. Here there may be opportunities for joint work.
Standardisation	In the area of Air Traffic Management there are two different systems being developed in the EU and US respectively. It is important that these are interoperable.
Regulation	Autonomous aircraft – safety for operation in civil airspace – here there is an opportunity for the CAA, EASA and the FAA to work together
Maritime Sector	
Research/Policy	Research on navigation for ships, increased autonomy and emissions reductions
Regulation	Harmonisation of regulations on emissions, e.g. IMO
Regulation	Safety regulations are needed to further reduce crew levels and move towards autonomous ships, e.g. minimum crew levels may need to be removed
Standardisation	EU activities on E-Maritime and MAF need to be harmonised with US activities to allow interoperability
Potential Areas for Collaboration 5G	
Research/Policy	Currently work on 5G in the US and EU is disconnected and fragmented. The 5G PPP in Europe would provide a good link with any initiative which is funded in US.
Regulation	Spectrum harmonisation at a global level is needed so that the same frequencies are used worldwide (to avoid what happened with 4G LTE)
Standardisation	There are many initiatives driven by large companies such as NTT Docomo, Samsung, Ericsson, T-Mobile and Verizon. There is a need for all companies to work together and this is already happening in initiatives such as NGMN 5G. There is a need for a strong EU-US voice in these initiatives.

Potential Areas for Collaboration Big Data	
Research/Policy	Big Data and Open Data are both viewed as being essential for the development of many areas. There are very strong policy initiatives on Big Data on both sides of the Atlantic and there are many opportunities for synergies working together at the foundational level and also in terms of engaging with activities such as those at NIST. The area of open data is less clear with many local initiatives at national levels. The lack of open data is currently a barrier to many applications. The power of open data is becoming more apparent from pilot initiatives around the world and this may lead to replication in other cities and countries. The uptake of this is, however, fragmented and initiatives that would allow replication would be beneficial.
Regulation	Regulation is a key enabler in the field for global adoption of services and this is already well recognised with activities such as Safe Harbour and Privacy Shield.
Standardisation	Standardisation activities are already being addressed at an international level and this should be further promoted.
Potential Areas for Collaboration IoT/CPS	
Research/Policy	Engineering trustable, reliable, evolvable and affordable Cyber-Physical Systems connected by the Internet of Things is a scientific and technological challenge that requires huge efforts. Here joining forces would help to advance the technology more quickly and address societal challenges. EU and US companies could better compete on world markets.
Research/Policy	Integration of mixed-criticality systems – combining the CPS and IoT worlds
Research/Policy	Provide guidance and best practice on implementation of smart functionalities
Regulation	Regulation (changes) will be needed to allow new methods of certifying systems for safety
Regulation	CPS/IoT deployments at scale have many implications including implications for privacy (applications rely on collecting and utilising data from a myraid of sensors). Regulation on privacy and the sharing of data regulation has a crucial role in the development of CPS and IoT.
Regulation	The interconnectedness of systems leads to vulnerabilities to unintentional errors and cyber-attacks. Regulation is needed with respect to security.
Regulation	There is a need for business models and regulation to support market access.
Standards	There is a need to provide standards for interoperability that support the creation of an ecosystem of developers and users of CPS and IoT systems. Here a harmonization between the US and Europe is not only advantageous but strongly needed.

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.

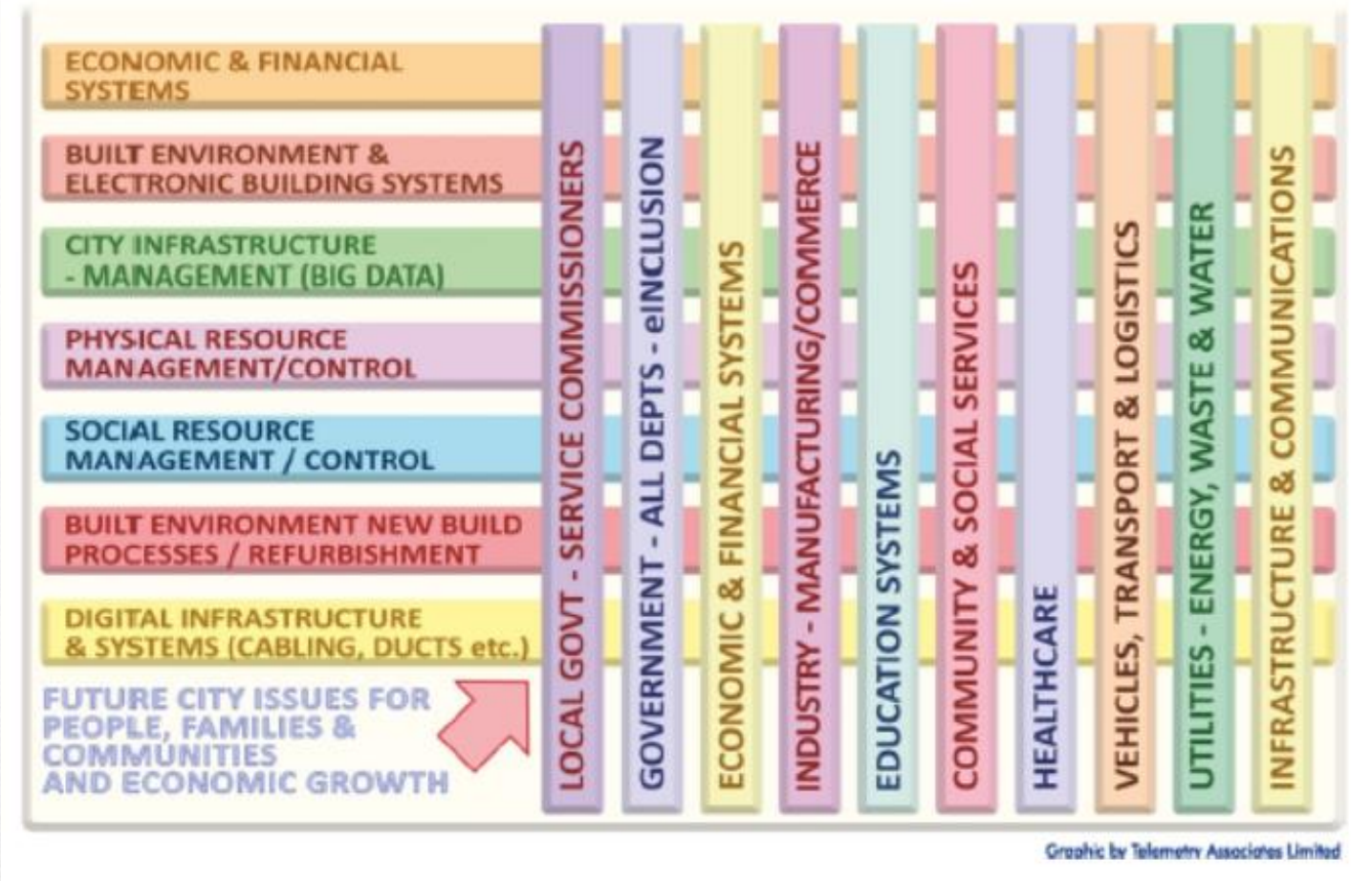


Source: IBM Center for Economic Development analysis.

PICASSO EU-US ICT collaboration

THINK WIRELESS TECHNOLOGIES LTD

Features of Smart Cities

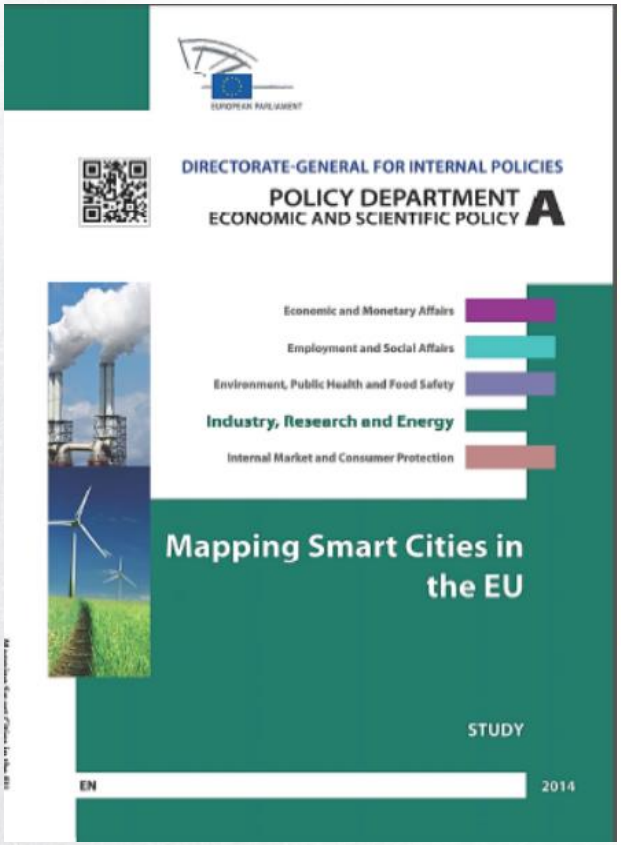


“Smart Cities” is a mixture of areas

PICASSO EU-US ICT collaboration

THINK WIRELESS TECHNOLOGIES LTD

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

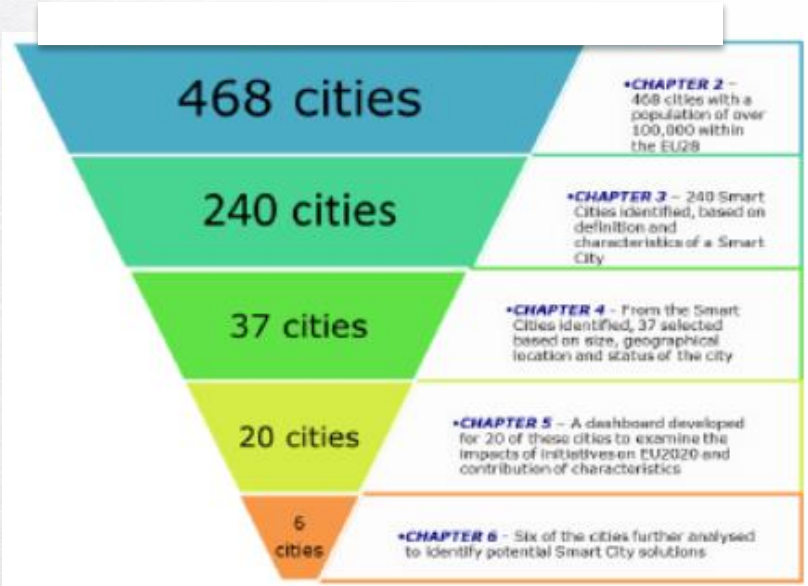
Recommendation	Intended for
Supporting the development of Smart Cities	
Use demand-side measures to stimulate demand for city-based 'Smart solutions'	Member State and local government procurement agencies, Horizon 2020, service users, standards bodies, national regulatory agencies
Selective use of regulatory 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!

PICASSO EU-US ICT collaboration

THINK WIRELESS TECHNOLOGIES LTD

Key Findings



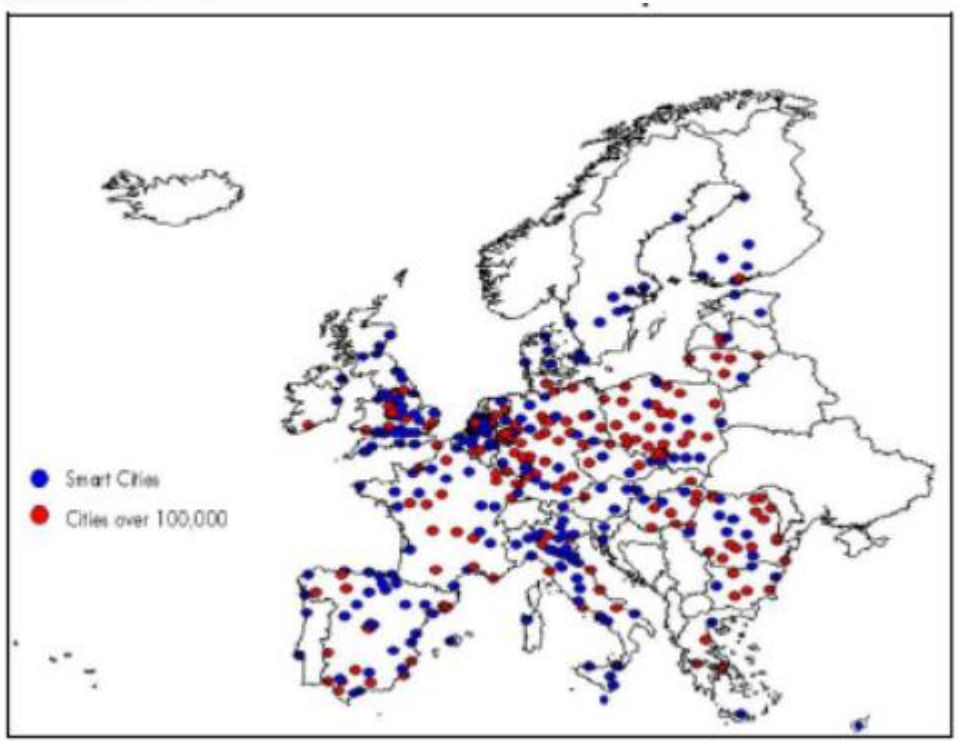
KEY FINDINGS

- 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.

PICASSO EU-US ICT collaboration

THINK WIRELESS TECHNOLOGIES LTD

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	++			+	++

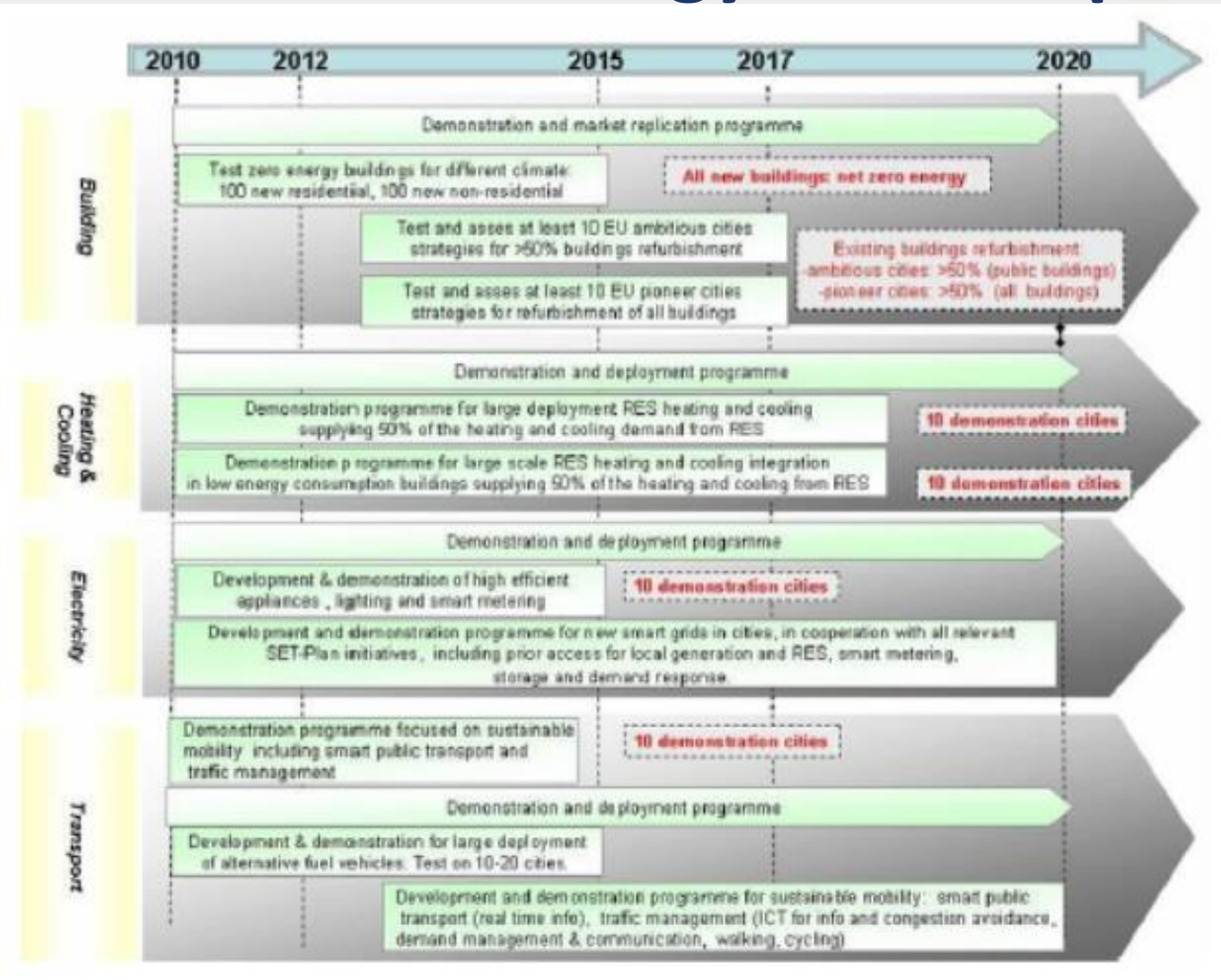
50 Smart City Projects

- UK, Spain and Italy, have the largest number of Smart Cities – more than 30 each
- Germany and France (other large countries) have fewer Smart Cities
- Smaller countries have absolute lower numbers of Smart Cities

PICASSO EU-US ICT collaboration

THINK WIRELESS TECHNOLOGIES LTD

Smart Cities Technology Roadmap

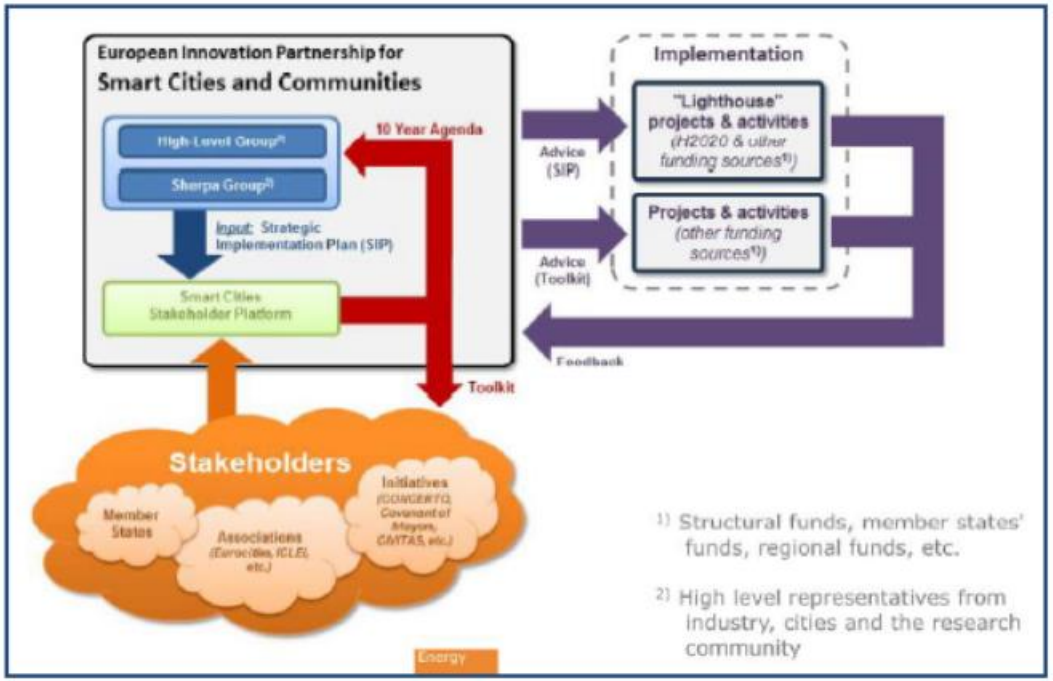


Source:http://setis.ec.europa.eu/implementation/technology-roadmap/european-initiative-on-smart-cities

PICASSO EU-US ICT collaboration

THINK WIRELESS TECHNOLOGIES LTD

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.

PICASSO EU-US ICT collaboration

THINK WIRELESS TECHNOLOGIES LTD

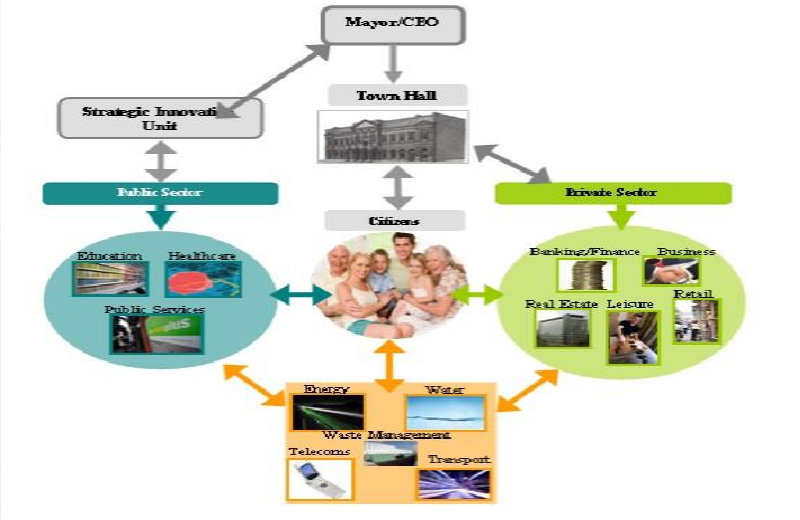
Plan

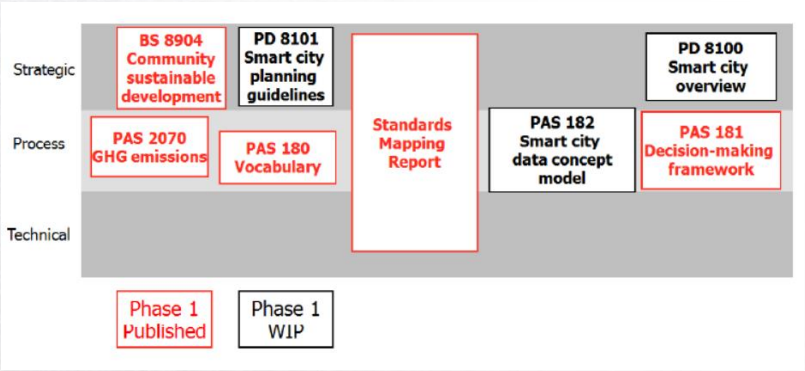
- European Innovation Partnership on Smart Cities and Communities Operational Implementation Plan: First Public Draft Sherpa Group Feb 2014.
- Also a programme for smaller cities Small Giants – less than 250,000 inhabitants

PICASSO EU-US ICT collaboration

THINK WIRELESS TECHNOLOGIES LTD

National Initiatives - UK





- **The smart cities industry is valued at more than $400 billion globally by 2020**, with the UK expected to gain a 10% share ($40 billion)
- Future Cities Demonstrator Programme is a £33m TSB project which aims to demonstrate at scale the added value of integrating city systems
- Future Cities Catapult. This has been set up to act as a global centre of excellence in urban innovation
- e-infrastructure Leadership Council
- HyperCatCity brings together London, Bristol and Milton Keynes

Business very engaged

PICASSO EU-US ICT collaboration

THINK WIRELESS TECHNOLOGIES LTD

National Initiatives

- **Spain** - Smart Santander is a city-scale experimental research facility to stimulate development of new applications and provide realistic user acceptability tests for assessment. The project has a vision not only to deploy 12,000 sensors in Santander but also to deploy 20,000 sensors in Belgrade, Guildford and Lübeck.
- **Spain** - Barcelona has established a number of projects that can be considered “smart city” applications within its "CityOS" strategy
- **Netherlands** - Amsterdam Smart City (ASC) is a partnership between companies, governments, knowledge institutions and the people of Amsterdam to turn the city into a Smart City - 90 projects
- **Estonia** - Tallinn is one of the world's most technologically advanced cities. Estonians carry chip-embedded identification cards which are used for voting, prescriptions and many other transactions. NATO centre for cyber-security
- **Sweden** - Stockholm’s smart city technology is underpinned by the city owned Stokab dark fibre system and a Green IT strategy

US Initiatives

- **White House Smart Cities Initiative** will invest over $160 million in federal research and leverage more than 25 new technology collaborations to help local communities tackle key challenges such as reducing traffic congestion, fighting crime, fostering economic growth, managing the effects of a changing climate, and improving the delivery of city services.
- The President's 2017 budget proposal includes a focus on cyber-physical systems and Smart Cities.
- The Networking and Information Technology Research and Development Program has launched a **Smart and Connected Communities** programme.
- NIST and several partners (usignite) are leading the **Global City Teams Challenge** to help communities around the world work together to address issues ranging from air quality to traffic management to emergency services coordination.

  - Partners: IBM, AT&T, Intel, NSF, ITA, DoT, State Department, GSA, FIWARE, World e-Governments (WeGO), IIC, The Kingdom of Netherlands and the Republic of South Korea.
  - Participating Organizations: Qualcomm, Bosch, Siemens, CH2M Hill, Mathworks, Pecan Street, Inc., Yeti Analytics, MIT, Vanderbilt, UT Dallas, University of North Texas, Ohio State University and Columbia University

PICASSO EU-US ICT collaboration

THINK WIRELESS TECHNOLOGIES LTD

US Smart Cities

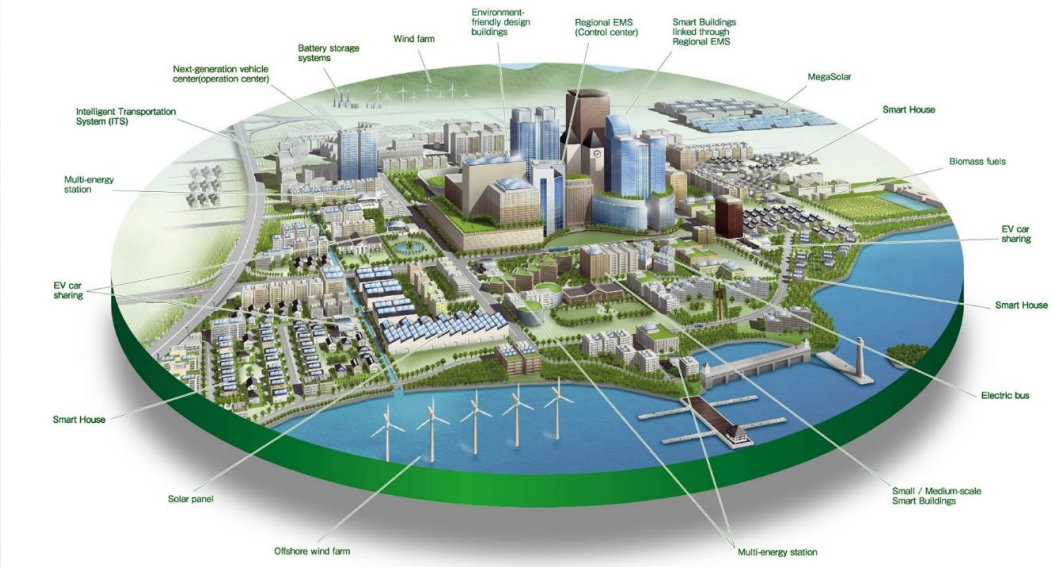
- **Boston** - has introduced Time to Destination message signs and Smart Parking Sensors to better manage traffic
- **San Francisco** – has introduced a large number of free WiFi hotspots which cover downtown. Citizens are encouraged to participate in energy conservation through provision of web access to precise, near real-time energy use data and advice on how they can save energy. The city also has over 100 electric vehicle charging stations to promote the use of hybrid and electric cars

- **Seattle** - is one of the greenest cities in the US. The city's electric meters are being upgraded to give more accurate readings of electricity consumption to allow management. Seattle has partnered with Microsoft to launch its High Performance Building Program
- **San Jose** - in partnership with Intel San Jose has initiated a project, "Smart Cities USA", which is tracking real-time data on air quality, noise pollution, and traffic flow
- **Washington DC** - is one of the top cities in the U.S. for transit use and e-governance. Washington D.C. has been a pioneer in the adoption of new technology, including the launch of a private cloud in 2010 and the early use of mashups to become a GIS model city
- **New York** - $20 billion Hudson Yard Project
- **Chicago** - has provided 851 open data sets and the Chicago's Digital Excellence Smart Communities Program

PICASSO EU-US ICT collaboration

THINK WIRELESS TECHNOLOGIES LTD

Smart Energy



- 70% of the EU population lives in urban areas, and the figure is likely to increase over the next few decades
- Cities are main centres for all economic, social and cultural activities in Europe and create around 80% of the EU's gross domestic product
- Urban areas consume 70% of energy, and account for 75% of the EU's greenhouse gas emissions, thus, making cities the place where most energy savings could be made.

PICASSO EU-US ICT collaboration

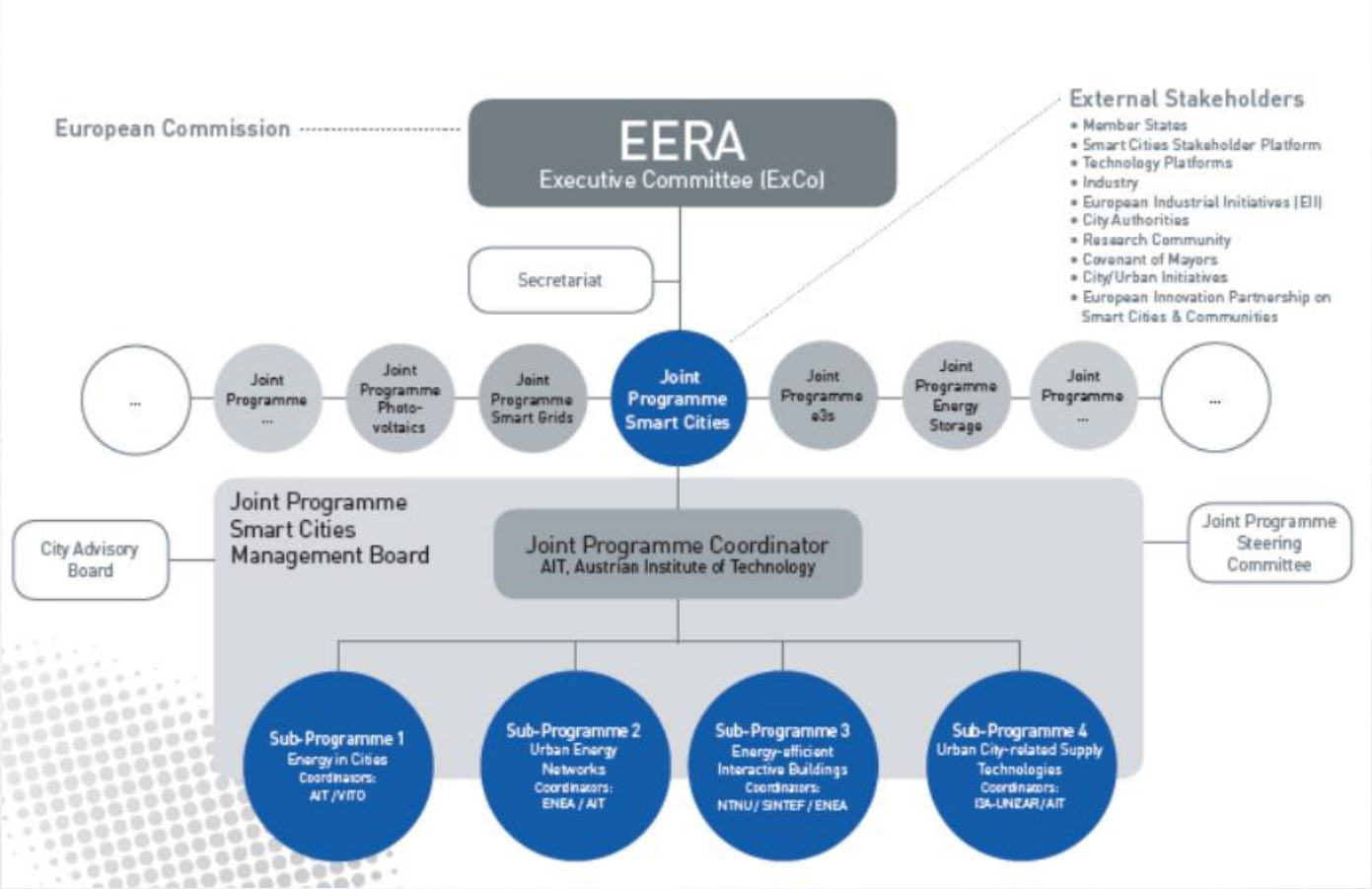
THINK WIRELESS TECHNOLOGIES LTD

European Initiatives

The ICT Roadmap for Energy Efficient Neighbourhoods (IREEN)

- Notably nearly 50% of European Smart City initiatives address environmental problems.
- The **European Strategic Energy Technology Plan (SET Plan)** has identified the need for development of energy technologies to combat climate change and the need for securing energy supply at the European and global level.
- To support this the **European Energy Research Alliance (EERA)** has been set up by leading European research institutes
- The SETIS Initiative has been created to support cities and regions in sustainable use and production of energy.
- An **ICT Roadmap for Energy Efficient Neighbourhoods** has been created and KIC InnoEnergy has been set up as a commercial company dedicated to promoting innovation, entrepreneurship and education in the sustainable energy field.
- It is planned to build 100 Positive Energy Blocks (PEB) across the EU.

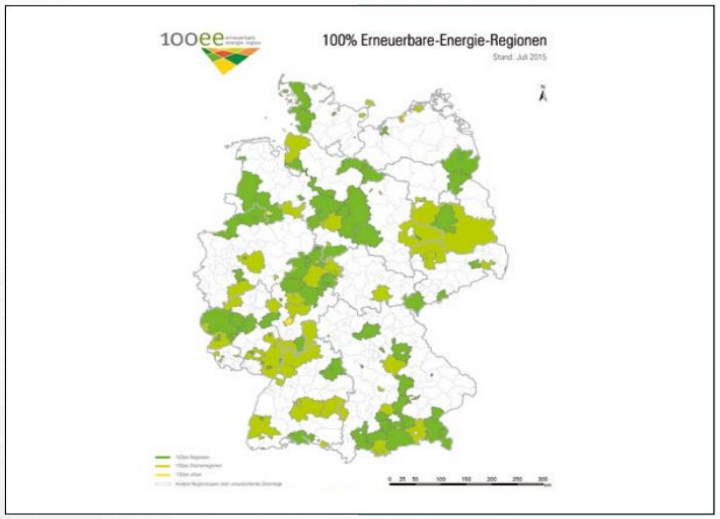
EERA (European Energy Research Alliance) Joint Programme on "Smart Cities"

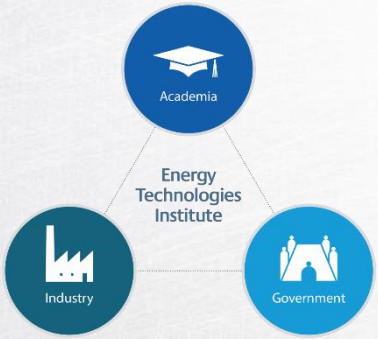


PICASSO EU-US ICT collaboration

THINK WIRELESS TECHNOLOGIES LTD

Germany, France and UK





- German federal government's 2010 plan to **phase out nuclear power completely**. A new mix of renewables are being introduced.
- In France over **90% of electricity is from nuclear or hydro sources.** In 2013 French electricity prices for medium-size industrials were about 90% that of the EU-27 average, and those for medium-size households (at less than 8 c/kWh) were less than half of the EU-27 average. SmartGrids France is introducing smart metering
- **UK plans to cutting greenhouse gas emissions by 80% by 2050**. The low carbon economy strategy in the UK is driving the setup of public private research partnerships and a range of initiatives for electivity and heating. Every home will be supplied with a smart meter helping consumers to understand their energy consumption and make savings.
- The ETI is a public private research partnership, involving six companies whose funding of projects is matched by the public sector, in particular EPSRC.

PICASSO EU-US ICT collaboration

THINK WIRELESS TECHNOLOGIES LTD

US Energy Programmes

Category	$ Million
Integrated/Crosscutting	2,150
AMI	818
Distribution	254
Transmission	148
Customer Systems	32
Manufacturing	26
Total	3,429

18 million smart meters
1.2 million in-home display units
206,000 smart transformers
177,000 load control devices
170,000 smart thermostats
877 networked phasor measurement units
671 automated substations
100 PEV charging stations

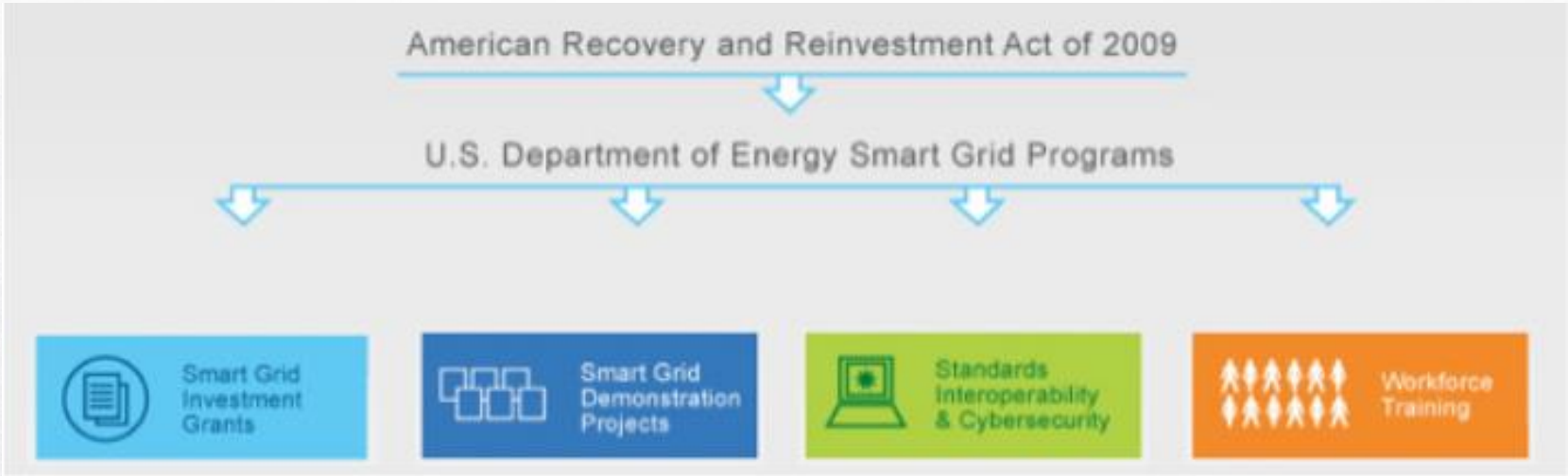
Geographic Coverage of Selected Projects

- In the US as part of the **Reinvestment and Recovery Act** there are a number of government initiatives and policies including totalling **$3.4 billion** of investment grants for Smart Grid projects. This includes funding to promote energy-saving choices for consumers, increasing efficiency, and fostering the growth of renewable energy sources such as wind and solar.
- The **Energy Independence and Security Act of 2007** (EISA) also made it policy to modernise the nation's electricity transmission and distribution system to create a smart electric grid. This is supported by the Administration's commitment in the "Blueprint for a Secure Energy Future" and "A Policy Framework for the 21st Century Grid: Enabling Our Secure Energy Future."

PICASSO EU-US ICT collaboration

THINK WIRELESS TECHNOLOGIES LTD

DoE Smart Grid



- The **American Recovery and Reinvestment Act of 2009** (Recovery Act) provided the U.S. Department of Energy with $4.5 billion to modernize the electric power grid and to implement Title XIII of the Energy Independence and Security Act (EISA) of 2007.
- The two largest initiatives are the **Smart Grid Investment Grant (SGIG) Program and the Smart Grid Demonstration Program** (SGDP), which were originally authorized by EISA , and later modified by the Recovery Act . The DOE Office of Electricity Delivery and Energy Reliability (OE) is responsible for managing these five-year programs.

PICASSO EU-US ICT collaboration

THINK WIRELESS TECHNOLOGIES LTD

Rest of the World

- Around the world different approaches are being adopted and a wide variety of technologies and services are being demonstrated driven by national and regional business drivers.
- In the US peak load reduction technology and dynamic pricing tariffs are being pursued.
- In Europe emphasis is on improving energy efficiency and reducing emissions through decentralised production.
- In the Asia-Pacific region China is modernising and improving grid reliability and Australia and New Zealand are exploring new techniques for load management. There are major investments in **China ($128 billion)** to reduce carbon intensity by investment in renewable power and to create grid interconnectivity with neighbouring countries such as Russia, Mongolia, Kazakhstan, Pakistan, Myanmar, Laos, Nepal and Thailand. Since 1992 China has relied heavily on electricity it purchases from Russia.
- Other countries also actively pursuing smart grids are Brazil, Mexico, South Korea and Japan.

PICASSO EU-US ICT collaboration

Smart Grid Regulation

- The smart grid market is led by regulation and reductions in emissions, consumer choice and energy security are driving adoption of smart grid technologies.
- Regulation in the UK and Germany is introducing smart metering and tariffs. A number of pricing structures are being explored: tiered pricing rates that reflect system capacity and time-of-use pricing (off-peak/on-peak) schemes. Introducing "Critical Peak" prices has been found in a US pilot to be the most effective technique to trigger load reduction.
- **Across Europe grid regulation varies considerably making smart grid investments difficult.** In Europe the Electricity Directive and the Energy Services Directive provide a mix of obligations and incentives to Member States to establish a common regulatory framework.
- Other bodies also need to be involved such as The Agency for the Cooperation of Energy Regulators **(ACER) that fosters cooperation among European energy regulators to ensure market integration and the harmonisation of regulatory frameworks** within the framework of the EU's energy policy objectives and The **Council of European Energy Regulators (CEER)** that represent national regulators

Cyber-Security

- Security is another key concern and smarter grids lead to increased vulnerabilities from intrusions, error-caused disruptions, malicious attacks, destruction, and other threats. As the electric grid network is key to the operation of a country, cyber-security is a key topic on both sides of the Atlantic.
- The European Commission has put together a **multi-stakeholder and multidisciplinary group of experts** to discuss and work on relevant matters regarding the security and resilience of communication networks and information systems for Smart Grids across Europe. Although standards for smart grid cyber-security are already available these need to be maintained and enhanced as it and technology evolves.
- In Europe **Alstom Grid, Intel, and McAfee produced a white paper** on smart grid cyber-security.
- In the **US the Administration has proposed specific cyber-security legislation** to ensure that grid operators and all stakeholders have access to actionable threat information and provide support for research, development, and demonstration of cyber-security systems. The aim is to identify and prioritise relevant cyber risks - including malware, compromised devices, insider threats, and hijacked systems - and develop standards and guidelines that enable the design of effective plans for mitigating those risks.
- A **number of threat warning bodies have been set up in the US, Electricity Sector** - Information Sharing and Analysis Center, the United States Computer Emergency Readiness Team, and the National Electric Sector Cyber-security Organization. The NIST Information Technology Laboratory (ITL), Computer Security Division leads the Smart Grid Interoperability Panel (SGIP) Cyber-security Committee (SGCC) which has produced the **NISTIR 7628 Guidelines for Cyber-Security (**Volumes 1, 2, and 3) which is widely used by utilities, vendors, and regulators in the US.

Standards

- In the smart grid area there is a need for standards for interoperability and safety. Standards are voluntary in Europe and are developed by industry and market actors. The European Commission and EFTA have issued the **Smart Grid Mandate M/490** which was accepted by CEN, CENELEC and ETSI.

- In the US EISA asked NIST and FERC to facilitate the development and adoption of **interoperability standards**. NIST is leading this coordinating the development of a framework that includes protocols and model standards for information management to achieve interoperability of Smart Grid devices and systems.

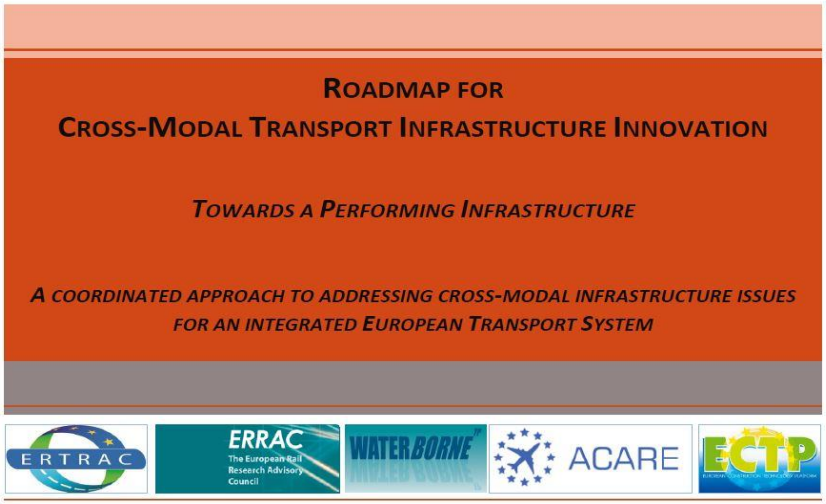
Smart Transportation

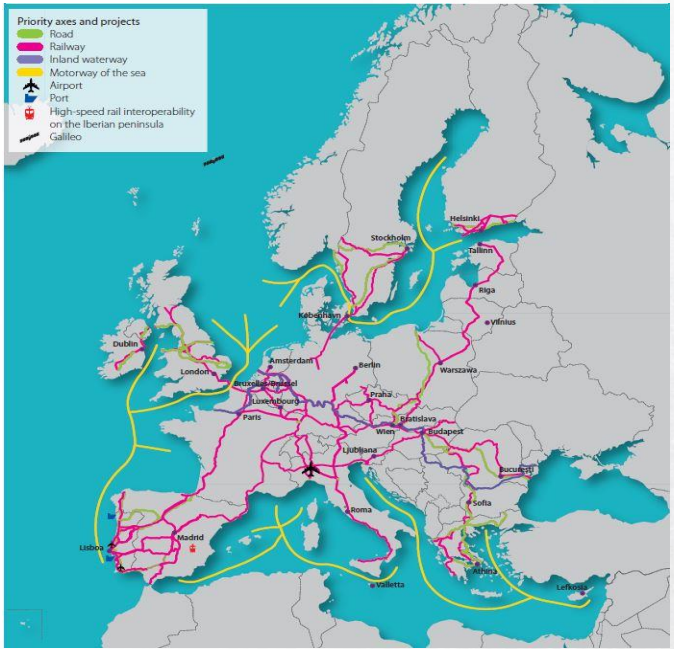
European Parliament and Council introduced the Directive 2010/40/EU in July 2010 on the framework for the deployment of Intelligent Transport Systems (ITS) in the field of road transport and for interfaces with other modes of transport. The European Commission's aim is to accelerate and coordinate the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

PICASSO EU-US ICT collaboration

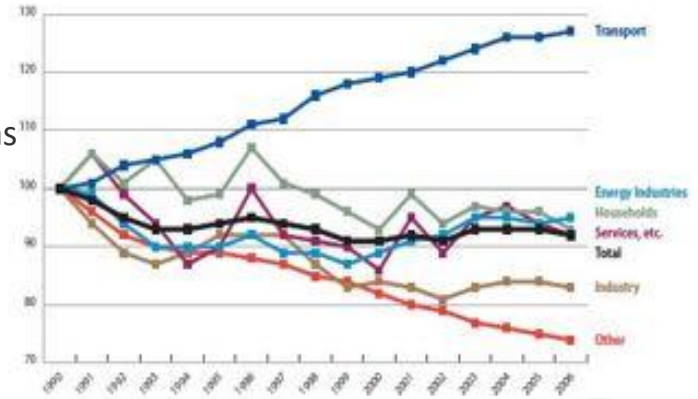
THINK WIRELESS TECHNOLOGIES LTD

Integrated European Transport System – Sustainable Transport





- 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
- Emissions are a key issue – Transport accounts for ¼ of all emissions
- Infrastructure needs to support continuing increase in demand – safety reduce fatalities by 50%
- EU funding Trans-European Networks for Transport (TEN-T)



PICASSO EU-US ICT collaboration

THINK WIRELESS TECHNOLOGIES LTD

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).

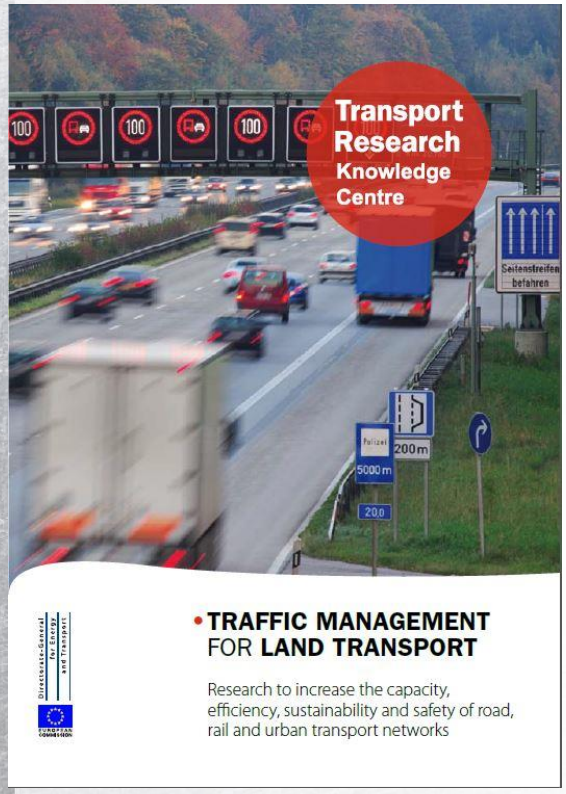
EU policy is to promote integrated traffic management and control on the **Trans-European Networks** (**TEN-T**), which cover all transport modes, to enable them to fulfil their function of offering high-quality core networks and corridors linking all countries and regions of Europe. This includes Air 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.

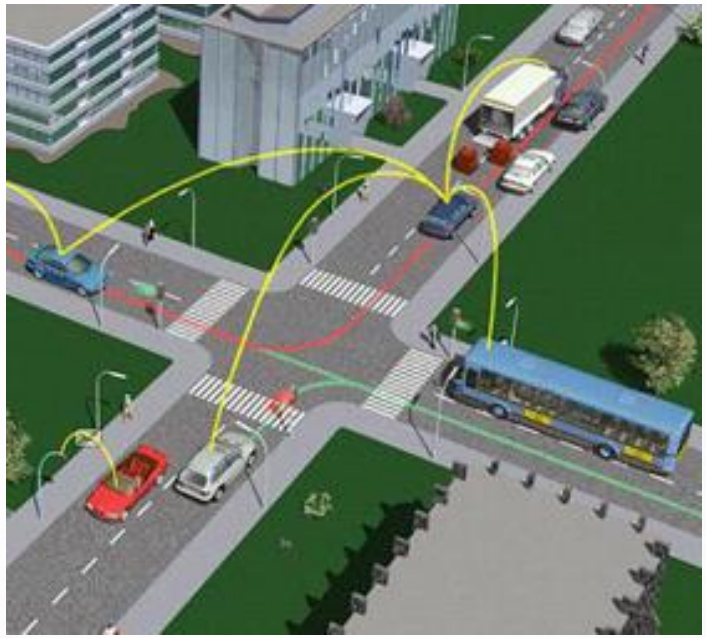
White Paper

PICASSO EU-US ICT collaboration

THINK WIRELESS TECHNOLOGIES LTD

Traffic Flow Control and Integration with Infrastructure





CAR 2 CAR
COMMUNICATION CONSORTIUM

PICASSO
EU-US ICT collaboration

THINK
WIRELESS TECHNOLOGIES LTD

Autonomous Vehicles

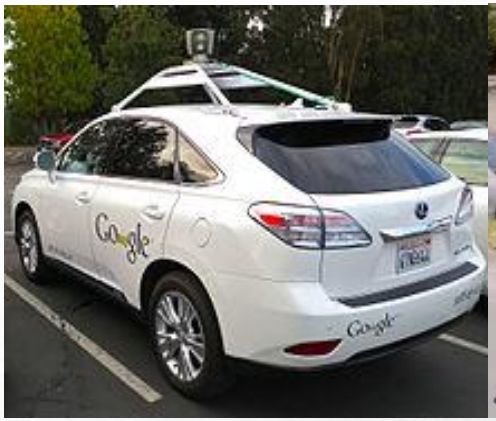
HAVEit consortium (17 partners) Continental, Volvo Technology AB, Volkswagen AG, automotive suppliers and scientific institutes from Germany, Sweden, France, Austria, Switzerland, Greece and Hungary. EUR 28 million

Automated Modes

- Normal - Lane keep assist and emergency brake assist
- Longitudinal automation - no need to accelerate or brake
- Lateral automation - no need to steer

Future Transport Catapult

- Google equipped 6 Toyota PRIUS, 3 Lexus RX450h and an Audi TT with $150,000 in equipment.
- By April 2014, the cars had logged nearly 700,000 autonomous miles (1.1 million km).
- Google have also announced their own autonomous car

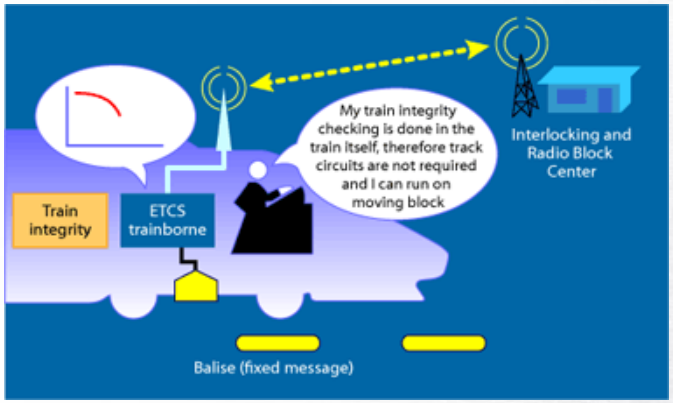


PICASSO EU-US ICT collaboration

THINK WIRELESS TECHNOLOGIES LTD

Rail

- The interoperability regulations and the 2011 Transport White Paper require that the **European railway system behaves as a single network**. In Europe the Strategy for European Rail Research – Vision 2020, the Strategic Rail Research Agenda, and "Railroute 2050" vision highlights the need for **the European Railway Traffic Management System (ERTMS)** to replace the existing 20 train control systems utilised across the European Union. Key initiatives are the H2020 supported FOSTER-RAIL and SHIFT²RAIL joint technology initiatives to focus research and innovation (R&I).

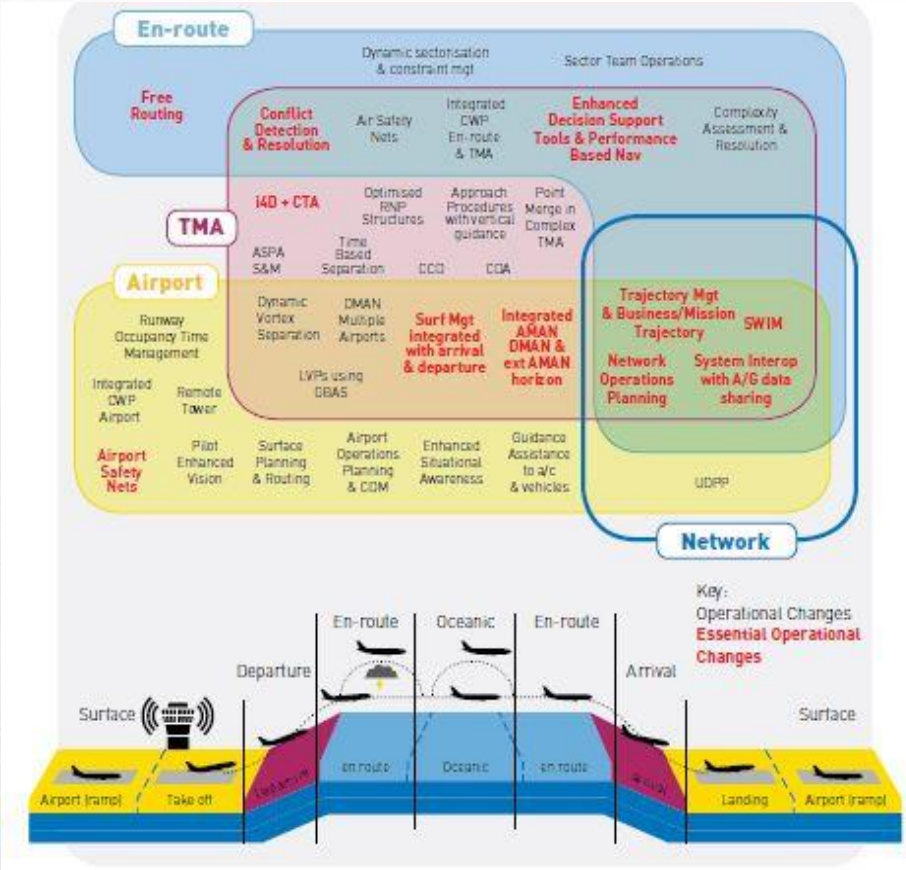


- In the US there is a major need to modernise the rail system and although there has been investment of **$11 billion on High Speed Rail initiatives** this has been largely spent on upgrading the existing Amtrak service which is limited to 110 miles per hour. A further $10 billion has been requested by Congress. Some high speed rail projects are going ahead, e.g. the controversial Los Angeles - San Francisco route, and privately funded initiatives from All Aboard Florida with a $1.5 billion loan from the Federal Railroad Administration and the Texas Central Railway company, which plans to introduce Japanese bullet trains between Houston and Dallas.

Waterborne, Vision 2025 and US Maritime

- A key driver in the maritime industry is improving safety of waterborne operations as accidents come with high costs in terms of loss of life, environmental damage and with high economic impact. Traffic management is key for safer and more secure operations. The technology can also be used for optimised shipping operations and voyage optimisation, condition based maintenance, reducing costs and reducing emissions which is driven by strict legislation in Europe at a national level and also at local level in ports.
- In Europe the **WATERBORNE European Technology Platform has defined the Marine Vision 2020** and Strategic Research Agenda which drives funding for projects. There is a major e-Maritime initiative to exploit advanced information technologies within the maritime sector. Unmanned navigation and autonomous ships are also being researched but there are considerable hurdles to adoption coming from regulators concerned about safety and unions who are concerned about job losses. Current regulations dictate minimum crew levels by international conventions.
- In the US the **Maritime Administration of the US Department of Transportation has highlighted that policy reforms are needed to address international shipping trade**. Offices have been created at major US gateway ports to interact with key stakeholders to identify Federal and state funding and cooperate on projects**. Public private partnerships** are being used to fund redevelopment of port infrastructure. This is being strongly supported by the Transportation Infrastructure Finance and Innovation Act (TIFIA) programme that provides direct loans, loan guarantees and credit with **$1.435 billion** in capital over five years. A strong domestic maritime industry is seen as being critical for America's economic, national, and homeland security. The maritime industry is strongly represented by the American Maritime Partnership (AMP) with 450 members and the **Jones Act** requires that any vessel transporting goods or passengers between two points in the United States or engaging in activities in US waters must be US owned, US built, and US crewed.

SESAR and NextGen ATM



Single European Sky aims to reform the architecture of European air traffic control to meet future capacity and safety needs

Challenge

- 20.4 million yearly flight movement by 2030 predicted by Eurocontrol (twice current figure)
- 2.1 billion euros invested in R&D during the development phase

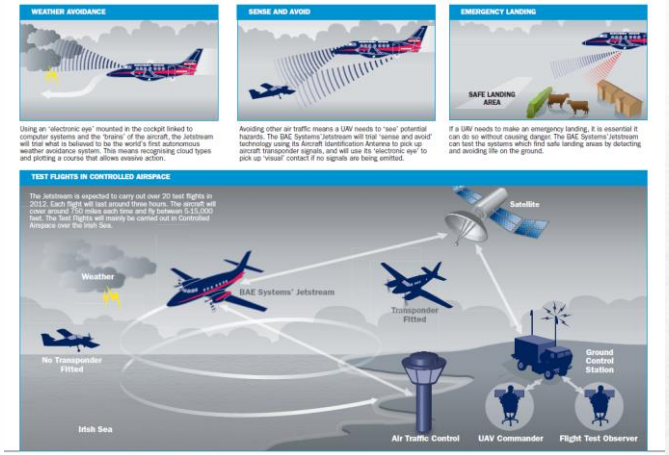
Key difference between NextGen and SESAR is in their solution, - SESAR's emphasis is on i4D (using aircraft RTA capabilities) - NextGen's emphasis is on ADS-B for Interval Management. This potentially may lead to a global harmonisation problem for aircraft operators and manufacturers, i.e. multiple solutions for the same operational problem in the same timeframe.

PICASSO EU-US ICT collaboration

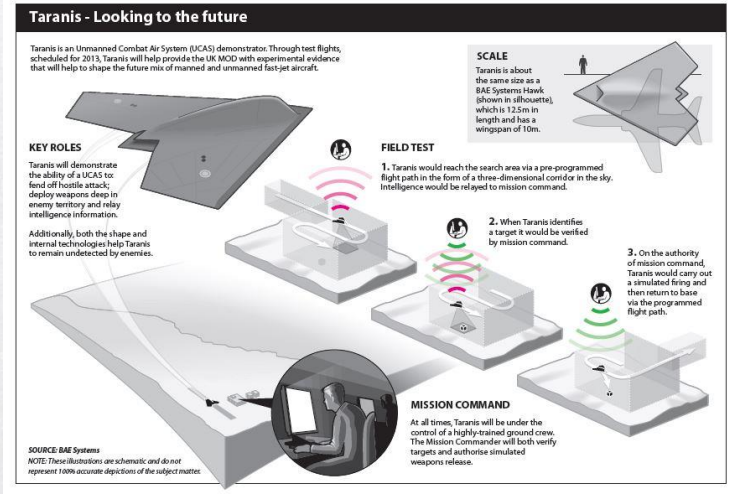
THINK WIRELESS TECHNOLOGIES LTD

UAVs – Many Programmes

Watchkeeper THALES €1bn UK Armed Forces



ASTRAEA UK Civil UAV Programme



TARANIS UK Military Programme

LOCKHEED MARTIN

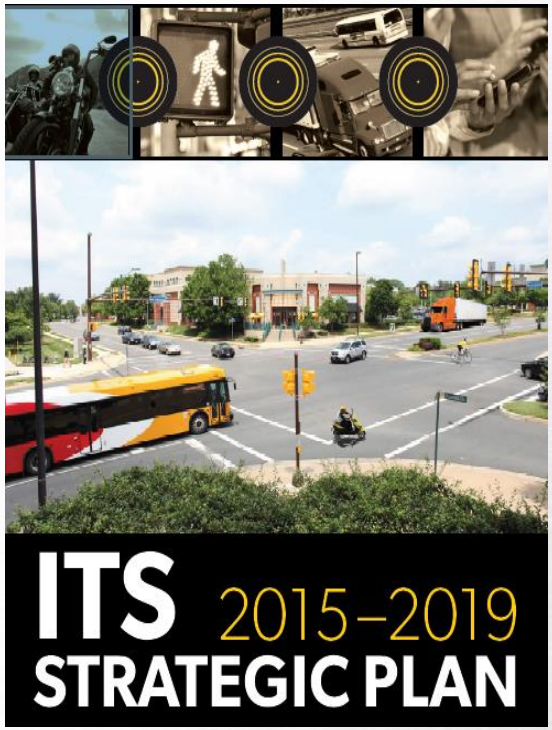
PICASSO EU-US ICT collaboration

THINK WIRELESS TECHNOLOGIES LTD

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"

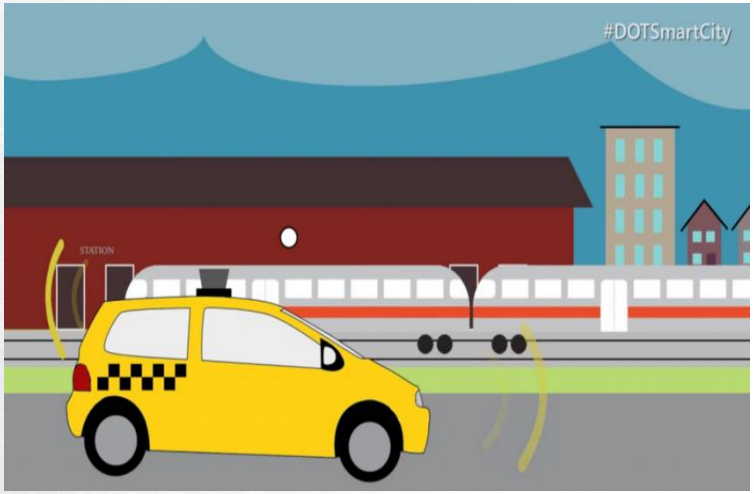


- Works with the Federal Highway Administration, Federal Motor Carrier Safety Administration, Federal Railroad Administration, Federal Transit Administration, Maritime Administration, and the National Highway Traffic Safety Administration to plan, program, and execute the ITS Research Program
- The focus 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

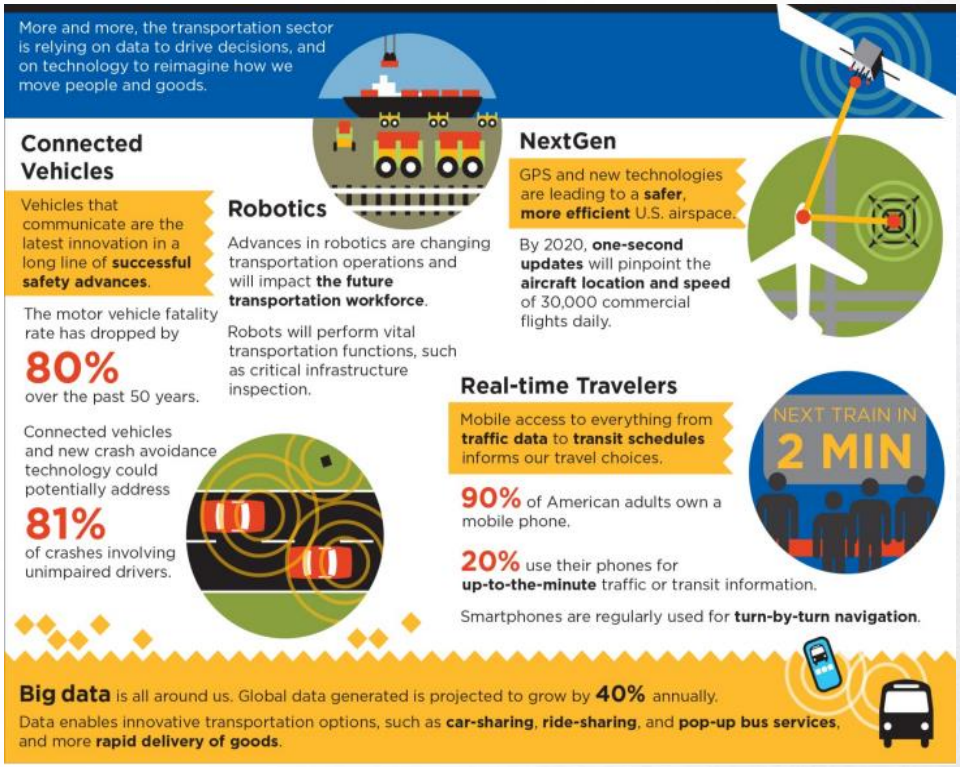
PICASSO EU-US ICT collaboration

THINK WIRELESS TECHNOLOGIES LTD

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.

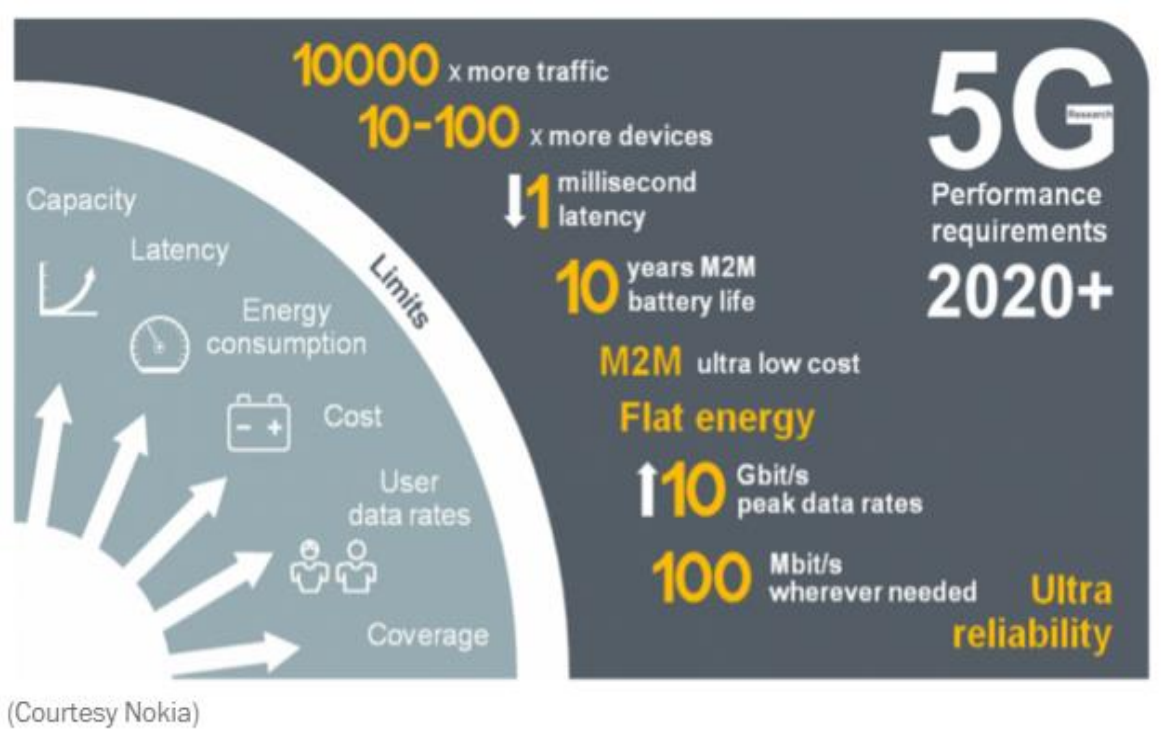


Forward-looking analysis from the U.S. Department of Transportation outlining the expected trends in the transportation system over the next three decades

PICASSO EU-US ICT collaboration

THINK WIRELESS TECHNOLOGIES LTD

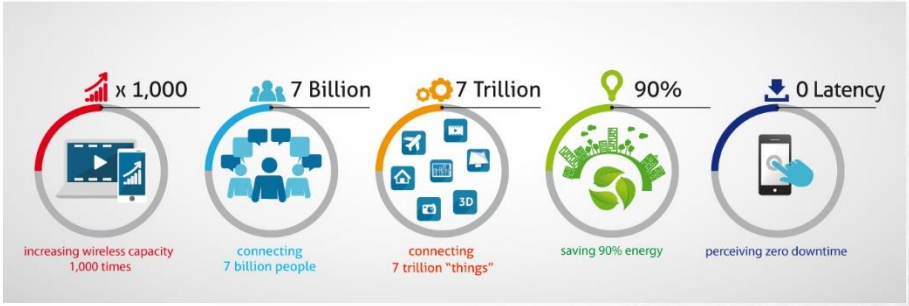
5G



(Courtesy Nokia)

The development of smart cities will require a substantially improved next generation of networks.

The 5G Infrastructure Public Private Partnership



Aims

- Providing 1000 times higher wireless capacity
- Saving up to 90% of energy per service provided
- Reducing the average service creation time cycle from 90 hours to 90 minutes
- Creating a secure, reliable and dependable Internet with a “zero perceived” downtime
- Facilitating very dense deployments of communication links to connect over 7 trillion wireless devices serving over 7 billion people

- Linkages to METIS 2020 Project, 5GrEEn, i-JOIN,CROWD.

PICASSO EU-US ICT collaboration

THINK WIRELESS TECHNOLOGIES LTD

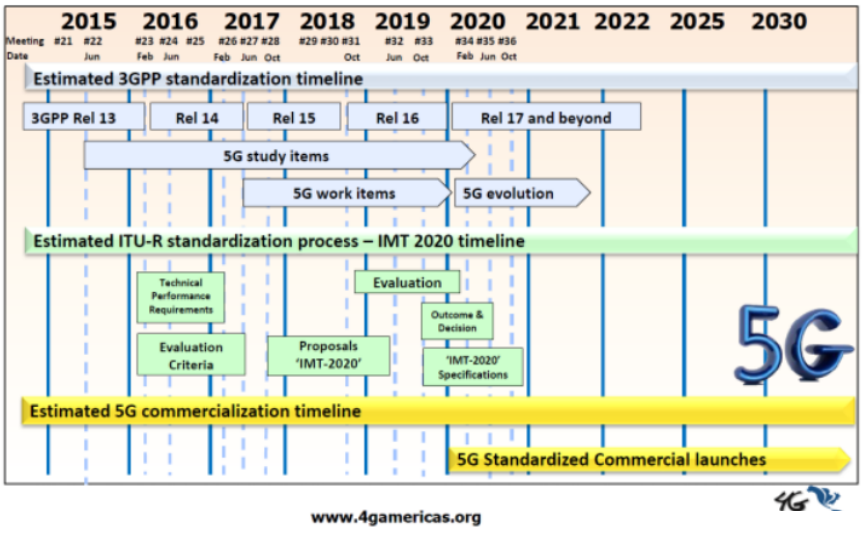
National Initiatives

- **5G Innovation Centre** University of Surrey opened a 5G Innovation Centre (5GIC) with the aim of securing the UK's role in leading the development of the next generation communications technology. The centre has over 170 researchers and has attracted over £70 million of investment,
- **Kings College London** Work at Kings College is concentrated on the Tactile Internet
- **Zwanzig20** is a partnership for innovation initiated by the Technische Universität Dresden and funded by the BMBF. The "Fast Wireless" project is looking at 1ms latency for distributed control applications with a very high number of users, i.e. sensors and actuators, per radio cell.
- **5G Lab Germany** 20 professors from TU Dresden collaborate in an interdisciplinary team with more than 500 scientists to advance research on the key technologies for the 5th generation of mobile communications (5G)
- **5G Berlin** is a Fraunhofer led research initiative formed in 2014 by Fraunhofer HHI and FOKUS working on wireless broadband research.
- **5G-Haus** is a virtual laboratory set up by Deutsche Telekom to develop the architecture and steer standardisation work in cooperation with Continental, Fraunhofer ESK and Nokia Networks.
- **5G Test Network Finland (5GTNF)** coordinates and combines the research and technology development activities from the 5G infrastructures built under Tekes - the Finnish Funding Agency for Innovation
- **Ericsson 5G** Within Europe Ericsson is very active in 5G and is supporting a number of projects at King's College London, the Technische Universität Dresden, the Royal Institute of Technology, Chalmers University of Technology and Lund University in Sweden. At a world-wide level Ericsson has also teamed with LG Uplus and MTS for 5G development, as well as working to unify 5G infrastructure through the 5GEx project.

US 5G

In the US there is a lot of activity in 5G mainly funded by NSF at the research level but there are no major 5G programmes being funded by government at present. This is something which is being called for by the community with a proposal for a major $500M programme on 5G from the White House.

Mobile Now Act On the 3rd of March, 2016, the Senate Committee on Commerce, Science, and Transportation approved the MOBILE NOW Act to boost the development of next-generation 5G wireless broadband by ensuring more spectrum is made available for commercial use and reducing the red tape for building wireless networks



PICASSO EU-US ICT collaboration

THINK WIRELESS TECHNOLOGIES LTD

US Activities

NSF Funded

- **University of Texas at Austin** The Wireless Networking and Communications Group (WNCG) is an interdisciplinary center for research and education at the University of Texas at Austin. The group is addressing mmWave research to demonstrate the viability of the technology for 5G systems

- **Standford University & Berkeley** Standard University in collaboration with Berkeley are working on Software-Defined Networking (SDN) and Network Functions Virtualization (NFV) which are two key pillars for 5G. This is sponsored by CableLabs, Cisco, Ericsson, Google, Hewlett-Packard, Huawei, Intel, Juniper, NEC, NTT Docomo, Texas Instruments and VMware.

- **NYU Wireless** New York University Wireless was established in 2012 as a multi-disciplinary research centre, focusing on 5G wireless research in the medical and computer science fields.

- **Rutgers University** The Cyber-Physical System (CPS) Lab at Rutgers University, funded by NSF, are working on dynamic provisioning and allocation under the Cloud Radio Access Network (C-RAN).

Industry Funded

- **T-Mobile US, Inc. and Ericsson** are working together and will jointly evaluate the performance and applicability of potential 5G key technologies. An aim is to develop a pre-standards 28GHz 5G test system for lab and field trials in the United States [250] with trials beginning in the second half of 2016. are already achieving more than 25 Gbps mobile throughput.

- **Verizon** Verizon is planning field trials of 5G networks in 2017 at their Basking Ridge headquarters with a planned entry into service date of 2020 with 1GBps. Verizon is also working with Alcatel-Lucent, Ericsson, Cisco, Nokia, Qualcomm and Samsung to test 5G in their innovation centers.

Standardisation

- The NGMN Alliance has defined a 5G Roadmap that shows an ambitious time-line with a launch of first commercial 5G systems in 2020.
- The South Korean mobile operator KT has said that it will launch a live 5G service for the 2018 Winter Olympic Games in the city of Pyeongchang.
- In China, three ministries: the Ministry of Industry and Information Technology (MIIT), the National Development and Reform Commission (NDRC) and the Ministry of Science and Technology (MOST) have set up an IMT-2020 (5G) Promotion Group to coordinate all 5G activities in Chinese industry and academia. In November 2013, Chinese telecom equipment vendor Huawei stated that it will invest $600 million in research for 5G technologies in the next five years. This does not include additional investment to productise 5G technologies for global telecom operators.
- Japan's government has been less active than the EU, China and South Korea in setting up national 5G R&D initiatives, however, Japanese companies are active and NTT Docomo plans to showcase 5G technology at the 2020 Tokyo Summer Olympics. The company is performing "experimental trials" of 5G technologies with six vendors: Alcatel-Lucent, Ericsson, Fujitsu, NEC, Nokia and Samsung. Companies in Japan are also leading the Japan's Association of Radio Industries and Businesses (ARIB) "2020 and Beyond AdHoc" group.
- The International Telecommunications Union wants to bring together people along with things, data, applications, transport systems, and cities in a smart networked communications environment. Mobile data traffic across the globe grew 69 percent between 2013 and 2014, reaching 2.5 exabytes (over a billion billion bytes) per month, according to Cisco. Analysts expect data consumption to climb to 24.3 exabytes per month by 2019 which cannot be met by existing 4G LTE. The International Telecommunication Union (ITU)'s IMT-2020 Focus Group [269] has defined a 5G network blueprint for technology improvements taking into account 60 research proposals to address gaps in the 5G wire-line network infrastructure, such as software and high-level network architecture [270].
- In order to get joint agreement on technical fundamentals and 5G spectrum bands globally by 2018 NTT Docomo (Japan), KT and SK Telecom (South Korea), and Verizon(US) are forming the 5G Open Trial Specification Alliance with the aim of driving the technology forward and creating standards for network equipment makers to follow.
- 3GPP standardization is progressing and is now targeting 5G, first study items are on new waveforms, channel modelling >6GHz, and a Radio Access Network architecture.
- The IEEE 5G initiative, which targets to create a global meta-standard for 5G, considering the requirements of the BRICK and low-income countries in Africa, Asia and South America to enable 5G applications in large rural, low populated areas.

Many activities going on!

PICASSO EU-US ICT collaboration

THINK WIRELESS TECHNOLOGIES LTD

Regulation

- The GSMA represents the interests of mobile operators worldwide, uniting nearly 800 operators with more than 250 companies in the broader mobile ecosystem, including handset and device makers, software companies, equipment providers and Internet companies, as well as organisations in adjacent industry sectors. Definition of roaming and interconnect in 5G, and the identification and alignment of suitable spectrum bands.
- The U.N.'s International Telecommunications Union is working on spectrum harmonization for 5G so that the same frequencies are used worldwide. Global harmonization is important for networking equipment and device manufacturers who operate in an international market to keep prices low for potentially billions of mobile devices.
- Harmonization was not possible for 4G LTE and this has resulted in slower deployment in some parts of the world, particularly Europe. The US has a dominant lead in 4G LTE but the rest of the world is now concentrated on 5G. A problem with 5G is that multiple international bodies are involved in different aspects of 5G standardisation. Long-term spectrum planning is essential and an issue in the US is that valuable 5G spectrum is already allocated to departments and agencies of the federal government, however, much of it is unused or underutilised.
- In many countries development depends on government funding but in the US innovation is driven by entrepreneurs. Putting in place the right policies is crucial to unlocking private investment for 5G technologies. It is estimated that network upgrades will cost $2 trillion. There is a push for "permissionless innovation in 5G design" in the US but this has been challenged by "net neutrality" regulations adopted by the FCC which are the subject of a legal challenge. This may inhibit 5G experimentation.

Need spectrum harmonisation!

PICASSO EU-US ICT collaboration

THINK WIRELESS TECHNOLOGIES LTD

PICASSO
EU-US ICT collaboration

THINK
WIRELESS TECHNOLOGIES LTD

Big Data Value Public-Private Partnership

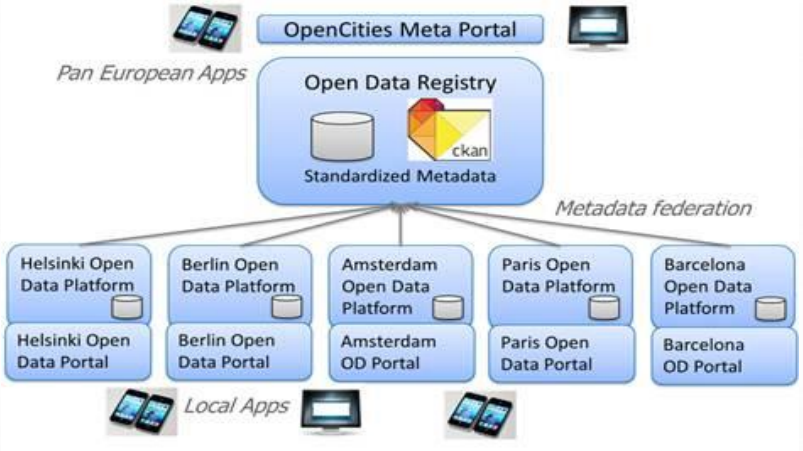
- Opens up new technological and technology-driven opportunities
- From improving healthcare solutions to better finding the most suitable urban transport
- Creating the cornerstone for future economic development and societal well-being.

- Established January 2015
- Aims to strengthen the data value chain, in order to allow Europe to play a relevant role in Big Data in the global market. The European Commission has teamed up with European industry (large players and SMEs), researchers and academia in a Public-Private Partnership (PPP) in order to cooperate in data-related research and innovation, enhance community building around data and to set the grounds for a thriving data-driven economy in Europe
- Big Data Value Association, the association of the European Big Data community which includes data providers, data users, data analysts and research organisations. The association is a non-profit, industry-led organisation whose founding members include ATC, IT Innovation, IBM, SINTEF, University of Bologna (CINI), Polytechnical University of Madrid, NOKIA Solutions and Networks, THALES, University of Duisburg Essen, Siemens, SAP, Engineering, TIE Kinetix, ANSWARE, Software AG, Orange, Atos, INDRA, ITI, VTT, Fraunhofer, DERI, and the Technical University of Berlin.

PICASSO EU-US ICT collaboration

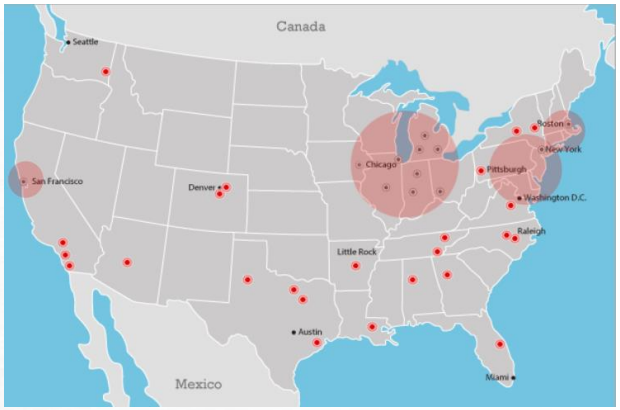
THHINK WIRELESS TECHNOLOGIES LTD

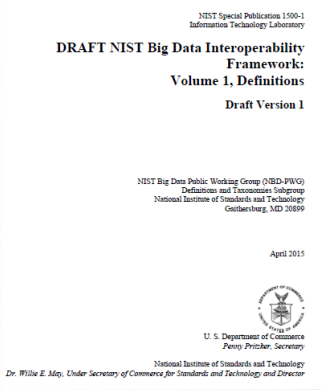
European and National Projects



- Open Cities Project
- Commons for Europe
- Citadel on the Move
- The City of Helsinki is looking for new ways to support developers who want to use open data in order to create digital services for their citizens. The Open Helsinki – Hack at Home programme
- The Open Data Institute (ODI) was officially launched at Shoreditch in December 2012 with the support of £2 million per year for five years from the Technology Strategy Board and $750,000 from the Omidyar Network. The Institute, founded by Sir Tim Berners-Lee and Prof Nigel Shadbolt, is an independent, non-profit, limited company. Its remit is to catalyse an open data culture that has economic, environmental and social benefits.

US Big Data





NIST Special Publication 1500-1
Information Technology Laboratory

DRAFT NIST Big Data Interoperability Framework: Volume 1, Definitions

Draft Version 1

NIST Big Data Public Working Group (NBD-PWG)
Definitions and Taxonomies Subgroup
National Institute of Standards and Technology
Gaithersburg, MD 20899

April 2015

U. S. Department of Commerce
Penny Pritzker, Secretary

National Institute of Standards and Technology
Dr. Willie E. May, Under Secretary of Commerce for Standards and Technology and Director

- The Policy in the US focuses more on the actual uses of Big Data and less on its collection and analysis. There is also an accent on policies to strengthen and stimulate US research in practical privacy-related technologies. Additionally, there is focus on aspects of social science that promote the successful application of technologies.
- **NIST Big Data Public Working Group (NBD-PWG)** NIST is leading the development of a Big Data Technology Roadmap. This roadmap will define and prioritize requirements for ***interoperability***, ***portability***, ***reusability***, and ***extensibility*** for big data analytic techniques and technology infrastructure in order to support secure and effective adoption of Big Data.
- **NSF's strategy is the Cyberinfrastructure Framework for 21st Century Science and Engineering, or "CIF21".** The aim of CIF21 is to foster the development and implementation of a national cyberinfrastructure for researchers in science and engineering to achieve a democratization of data. NSF announced new awards ($10 million each) under its CIF21 and Expeditions in Computing programmes, as well as awards to expand statistical approaches to address Big Data, support cyberinfrastructure, the geosciences and training.
- **BD2K** funds research and training activities that support the use of Big Data to advance biomedical research and discovery. The BD2K Centers of Excellence programme has established 11 Centers of Excellence for Big Data Computing and one Center that is a collaborative project with the NIH Common Fund LINCS programme, called the LINCS-BD2K Perturbation Data Coordination and Integration Center.

Defense

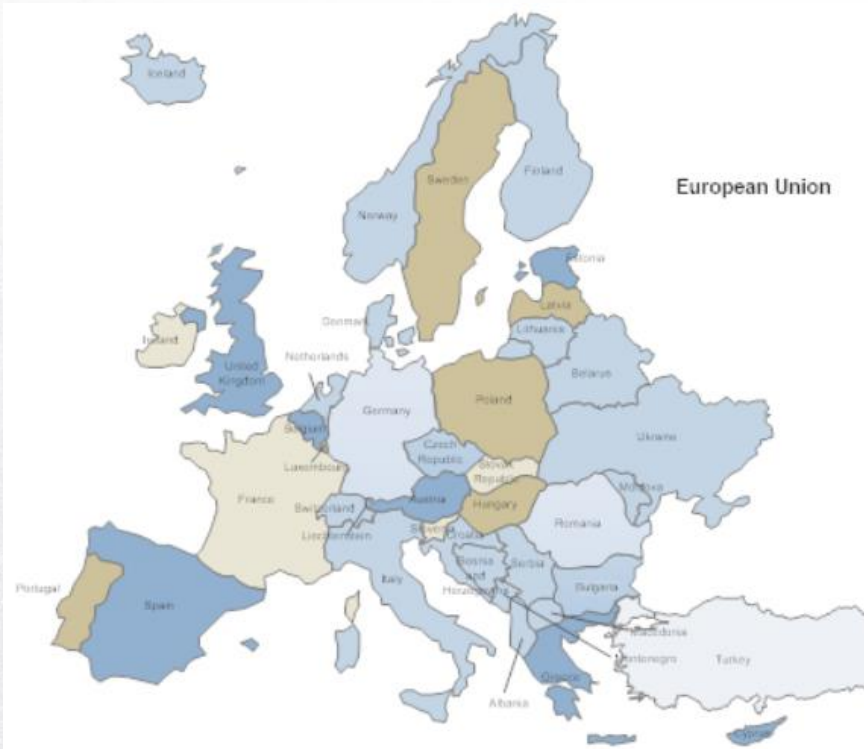
- The Defense Advances Research Projects Agency (DARPA) is promoting the creation of open-source software tools that can help with the processing and analysis of Big Data. It is planned to provide tools from **DARPA's XDATA programme** to the wider community.
- Big Data is major priority for agencies within the Department of Defense, with many opportunities for contractors working on intelligence gathering, analysis and cyber-security.
- Deltek forecasts that Defense spending on Big Data will rise steadily for the rest of the decade at a compound annual growth rate (CAGR) of 8.7%.
- Major programmes are the **Cyber National Mission Force and the new Joint Management System (JMS) software**. The JMS is critical to the secure functioning of DoD's Joint Regional Security Stacks. The new commercial software should have the ability to "harvest security insights from data that is not intuitively security-related."
- DISA is also looking for Big Data analytics to add to its Cyber-Security Advanced Analytics Cloud (CSAAC) which defends DoD networks where they connect to the Internet.
- Defense Insider Threat Management and Analysis Center (DITMAC) to identify and mitigate the security challenges posed by insider threats.

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	53.81	65.01
France	10	79.39	64.31	39.07	63.92
Netherlands	10	85.82	67.00	21.42	63.66
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	30.22	18.27	40.11
Portugal	27	60.38	38.04	19.25	38.63
Brazil	28	66.03	32.16	27.97	36.83
Singapore	29	70.28	35.29	8.97	36.29
Ireland	29	61.61	32.55	23.92	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

PICASSO EU-US ICT collaboration

THINK WIRELESS TECHNOLOGIES LTD

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.

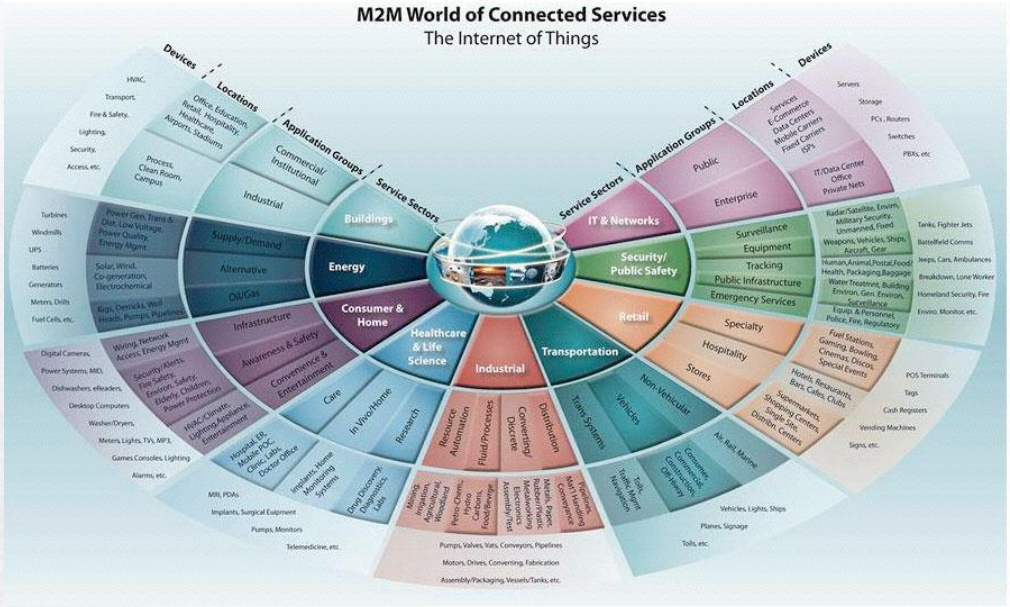
- **"Safe Harbour Privacy Principles"** have been defined with the aim of enabling some US companies to comply with privacy laws that protect European Union and Swiss citizens. According to the principles US companies who store customer data may self-certify that they adhere to 7 key principles that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

PICASSO EU-US ICT collaboration

THINK WIRELESS TECHNOLOGIES LTD

Big Data Standards

- **ISO/IEC Joint Technical Committee (JTC) 1** on Information Technology has set up a Working Group (WG) focused on standardization for Big Data. The American National Standards Institute (ANSI) holds the secretariat to JTC 1. The objective is to identify standardization gaps, develop foundational standards for Big Data, develop and maintain liaisons with all relevant JTC 1 entities and raise awareness of standardisation efforts.
- **IEEE Standards Association** has introduced a number of standards related to Big Data applications enabled by the Internet of Things and a specific standard is under development. This standard "IEEE Standard for an Architectural Framework for the Internet of Things (IoT)" defines the relationships between devices used in industries, including transportation and health care. It also provides a blueprint for data privacy, protection, safety, and security, as well as a means to document and mitigate architecture divergence.
- **International Telecommunications Union (ITU)** created its first standards for Big Data services, entitled 'Recommendation ITU-T Y.3600 "Big Data - cloud computing based requirements and capabilities" in 2015.



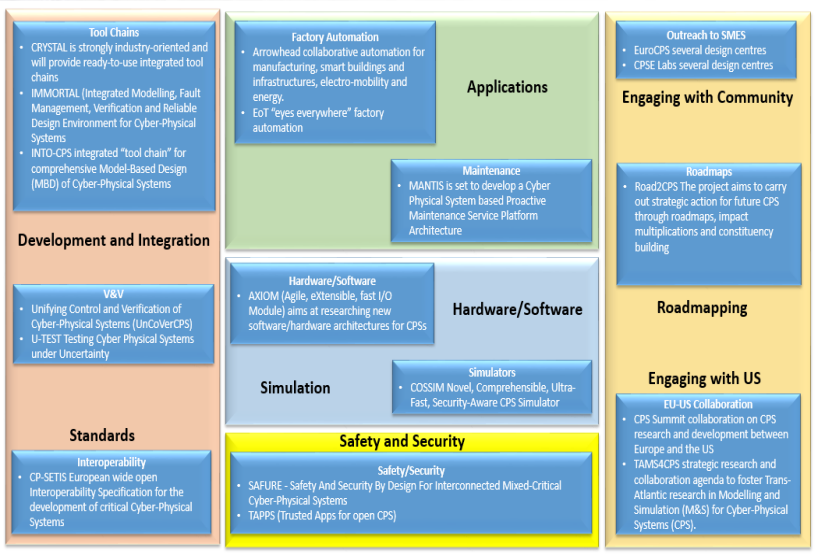
IoT/CPS

Smart Everywhere

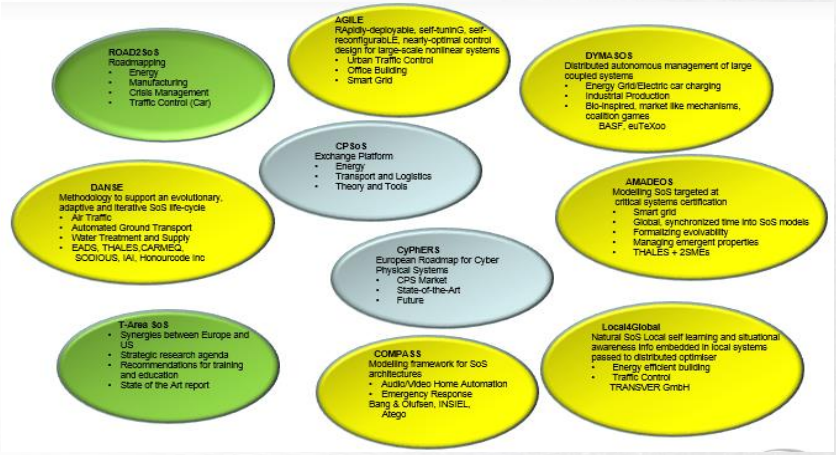
The IERC (IoT European Research Cluster), H2020 CPS Cluster and CPSoS Cluster

40 European projects including CLOUT, VITAL, SOCIOTAL, RERUM, COSMOS, CITY PULSE, ALMANAC, SMARTIE, SMART-ACTION, FITMAN, ASPIRE, CASCADAS, CONFIDENCE, CuteLoop, DACAR, EPoSS, EU-IFM, EURIDICE, GRIFS, HYDRA, IMS2020, Indisputable Key, iSURF, LEAPFROG, PEARS Feasibility, PrimeLife, RACE networkRFID, SMART, StoLPaN, SToP, TraSer, WALTER, IOT-A, INTREPID, IOT@Work, ELLIOT, SPRINT, NEFFICS, IOT-I and CASAGRAS2.

IERC



CPS

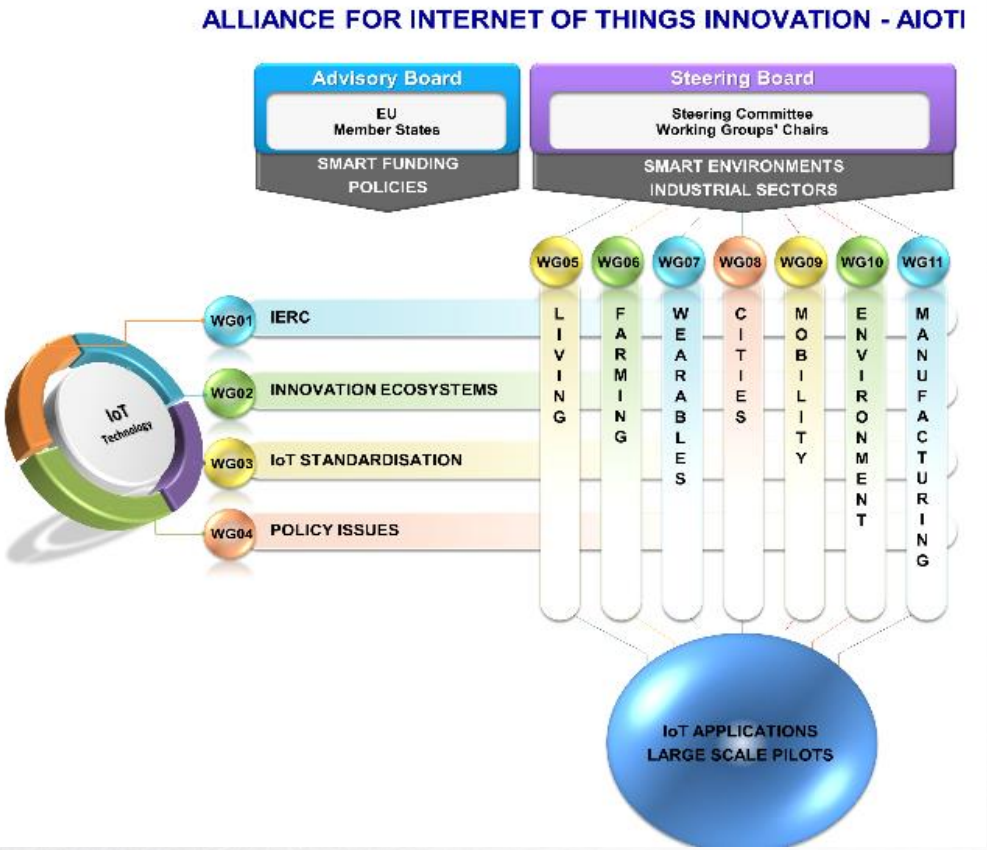


CPSoS

PICASSO EU-US ICT collaboration

THINK WIRELESS TECHNOLOGIES LTD

AIOTI



- Pilot Projects and Collaborations
  - Pilot 1: Smart living environments for ageing well
  - Pilot 2: Smart Farming and Food Security
  - Pilot 3: Wearables for smart ecosystems
  - Pilot 4: Reference zones in EU cities
  - Pilot 5: Autonomous vehicles in a connected environment
- EU-Japan
- EU-South Korea

PICASSO EU-US ICT collaboration

THINK WIRELESS TECHNOLOGIES LTD

BUTLER and FIWARE

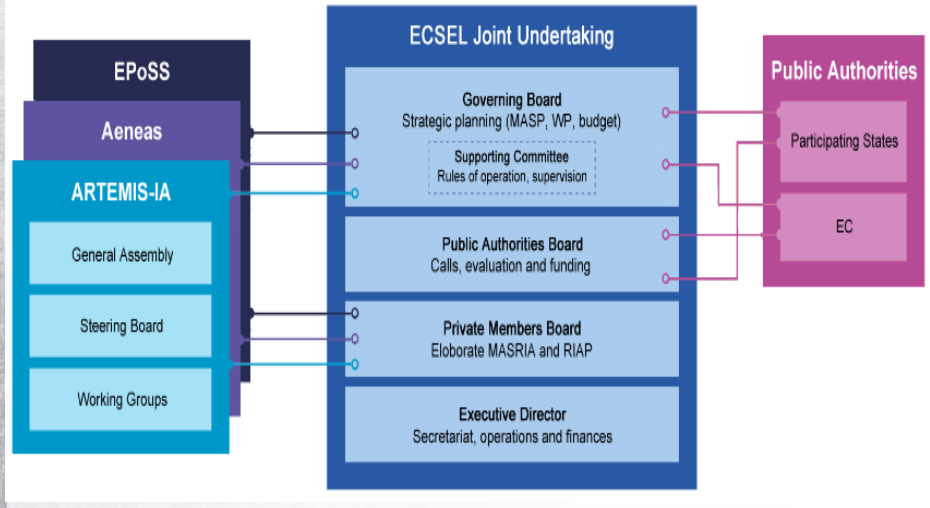
BUTLER (uBiquitous, secUre inTernet-of-things with Location and contEx-awaReness)

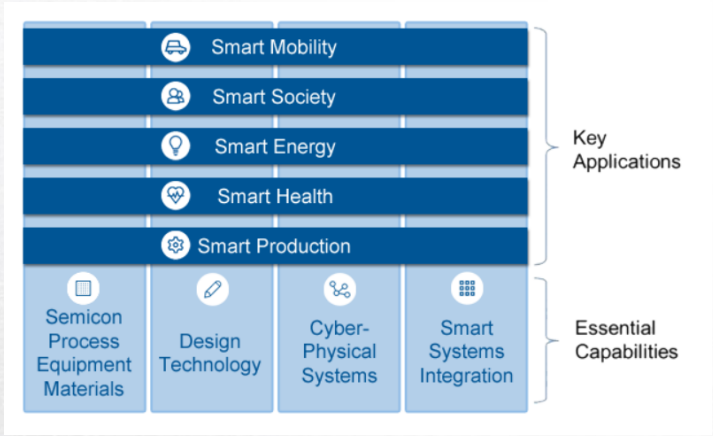
- Project to develop secure and smart life assistant IoT applications using a context and location aware, pervasive information system.
- BUTLER is now finished and **BUTLER components are available** on the Open Platform
- Scenarios, e.g. Home, Office, Transportation, Health, etc. Several field trials were also performed.

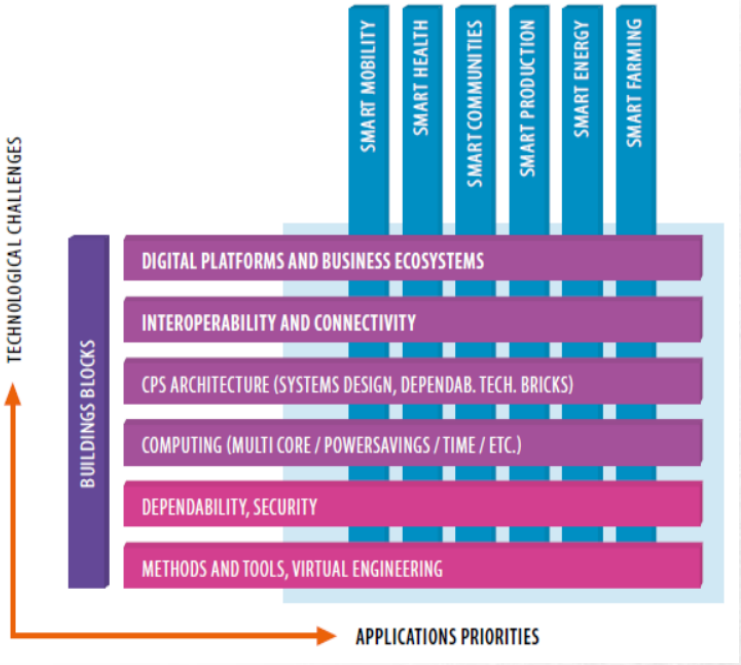
FIWARE

- FIWARE is an EU initiative to create a truly open, public and royalty-free architecture and set of open specifications that will allow developers, service providers, enterprises and other organizations develop products.
- A key aim is to provide an infrastructure to support cost-effective creation and delivery of digital services. A set of open APIs are being provided to developers to foster innovation and entrepreneurship.
- FIWARE is seen as a foundation for the Future Internet, cultivating a sustainable ecosystem. The project is developing 16 Future Internet Accelerators including applications on Smart Cities, E-Health, Transport, Energy and Environment, Agrifood, Media and Content, Manufacturing and Logistics, Social and Learning.

ECSEL Joint Undertaking and ARTEMIS-IA







CRYSTAL
EMC2

PICASSO
EU-US ICT collaboration

THINK
WIRELESS TECHNOLOGIES LTD

I4MS and Smart Everything Everywhere

I4MS under the PPP Factories of the Future

Smart Anything Everywhere under Components & Systems

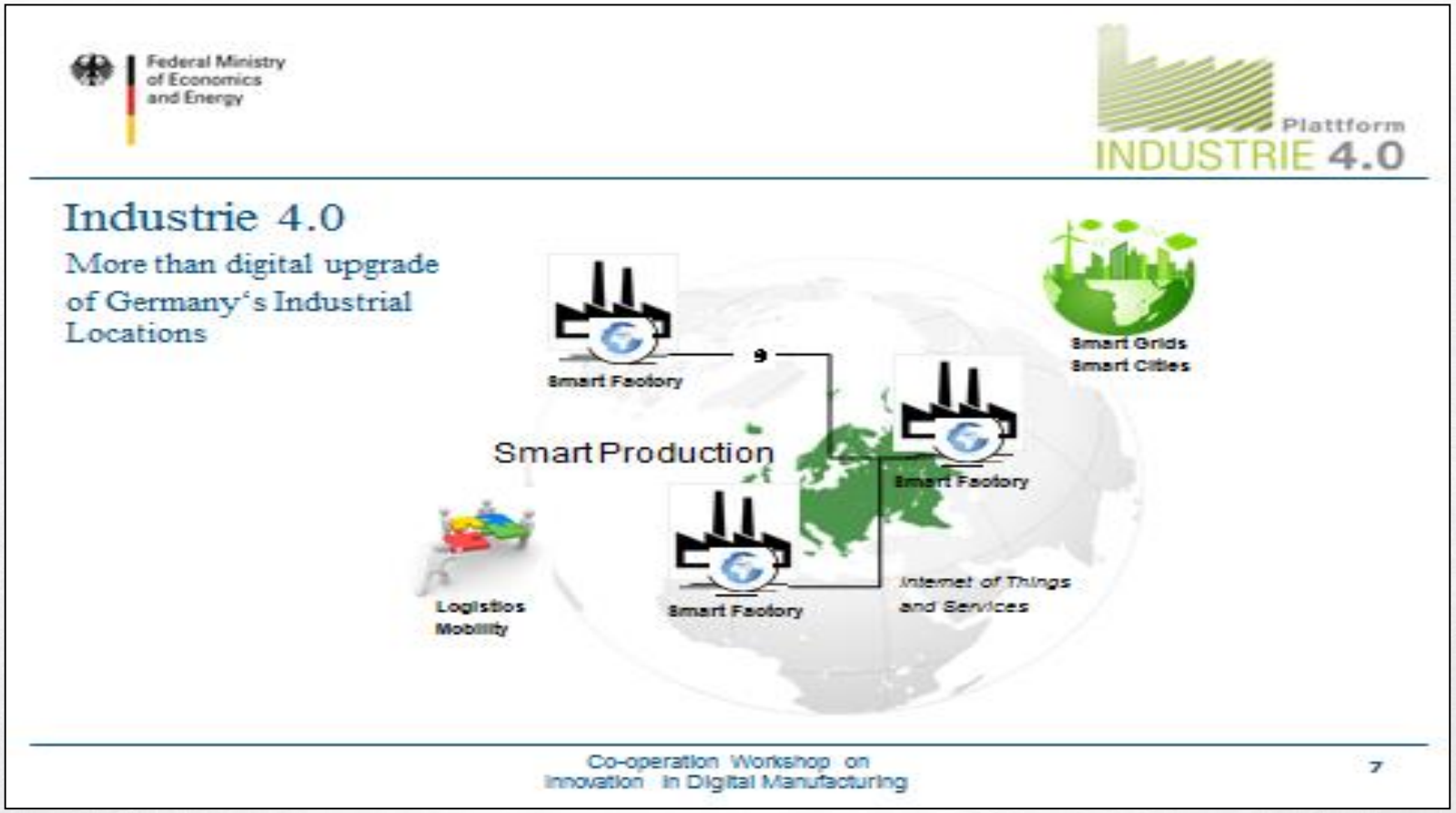
Status:

- 102 M€ – 11 projects – 70 centres – 300 experiments
- New wave through 2015 calls ~53M€

PICASSO EU-US ICT collaboration

THHINK WIRELESS TECHNOLOGIES LTD

Industrie 4.0

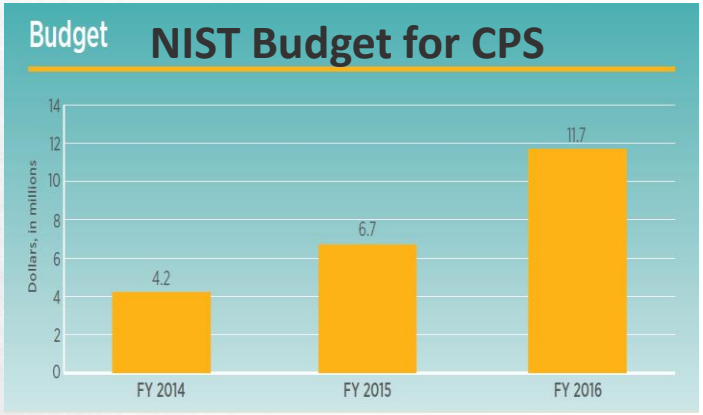


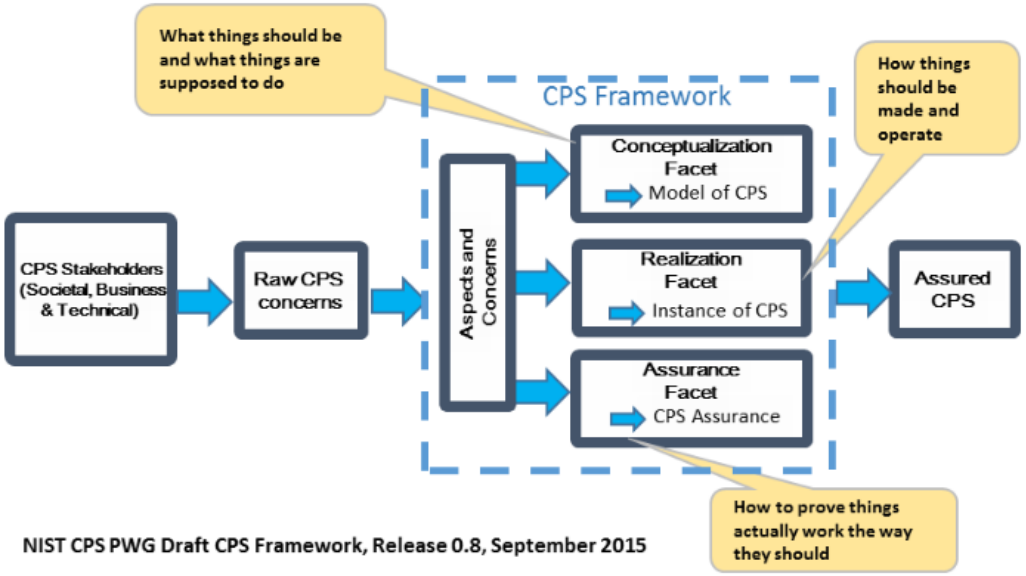
PICASSO EU-US ICT collaboration

THINK WIRELESS TECHNOLOGIES LTD

US CPS

- NSF Cyber Physical Systems programme (300 projects!)
- NIST Framework for CPS





NIST CPS PWG Draft CPS Framework, Release 0.8, September 2015

- NITRD The Networking and Information Technology Research and Development Program. The CPS SSG is coordinating programs, budgets, and policy recommendations for Cyber Physical Systems (CPS) research and development (R&D). This includes identifying and integrating requirements, conducting joint program planning, and developing joint strategies for the CPS R&D programs conducted by agency members of the NITRD Subcommittee. (Federal IoT/Cyber-physical systems)

NITRD The Networking and Information Technology Research and Development Program

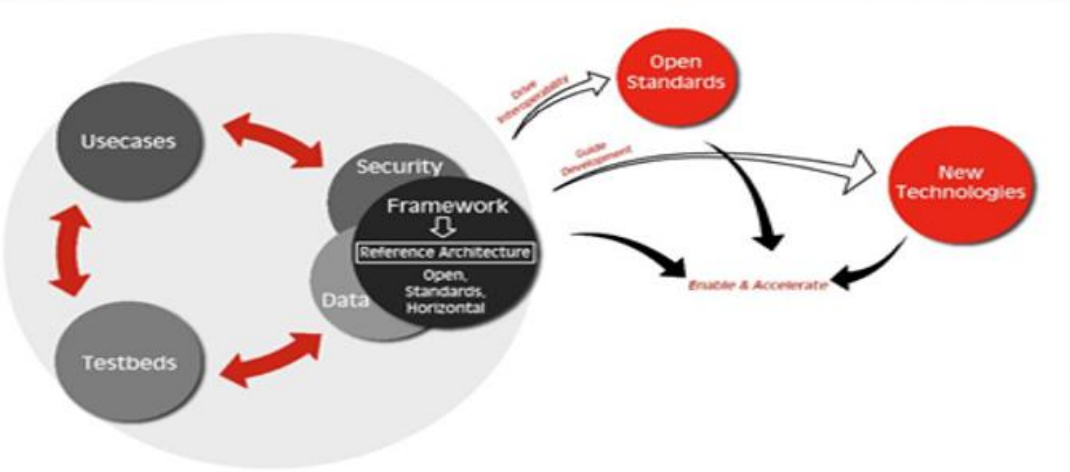
R&D Gaps	DARPA	DHS	DOD/services	DOE	DOE/ARPA-E	DOT	FDA	NIH	NASA	NIFA	NSA	NIST	NSF	OASD (R&E)	Others
Mission R&D: Crosscutting Research and Development															
Core CPS Science and Technology – control, real-time computing, communication concepts, modeling, hardware, and software platforms. Advanced engineered systems: manufacturing, energy, medical devices, transportation		X							X			X	X		
Science of Security for CPS				X							X	X	X		
CPS Virtual Organization (CPS-VO)		X				X					X		X		X
Complex systems, cascading failure, engineered resilient systems, fault identification, diagnosis and recovery		X	X						X			X		X	
Mission R&D: Sector-Specific Challenges															
Aviation safety, certification, enabling bold, visionary aviation systems and technology for a safe, efficient Next Generation airspace									X						
Intelligent transportation infrastructure systems, enabling technology for high confidence next-generation transportation (NextGen, automotive autonomy, intelligent vehicles)		X	X			X			X			X	X		
New control architectures/algorithms and power electronics for distributed generation, storage, and managed consumption			X		X				X			X			
Smart food systems that support safety, logistic efficiencies, cold-chain integrity, and traceability										X					
Time-critical systems, mixed criticality architectures, verification, aviation autonomy		X	X						X						
Rapid design and manufacturing of advanced CPS technologies. Rapid verification and real-time health monitoring and reconfiguration/re-verification. Application to autonomous systems	X		X						X						
Real-time physiological sensing, modeling, control, and feedback; advanced medical devices and system interoperability, integration, and certification							X	X	X			X			
Mission R&D: Crosscutting Standards-Based Platform Technologies															
Cyber-Physical Systems Engineering Testbed		X										X			

R&D Gaps	DARPA	DHS	DOD/services	DOE	DOE/ARPA-E	DOT	FDA	NIH	NASA	NIFA	NSA	NIST	NSF	OASD (R&E)	Others
Measurement Science and Standards for Model-Based Diagnostics & Prognostics, Time Synchronization, Industrial Cybersecurity												X			
Measurement Science and Standards for Quality Measurement Systems for CPS, Wireless Networking for CPS, Advanced Battery Technology for CPS, Multi-Physics Modeling and Optimization, Adaptive and Predictive Control in CPS												X			
Standards-Based Integrated Architectures and Prototype Platform for CPS		X							X			X			
Education and Crosscutting Research Centers															
Future of skills development and instructor resources for CPS including online CPS training and educational infrastructure resources (e.g., CPS virtual laboratory)		X							X				X		
Research and Infrastructure for innovation in Medical CPS Pilot							X	X				X	X		
CPS Outreach Centers (CPS Government, Industry, Academia cooperative research model)													X		X
Industrial Internet Consortium		X										X			
Transportation CPS Pilot (NSF Engineering Research Centers model)						X			X				X		X

PICASSO EU-US ICT collaboration

THINK WIRELESS TECHNOLOGIES LTD

Industrial Internet Consortium

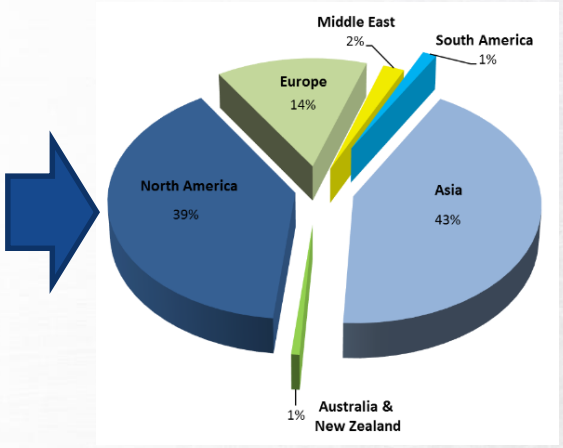


- The US Industrial Internet Consortium (IIC) although originally American is now attracting members from all over the world. It is a non-profit organisation with 14 staff.
- Launched by AT&T, CISCO, GE, IBM and Intel, it is strongly tied to Object Management Group (OMG).
- There are currently 130 members (20 from the EU) and it is growing quickly.
- There are 20 working groups. The consortium has developed use cases in healthcare, transportation, manufacturing and smart grid and 3 approved testbeds have been developed.

ALLSEEN ALLIANCE and Open Interconnect Foundation

Open environment for the Internet of Things

Open Interconnect Foundation

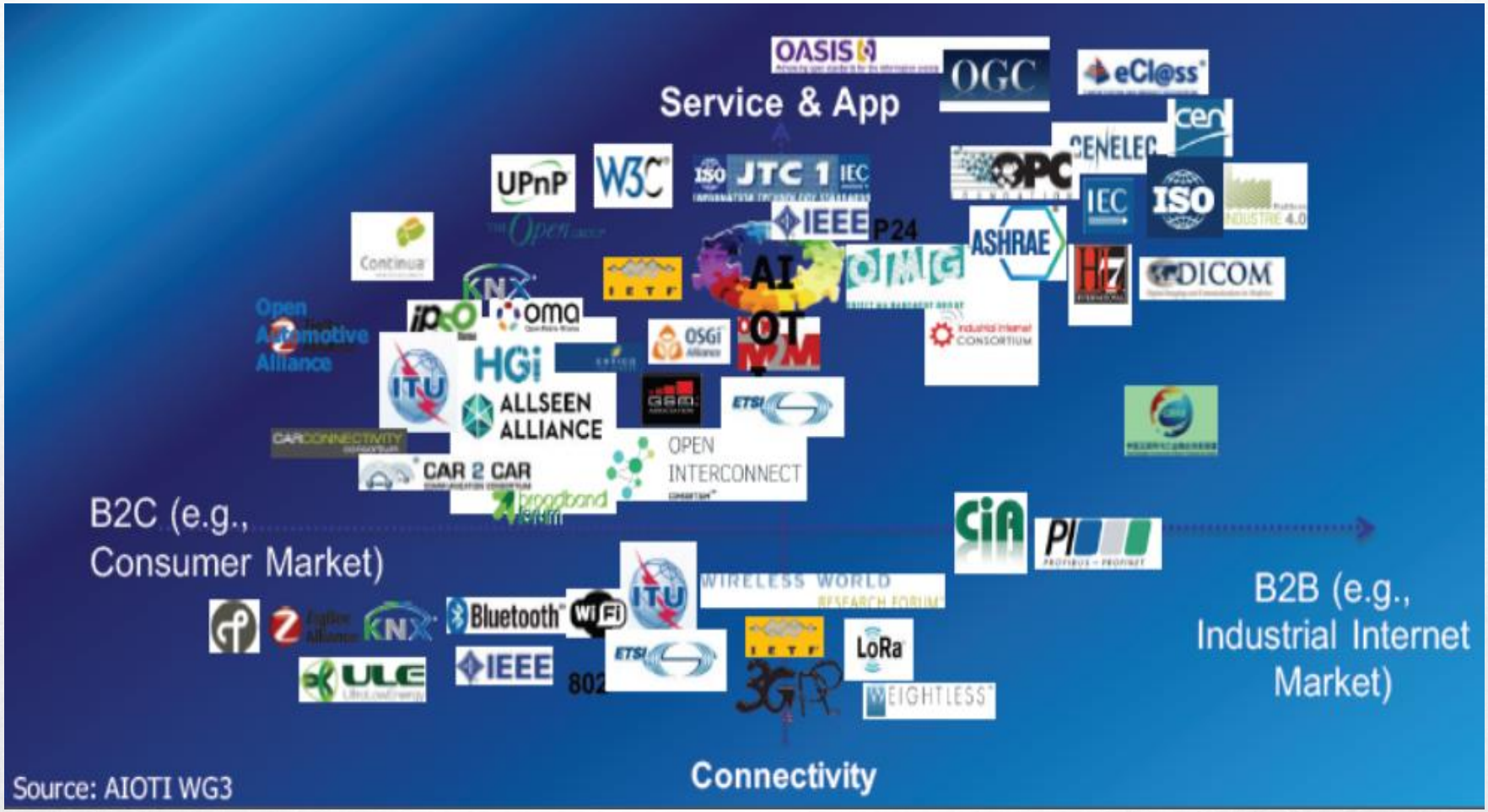


The aim is to come up with a single specification, or at least an open source common set of protocols and projects, for wearables, home appliances, industrial equipment, etc. to provide OCF-certified products

PICASSO EU-US ICT collaboration

THINK WIRELESS TECHNOLOGIES LTD

Worldwide Alliances



Potential Collaboration Areas

Potential Areas for Collaboration Smart Cities	
Research/Policy	Integration of mixed-criticality systems – combining the CPS and IoT worlds
Research/Policy	Cyber-Security – bringing together expertise in Europe, e.g. Estonia, The Internet of Things Security Foundation (IoTSF) UK and the National Cyber-security Center of Excellence
Research/Policy	Demonstration at scale and replication of solutions
Research/Policy	Anonymising data, encryption and processing in encrypted domains
Regulation	Regulation in the area of privacy and in allowing sharing of data to provide services
Regulation	Changes to allow new methods of certifying systems for safety
Standards	Development of Smart City Standards to provide guidance and best practice on implementation of smart functionalities
Standards	Interoperability, e.g. smart city standards targeted at mobility, transportation, M2M, energy efficiency, security and Smart Sustainable Cities.
Potential Areas for Collaboration Smart Energy	
Research/Policy	There are many synergies in research and policy in the areas of smart metering, energy efficient neighbour hoods, smart city energy management, low carbon economy and renewable energy. There may well be opportunities for joint research.
Research/Policy	In the area of cyber-security closer ties should be encouraged between the European Commission multi-stakeholder expert group on cyber-security and NISTs Smart Grid Interoperability Panel (SGIP) Cyber-security Committee (SGCC). Here there are critical lessons to be learned from the experience of Estonia and from the US guidelines, e.g. NISTIR 7628.
Regulation	Sharing of best practice regulation for smart metering and tariffs to manage system load capacity (off-peak/on-peak schemes).
Regulation	Introduction of harmonised regulation to allow stakeholders to make grid investments in EU and US
Standards	Currently standards for interoperability are being driven by the European Commission and EFTA, e.g. the Smart Grid Mandate M/490 which was accepted by CEN, CENELEC and ETSI. EISA in the US has asked NIST and FERC to facilitate the development and adoption of interoperability standards. Here there may be opportunities to harmonise standards development.
Potential Areas for Collaboration Smart Transportation	
Automotive Sector	
Research/Policy	There are many similarities in policy in the EU and US driven by climate change and increased urbanisation. There are opportunities to collaborate on Intelligent Transport Systems, autonomous cars, electric cars and alternative fuels.
Regulations	As the automotive market is global there are opportunities to harmonise regulations that promote adoption of green technologies, e.g. electric cars and reductions in fuel consumption and emissions.
Regulations	There is a need to address barriers to the adoption of autonomous cars at a global level. This requires regulation on safety, liability and also privacy.
Standardisation	Wireless standards are needed for ITS, for car-to-car and car-to-infrastructure communication. These need to be world-wide as the marketplace for automotive is global.
Rail Sector	
Research/Policy	There are opportunities for joint research on providing high availability in rail networks, maintenance approaches, emissions reductions and approaches to increasing capacity
Regulation	Automatic train control systems are already a reality in Europe and will be in place across Europe by 2023. Opportunities within the US may also be considered but regulation is required to support this.
Aerospace Sector	
Research/Policy	There are many research projects both industrial and academic exploring the use of autonomous aircraft. Here there may be opportunities for joint work.
Standardisation	In the area of Air Traffic Management there are two different systems being developed in the EU and US respectively. It is important that these are interoperable.
Regulation	Autonomous aircraft – safety for operation in civil airspace – here there is an opportunity for the CAA, EASA and the FAA to work together
Maritime Sector	
Research/Policy	Research on navigation for ships, increased autonomy and emissions reductions
Regulation	Harmonisation of regulations on emissions, e.g. IMO
Regulation	Safety regulations are needed to further reduce crew levels and move towards autonomous ships, e.g. minimum crew levels may need to be removed
Standardisation	EU activities on E-Maritime and MAF need to be harmonised with US activities to allow interoperability
Potential Areas for Collaboration 5G	
Research/Policy	Currently work on 5G in the US and EU is disconnected and fragmented. The 5G PPP in Europe would provide a good link with any initiative which is funded in US.
Regulation	Spectrum harmonisation at a global level is needed so that the same frequencies are used worldwide (to avoid what happened with 4G LTE)
Standardisation	There are many initiatives driven by large companies such as NTT Docomo, Samsung, Ericsson, T-Mobile and Verizon. There is a need for all companies to work together and this is already happening in initiatives such as NGMN 5G. There is a need for a strong EU-US voice in these initiatives.

Potential Areas for Collaboration Big Data	
Research/Policy	Big Data and Open Data are both viewed as being essential for the development of many areas. There are very strong policy initiatives on Big Data on both sides of the Atlantic and there are many opportunities for synergies working together at the foundational level and also in terms of engaging with activities such as those at NIST. The area of open data is less clear with many local initiatives at national levels. The lack of open data is currently a barrier to many applications. The power of open data is becoming more apparent from pilot initiatives around the world and this may lead to replication in other cities and countries. The uptake of this is, however, fragmented and initiatives that would allow replication would be beneficial.
Regulation	Regulation is a key enabler in the field for global adoption of services and this is already well recognised with activities such as Safe Harbour and Privacy Shield.
Standardisation	Standardisation activities are already being addressed at an international level and this should be further promoted.
Potential Areas for Collaboration IoT/CPS	
Research/Policy	Engineering trustable, reliable, evolvable and affordable Cyber-Physical Systems connected by the Internet of Things is a scientific and technological challenge that requires huge efforts. Here joining forces would help to advance the technology more quickly and address societal challenges. EU and US companies could better compete on world markets.
Research/Policy	Integration of mixed-criticality systems – combining the CPS and IoT worlds
Research/Policy	Provide guidance and best practice on implementation of smart functionalities
Regulation	Regulation (changes) will be needed to allow new methods of certifying systems for safety
Regulation	CPS/IoT deployments at scale have many implications including implications for privacy (applications rely on collecting and utilising data from a myraid of sensors). Regulation on privacy and the sharing of data regulation has a crucial role in the development of CPS and IoT.
Regulation	The interconnectedness of systems leads to vulnerabilities to unintentional errors and cyber-attacks. Regulation is needed with respect to security.
Regulation	There is a need for business models and regulation to support market access.
Standards	There is a need to provide standards for interoperability that support the creation of an ecosystem of developers and users of CPS and IoT systems. Here a harmonization between the US and Europe is not only advantageous but strongly needed.

Interviews

PICASSO EU-US ICT collaboration

THINK WIRELESS TECHNOLOGIES LTD

Concluding Remarks

- It is clear that there are many opportunities for joint collaborations between the EU and US
  - 15 areas where it may be possible to collaborate on research and policy
  - 16 areas where there is an opportunity to work together on regulations
  - 9 areas where it would be beneficial to work together on standards

- There are key opportunities in the areas of smart cities and IoT/CPS which are rapidly developing areas and where there are common research, regulatory and standardisation needs.

- There are also great opportunities in the areas of smart energy and smart transportation, however, here there is existing regulation and legislation which needs to be harmonised.

- For the underlying technologies, which are the basic building blocks of future applications: 5G, Big Data and IoT/CPS, there are many opportunities to work together which would allow bilateral access to EU and US markets and would allow technology and products to be sold on the world stage increasing the competitiveness of EU and US companies in existing and developing markets.

- **Europe 508 Million** **US 319 Million** **World 7.125 Billion**