PRIDA Track 1 (T1)

Connected and Autonomous Car

11/09/2020

Agenda

01 Introduction

02 Connected Car

03 Autonomous Car

04 Communications protocols

05 Societal, Legal and Economic Impacts

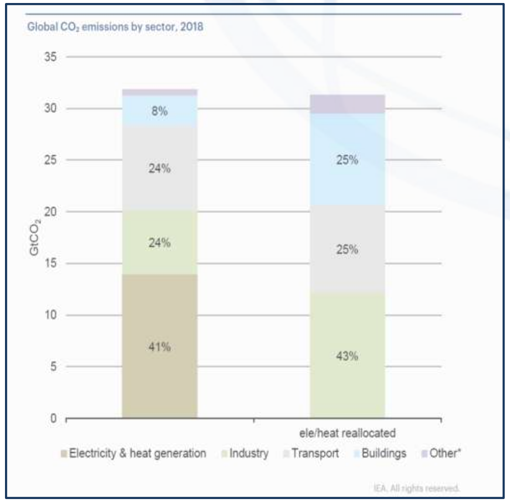
06 Conclusion





Introduction

Some Statistics



33.5 GtCO2

in 2018

http://wds.iea.org/wds/pdf/Worldco2_Documentation.pd

1 300 000 dead

50 000 000 Injured

500 Billions

World

300 000

Africa

90% of accidents are due to human error

Assistance

Automatisation

Autonomy

Peden M. et al., eds. Rapport mondial sur la prévention des traumatismes dus aux accidents de la circulation. Genève, Organisation mondiale de la Santé.

Connected Car

Connected Car: Definition

A connected vehicle integrates wireless telecommunications systems that allow it to:

- Collect, record and process information
- Exchange information with:
  - Other vehicles,
  - Road users (pedestrians, bicycles, etc.)
  - Road infrastructure.

The data collected by the vehicle are related to :

- Driving: like Information on the distance to another vehicle (measured by radar) or Geolocation data
- Life on board: for example, the transfer of music stored on a smartphone or a movie or the state of comfort inside the car

Since 2017, by decision of the European Union, all new vehicles must be connected in order to automatically make an emergency call in the event of an accident: this is the e-Call service. It is estimated that 80% of the vehicle fleet is already connected in 2020 (Statistica, 2017)

Connected Car: Applications

Connectivity makes it possible to offer more new services for the benefit of:

- Driver
- Passenger
- Builder
- Authorities, ….

These new services improve:

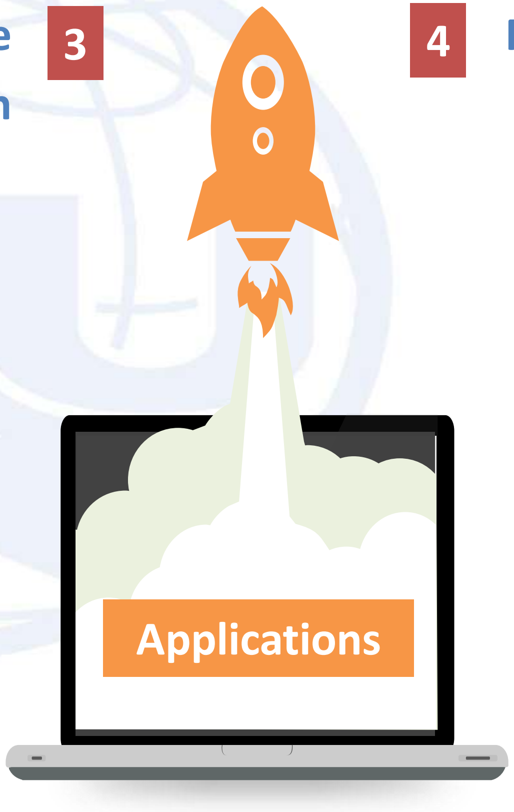
- Road safety,
- Traffic efficiency
- Energy savings
- Passenger comfort

Navigation assistance & driving optimization 3

Passive security 4

Commercial offers 2

Active security 5



Driver and passenger services 1

Cooperative & coordinated driving 6

Connected Car services: Commercial offers

Commercial offers: Data sent from a connected vehicle to servers forms the basis to many services:

- Predictive maintenance
- Scheduling maintenance or tire changes, etc.
- New insurance methods (towards individualization according to the type of driving)
- Other administrative or commercial services.

Connected Car services: Navigation assistance

The data received by the vehicle makes it possible to take into account the state of the traffic dynamically, in order to:

- To avoid traffic jams ...
- To define automated driving profiles (speeds, driving styles, etc.)
- Ensure the comfort of passengers
- adapt driving to the topology of the terrain, the state of traffic and the driving modes of other road users.

Connected Car services: Safety

Passive safety: The vehicle receives information indicating the problems:

- Visibility (fog ...)
- Grip
- Blocked road
- Presence of objects of people on the road, work areas
- Arrival of an oncoming vehicle

It automatically emits a distress signal in the event of an accident.

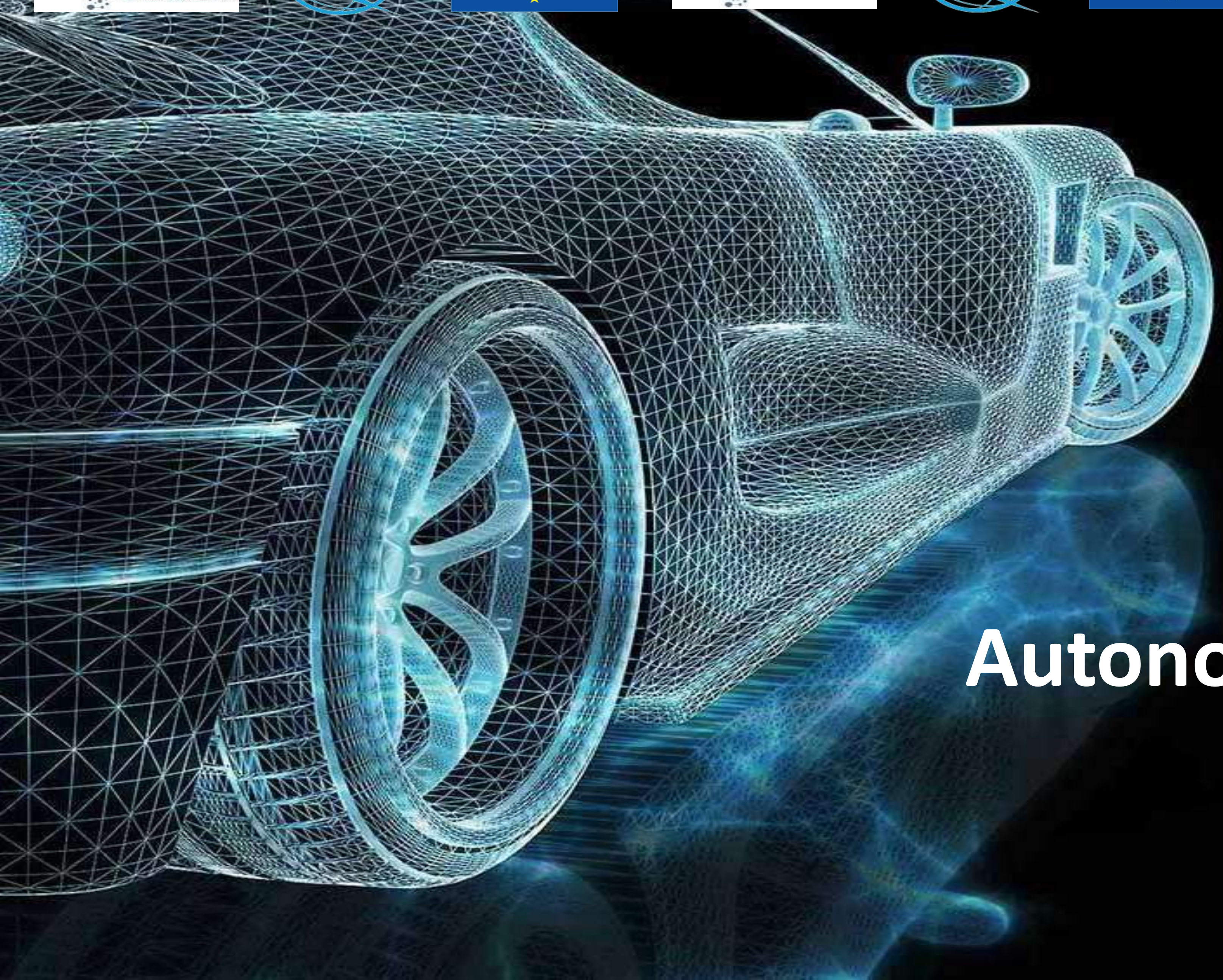
Active safety: Vehicle connectivity paves the way for assistive functions:

- Overtaking and collision avoidance,
- Management of intersections (warning and braking in the event of a hidden obstacle, non-compliance with a traffic light, etc.),
- Cooperative Adaptive Cruise Control (CACC).

Connected Car services: Cooperative Driving

Cooperative and coordinated driving: Coordination between vehicles allows:

1. better management of track occupancy
2. optimal fire management and the avoidance of bottlenecks and traffic jam
3. the construction of dynamic local maps becomes possible, thanks to the sharing of information captured by each vehicle.



Autonomous Car

Autonomous Vehicle: Definition

An autonomous vehicle is capable of driving, on an open road, without the intervention of a driver. The concept aims to develop and produce a vehicle that can circulate on public roads without human intervention in all situations.

An autonomous car is **Smart** & **Connected**

Automation levels: SAE international's J3016

SAE level	Name	Narrative Definition	Execution of Steering and Acceleration/ Deceleration	*Monitoring* of Driving Environment	Fallback Performance of *Dynamic Driving Task*	System Capability *(Driving Modes)*
***Human driver* monitors the driving environment**						
0	**No Automation**	the full-time performance by the *human driver* of all aspects of the *dynamic driving task*, even when enhanced by warning or intervention systems	Human driver	Human driver	Human driver	n/a
1	**Driver Assistance**	the *driving mode*-specific execution by a driver assistance system of either steering or acceleration/deceleration using information about the driving environment and with the expectation that the *human driver* perform all remaining aspects of the *dynamic driving task*	Human driver and system	Human driver	Human driver	Some driving modes
2	**Partial Automation**	the *driving mode*-specific execution by one or more driver assistance systems of both steering and acceleration/ deceleration using information about the driving environment and with the expectation that the *human driver* perform all remaining aspects of the *dynamic driving task*	**System**	Human driver	Human driver	Some driving modes
***Automated driving system* ("system") monitors the driving environment**						
3	**Conditional Automation**	the *driving mode*-specific performance by an *automated driving system* of all aspects of the dynamic driving task with the expectation that the *human driver* will respond appropriately to a *request to intervene*	System	**System**	Human driver	Some driving modes
4	**High Automation**	the *driving mode*-specific performance by an automated driving system of all aspects of the *dynamic driving task*, even if a *human driver* does not respond appropriately to a *request to intervene*	System	System	**System**	Some driving modes
5	**Full Automation**	the full-time performance by an *automated driving system* of all aspects of the *dynamic driving task* under all roadway and environmental conditions that can be managed by a *human driver*	System	System	System	**All driving modes**

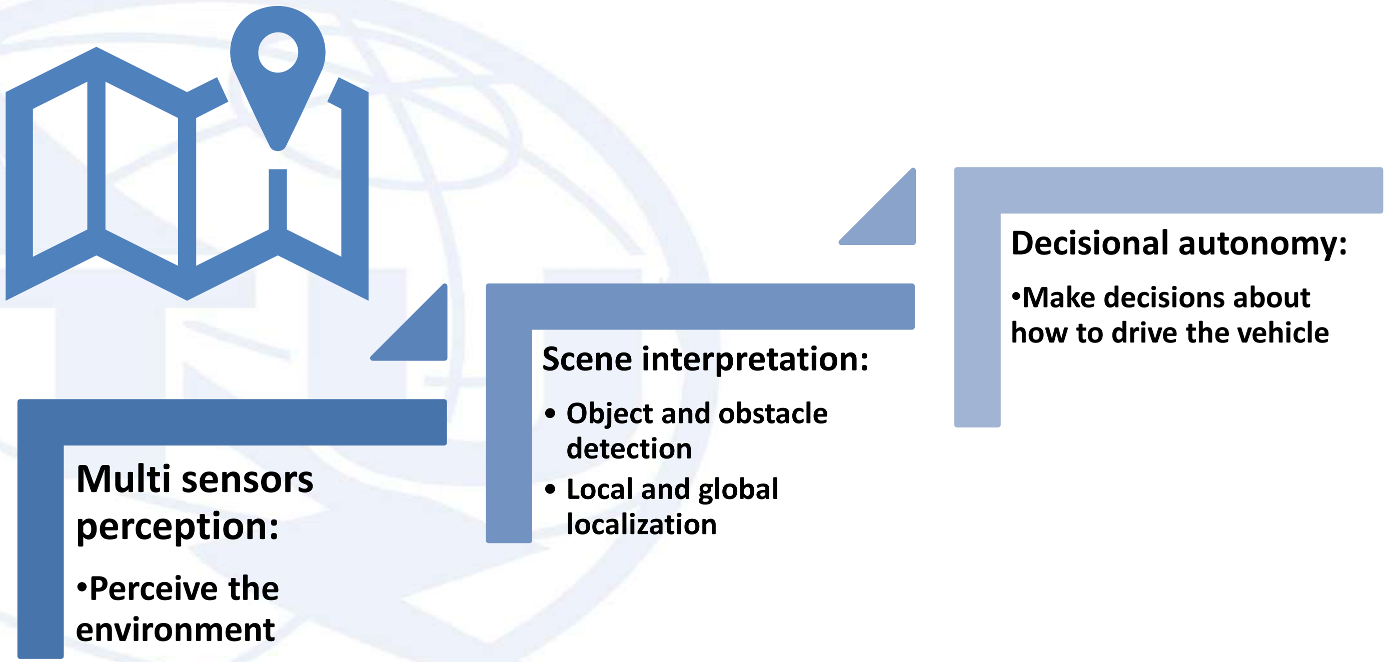
Autonomous Navigation

The Main functionality of an autonomous vehicle of level 3 or higher is the:

Autonomous Navigation

This functionality is ensured through 3 main capabilities:

1. Multi sensors perception
2. Scene interpretation
3. Decisional autonomy



Autonomous Navigation: Multi- Sensors Perception

Decisional Autonomy

Make decisions about how to drive the vehicle

Scene interpretation

Object and obstacle detection

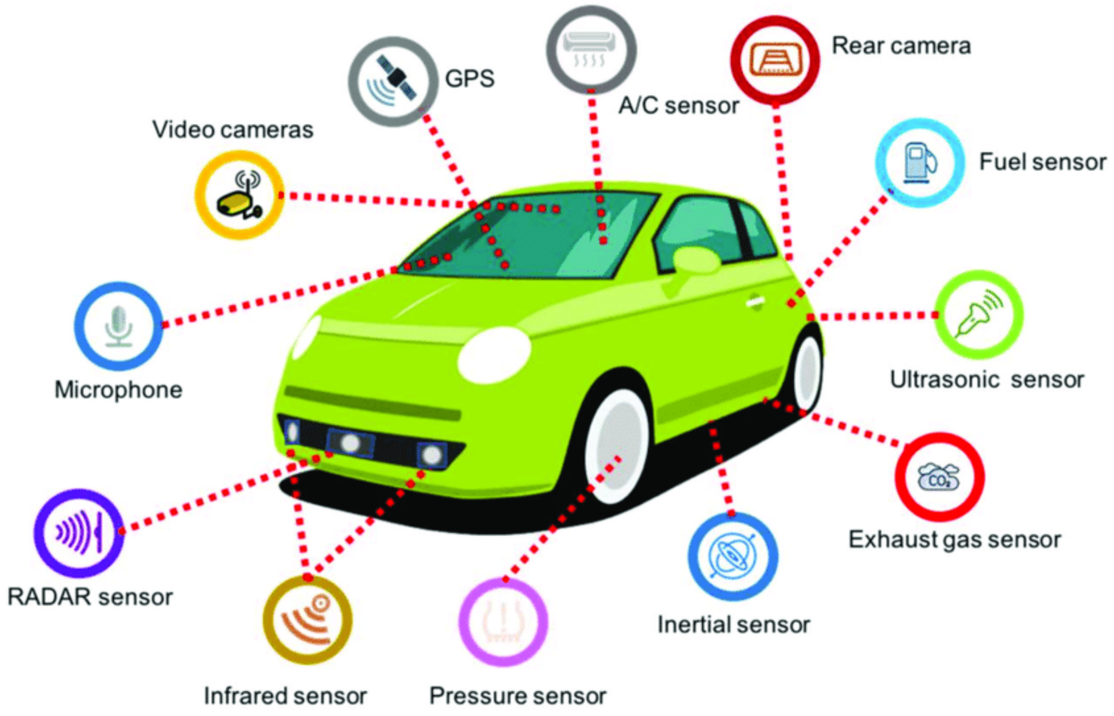
Local and global localization

Multi sensors perception

Perceive the environment

Multi-sensors Perception

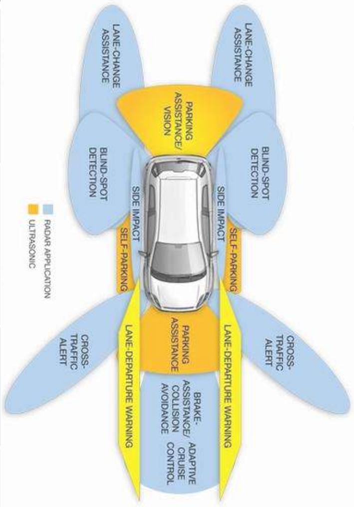
Multi-Sensors



https://www.researchgate.net/publication/324552482_Sensor_Technologies_for_Intelligent_Transportation_Systems

Sensors Categories

Category	Description	Example
Safety	Form the basis of safety systems and focus on recognizing accident hazards and events almost in real-time.	Micro-mechanical oscillators, speed sensors, cameras, radars and laser beams, inertial sensors, ultrasonic sensors, proximity sensors, night vision sensors, haptic.
Diagnostic	Focus on gathering data for providing real-time information about status and performance of the vehicle for detecting any malfunction of the vehicle.	Position sensor, chemical sensors, temperature sensors, gas composition sensors, pressure sensor, airbag sensor.
Traffic	Monitor the traffic conditions in specific zones, gathering data that improves the traffic management.	Cameras, radars, ultrasonic, proximity.
Assistance	Responsible for gathering data that provide support for comfort and convenience applications.	Gas composition sensor, humidity sensors, temperature sensors, position sensors, torque sensors, image sensors, rain sensors, fogging prevention sensors, distance sensors.
Environment	Monitor the environment conditions, offering drivers and passengers alert and warning services that are used to enhance their trips.	Pressure sensors, temperature sensors, distance sensors, cameras, weather conditions.
User	Focus on gathering data that support the detection of abnormal health conditions and behavior of the driver that can deteriorate the driver's performance.	Cameras, thermistors, Electrocardiogram (ECG) sensors, Electroencephalogram (EEG). sensors, heart rate sensor.



http://tpe-voiture-autonome.kazeo.com/les-principaux-capteurs-dune-voiture-autonome-a123093210

Sensor fusion: Examples

- Data from a laser sensor and a camera, or from a radar and a camera, are merged for obstacle detection and tracking
- The global location of the vehicle involves a fusion of data from GNSS (Satellite location), INS (Inertial Navigation) and odometry (measurement of wheel displacement).

- Tire pressure monitoring
- Parking assistance
- Obstacle detection
- Collision Anticipation
- Navigation system
- Self-piloting
- Night vision assist

FOR SAFER CARS EURO NCAP www.euroncap.com

The requirements of Euro NCAP (an international assessment body) will push manufacturers to develop sensor fusion systems to qualify their driver assistance systems (ADAS).

Autonomous Navigation: Scene Interpretation

Decisional Autonomy

- Make decisions about how to drive the vehicle

Scene interpretation

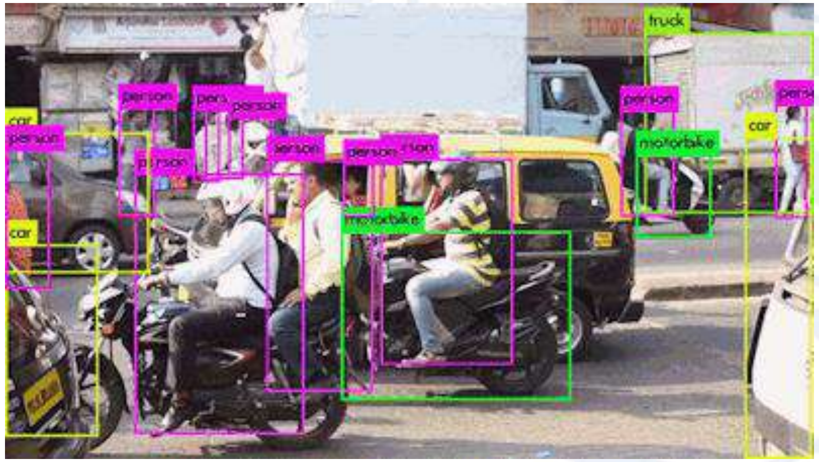
- Object and obstacle detection
- Local and global localization

Multi sensors perception

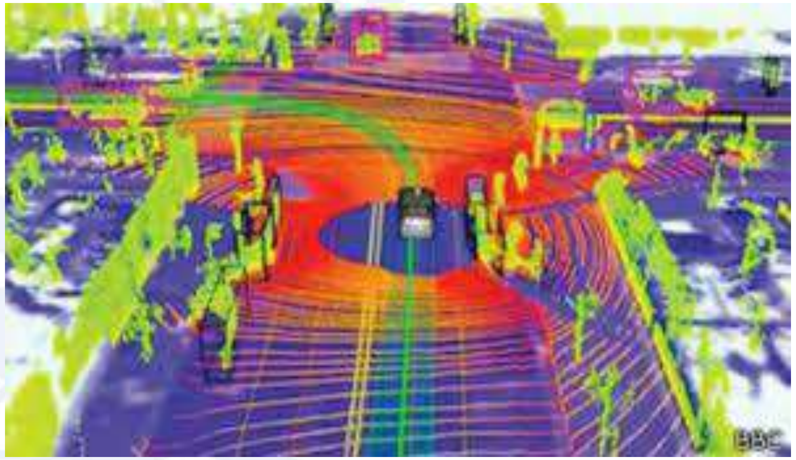
- Perceive the environment using multiple sensors

Scene Interpretation

Object and Obstacle Detection



Local and Global Localization



Object & Obstacle Detection

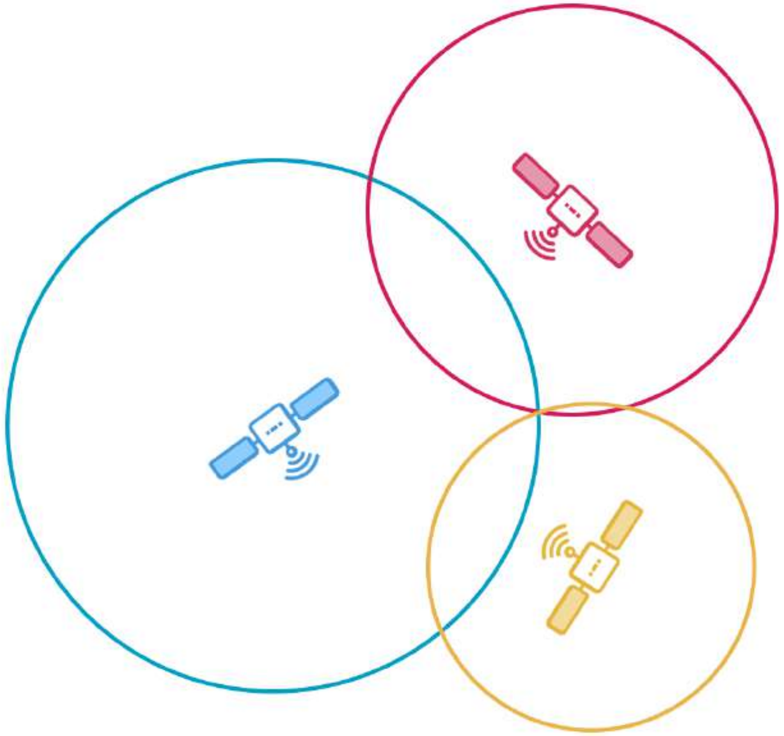
To understand its environment, the autonomous vehicle must :

know how to recognize objects and obstacles, whatever the objects to be detected: (pedestrians, vehicles, signs, etc.)

Machine learning techniques:

- Deep learning is considered very promising, provided sufficiently large learning base
- Numerous databases already exist for various types of objects and in particular vehicles, pedestrians and pedestrians, road signs ...
  - Daimler (Daimler Pedestrian Detection Benchmark): http://www.gavrila.net/Datasets/Daimler_Pedestrian_Benchmark_D/daimler_pedestrian_benchmark_d.html
  - Caltech:http://www.vision.caltech.edu/Image_Datasets/CaltechPedestrians/
  - Inria: https://dbcollection.readthedocs.io/en/latest/datasets/inria_ped.html

Global localization



Global positioning techniques are based on the satellite positioning system (GNSS)

Based on a set of satellites to provide to a user (via a GPS receiver):

- Its 3D position, (longitude, latitude and height)
- Its 3D speed
- The date and time

Local localization

Sensors that allow the position to be determined locally (without referring to a global external system)

1. The inertial unit: it is an instrument used in navigation, capable of integrating the movements to estimate:
   – its orientation,
   – its linear speed
   – its position. The position estimate is relative to the starting point

2. Odometry: is a device that measures the distance traveled by the car

3. The magnetic compass

Autonomous Navigation: Decisional Autonomy

Multi sensors perception:

Perceive the environment

Scene interpretation:

Object and obstacle detection

Local and global localization

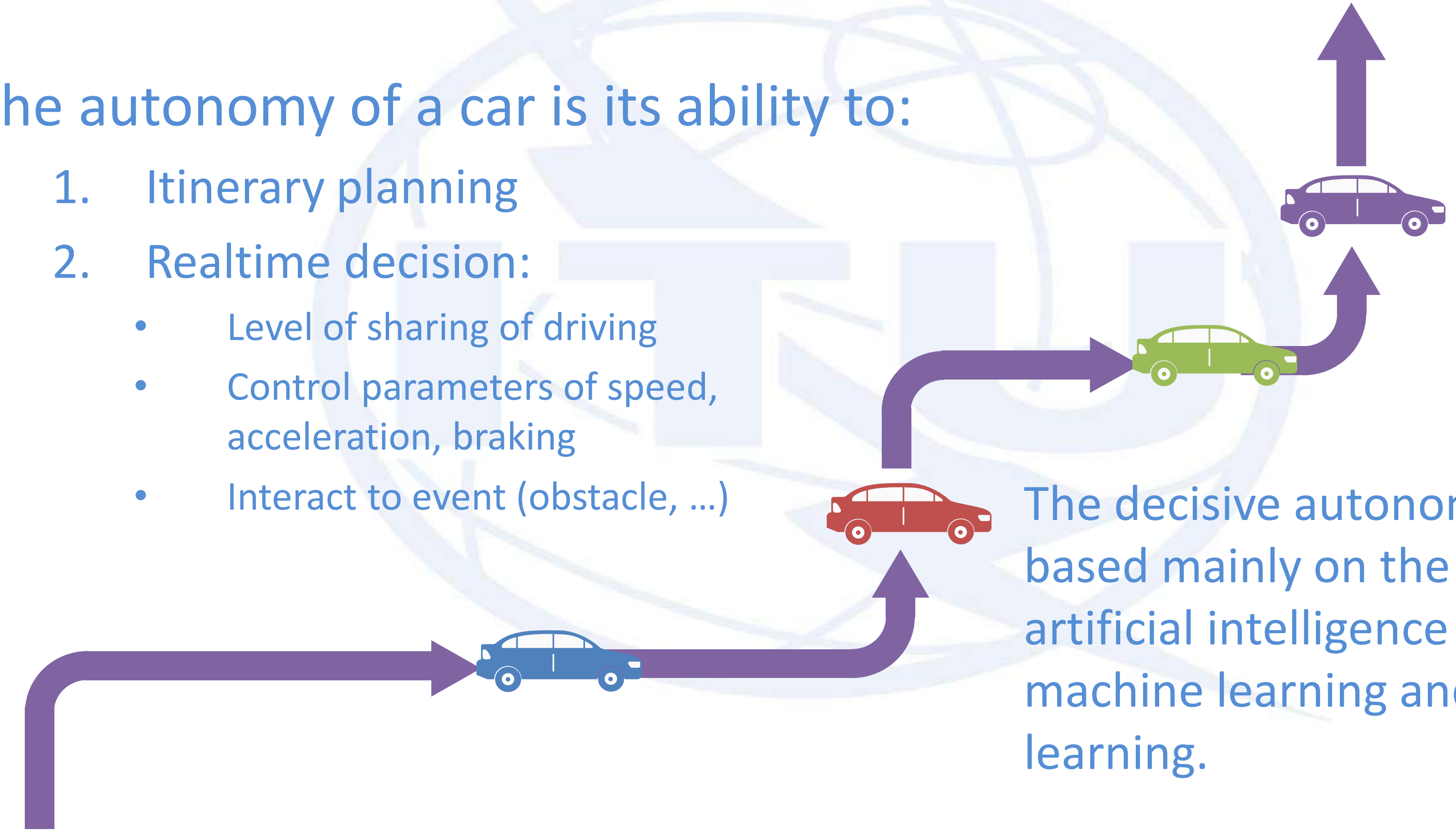
Decisional Autonomy:

Make decisions about how to drive the vehicle

Decisional Autonomy

The autonomy of a car is its ability to:

1. Itinerary planning
2. Realtime decision:
   - Level of sharing of driving
   - Control parameters of speed, acceleration, braking
   - Interact to event (obstacle, …)



The decisive autonomy is based mainly on the use of artificial intelligence technics: machine learning and deep learning.

Itinerary Planning

Energy optimization and pollutant emission reduction

Minimizing The consumption of the vehicle according to the topology of the route and the traffic conditions, in order to optimize energy consumption and pollutant emission

Passengers comfort

Minimizing traffic in places "at risk", on rough roads, or with many intersections and roundabouts

Time travel estimation

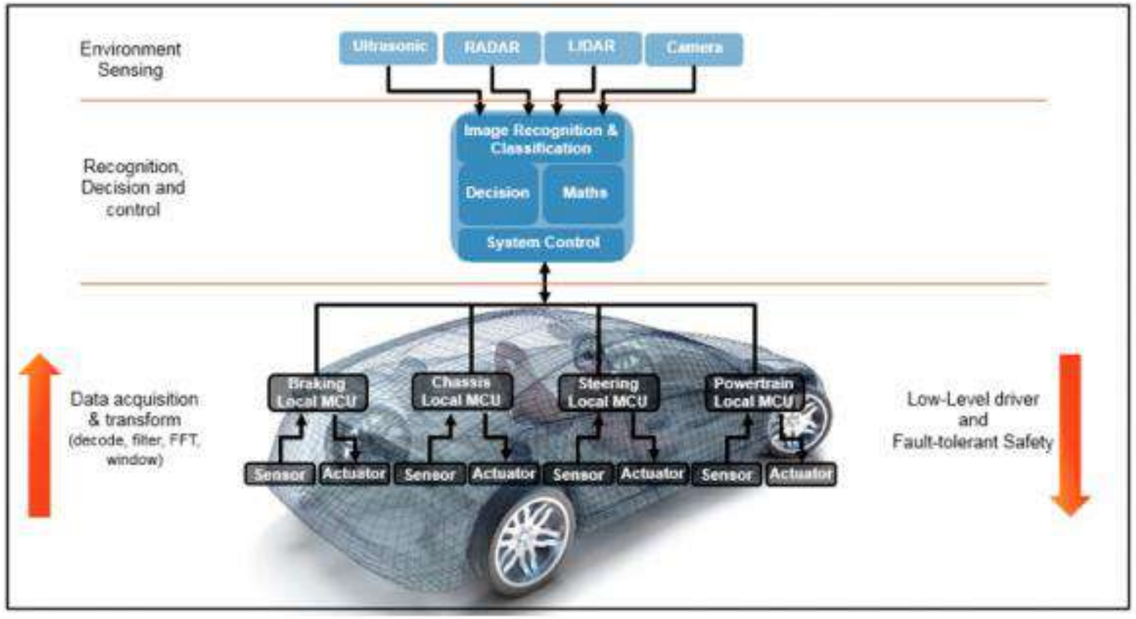
Model the traffic, for better estimation time travel

Command System for Autonomous Car

An autonomous car is considered as a mobile robot.

The control-command methods inspired by those developed for mobile robots, to ensure:

- The stability of the vehicle
- The passenger comfort, with constraints on longitudinal and lateral acceleration
- The slips avoidance or recovery , control the skating control .



Telecommunications Protocols

Protocols for connected and autonomous vehicles

Telecommunications and Cybersecurity

- Ensure reliable communication between vehicles and their environment
- One requirement: cybersecurity

Road safety requires a highly responsive and reliable exchange of information between neighboring vehicles, under any traffic density condition.

V2X: Vehicule to everything

V2I Vehicle-to-Infrastructure
Messages are exchanged between the vehicle and the infrastructure

V2D Vehicle-to-device
The exchange of information between a vehicle and any electronic device that may be connected to the vehicle itself.

V2N Vehicle-to-Network
Messages are exchanged with the application server which supports V2N communication

V2V Vehicle-to-Vehicle
Vehicles that support this type of communication can exchange messages (location, speed, state)

V2P Vehicle to Pedestrian
Messages are exchanged between pedestrians (vulnerable users) and vehicles

V2X: Technologies

There are several wireless networking technologies that could be used to connect a car.

Currently only 2 remain in very tough competition:

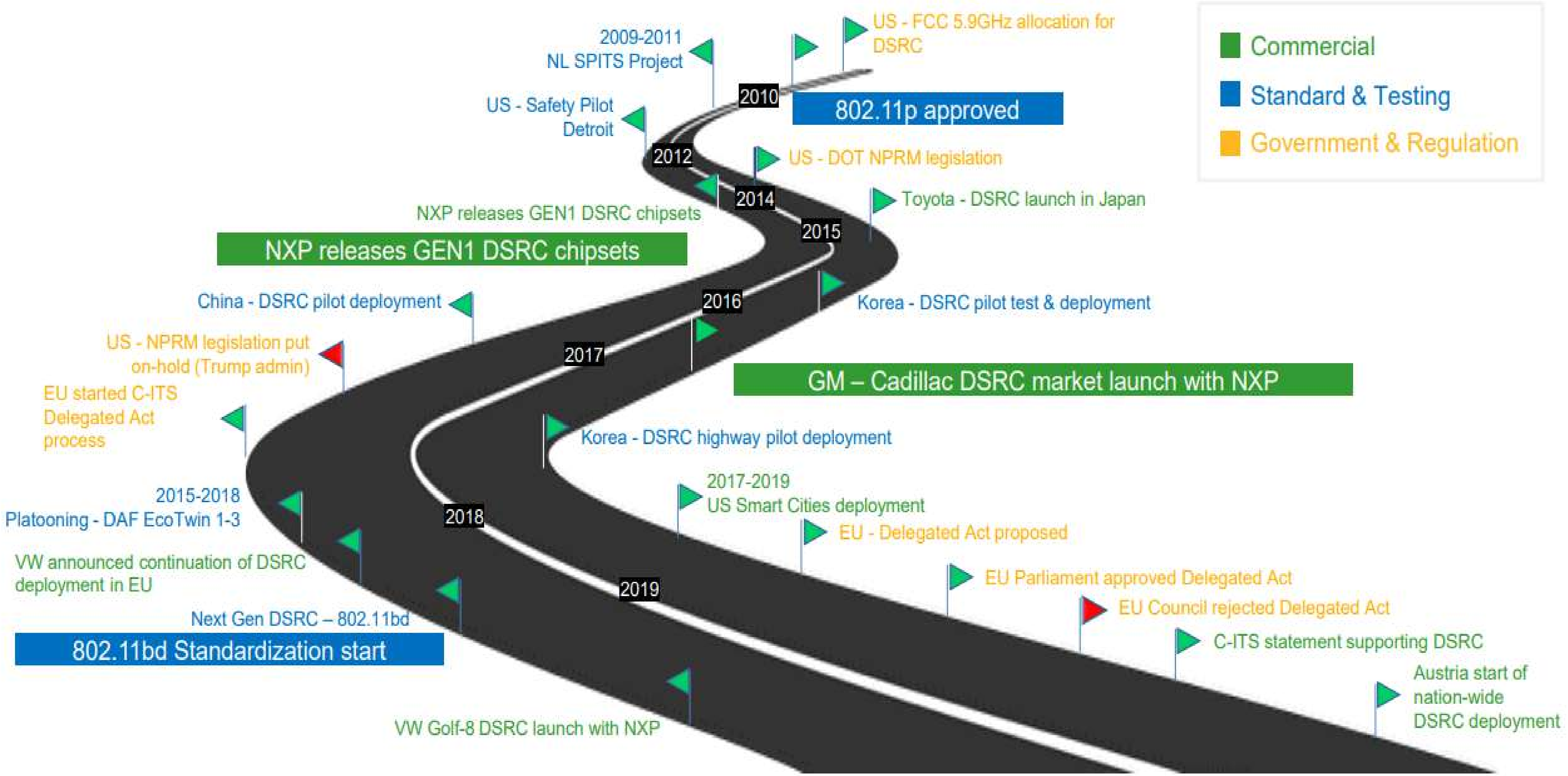
- WLAN-based: Wi-Fi (IEEE 802.11p)
- Cellular based: C-V2X

Caractéristiques de la liaison sans fil	Technologie			
	802.11 p WAVE	***1.0.1.a - Wi -fi***	**Cellulaire**	**Infrarouge**
Débit de données	3-27 Mb/s	6-54 Mb/s	< 2 Mb/s	< 1 Mb/s < 2 Mb/s
Portée de communication*	< 1000 m	< 100 m	< 15 km	< 100 m(CALM IR)
Puissance d'émission (max)	760 mW (US) 2 W EIRP (EU)	100 mW	2000 mW (GSM) 380 mW (UMTS)	12800 W/Sr pulse peak
Bande passante	10 MHz 20 MHz	1-40 MHz	25 MHz (GSM) 60 MHz (UMTS)	N/A
Spectre alloué	75 MHz (US) 30 MHz (EU)	50 MHz@2.5 GHz 300 MHz@5 GHz	Dépend de l'opérateur	N/A
Aptitude à la mobilité	Haute	Basse	Haute	Moyenne
Bande de fréquences	5.86-5.92 GHz	2.4, 5.2 GHz	800 MHz, 900 MHz, 1800 MHz,	835-1035 nm

DSRC: Wi-Fi (IEEE 802.11p)

- V2X based on Wi-Fi (IEEE 802.11p)
  - The IEEE first published specifications for this technology in 2012. It supports direct vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communication.
  - This technique is also known as Dedicated Short-Range Communications (DSRC) which is part of the IEEE 802.11 WLAN family of standards and is known in the United States as Wireless Access in Vehicle Environments (WAVE) and in Europe as ITS -G5.
- IEEE 802.11p (DSRC) technology is currently deployed in the United States, Europe and Japan

DSRC Journey



The C-V2X

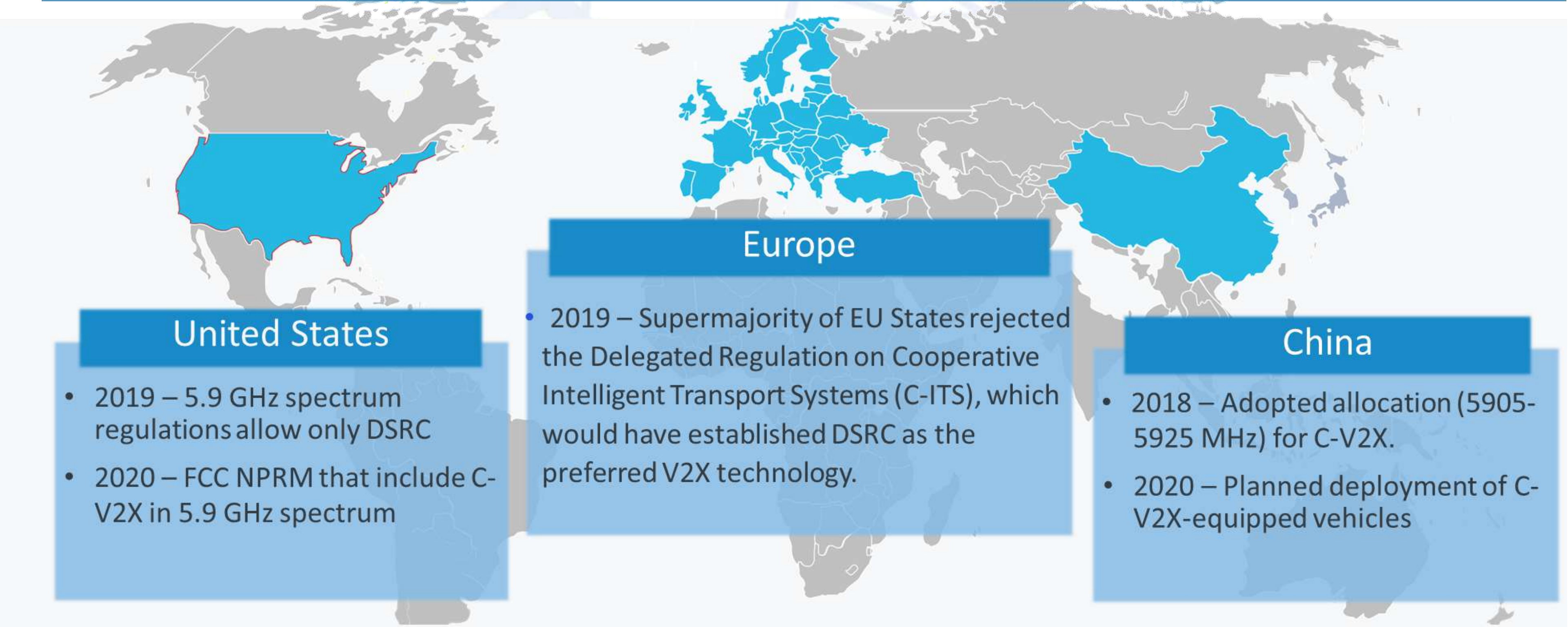
- C-V2X is based on the Cellular network
- Release of V2X specifications based on LTE as the underlying technology by 3GPP in 2017.
- It is generally referred as "cellular V2X" (C-V2X) to differentiate from V2X technology based on 802.11p.
- In addition to direct communication (V2V, V2I), the C-V2X supports extended communications over a cellular network (V2N).
- The evaluation prepared by 5GAA (5G Automotive Association) shows that the C-V2X has better functionality over IEEE 802.11p, while using solutions compatible with both technologies.

5GAA Vision


Precise positioning
Lane-level accuracy anywhere, anytime
Bluetooth
For high quality voice and audio
Wi-Fi
For in-car experiences and car OEM services
4G/5G
For car OEM services
4G/5G
For driver and passengers
C-V2X Direct Communications
For car-to-infrastructure communication
C-V2X Direct Communications
For car-to-car communication
Car connectivity in the 5G era
Heterogeneous connectivity
Secure, virtualized wireless links
Advanced Positioning
Multi-environment implementation
4G/5G is referring to C-V2X network communications (i.e. V2N); C-V2X Direct Communications is referring to V2V, V2I, V2P

C-V2X Adoption

Global Stakeholders Are Increasingly Recognizing the Benefits of C-V2X



United States

- 2019 – 5.9 GHz spectrum regulations allow only DSRC
- 2020 – FCC NPRM that include C-V2X in 5.9 GHz spectrum

Europe

- 2019 – Supermajority of EU States rejected the Delegated Regulation on Cooperative Intelligent Transport Systems (C-ITS), which would have established DSRC as the preferred V2X technology.

China

- 2018 – Adopted allocation (5905-5925 MHz) for C-V2X.
- 2020 – Planned deployment of C-V2X-equipped vehicles

5GAA Automotive Association

Airgain • Alpine Electronics • Analog Devices • Anritsu EMEA Ltd
AT&T • Audi BAIC • Beijing University • Bell Mobility • BMW • Bosch
CATT • Cetecom • China Transinfo • China Unicom • CMCC
Continental Daimler • Danlaw • DEKRA Denso • Deutsche Telekom
Ericsson • FEV • Ficosa • Ford • Fraunhofer Gemalto Hirschman Car
Hitachi Automotive US • Honda • Huawei Infineon • Intel Interdigital
Jaguar Land Rover • Juniper • KDDI • Keysight • KT • Laird Tech • LG
Murata • Nissan • Nokia • NTT DoCoMo • OKI • Orange • P3 Group
Panasonic • Proximus • PSA • Qualcomm • Rohde & Schwarz Rohm
SAIC • Samsung • Savari • SIAC • SK Telecom • Skyworks Softbank
Sumitomo • Telefonica • Telekom Austria • Telstra • TÜV • Valeo
Veniam • Verizon • Viavi • Vodafone • Volkswagen • ZF • ZTE

Key participants

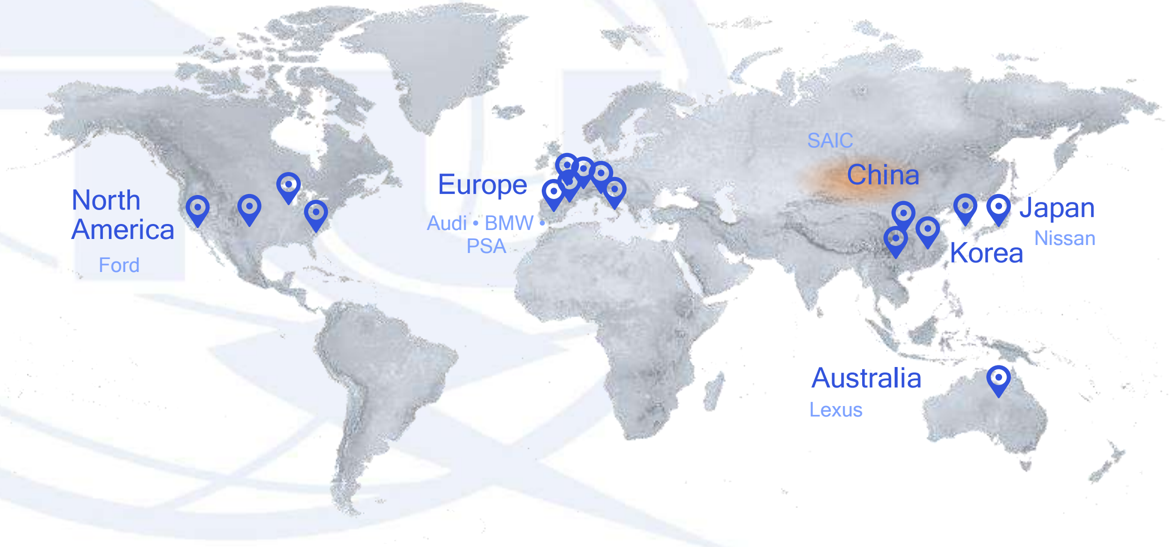
driving global C-V2X activities with Qualcomm Technologies

Ford
PSA
BMW
Daimler
SAIC
China Domestic OEMs
Continental
Bosch
LG

ZTE
Quectel
Lear
Valeo
WNC
CMCC
AT&T
DoCoMo
CMRI
McCain

Kapsch
SWARCO
Genvict
Nebula
R&S
Datang
Ficosa
And more ...

Driving C-V2X global presence



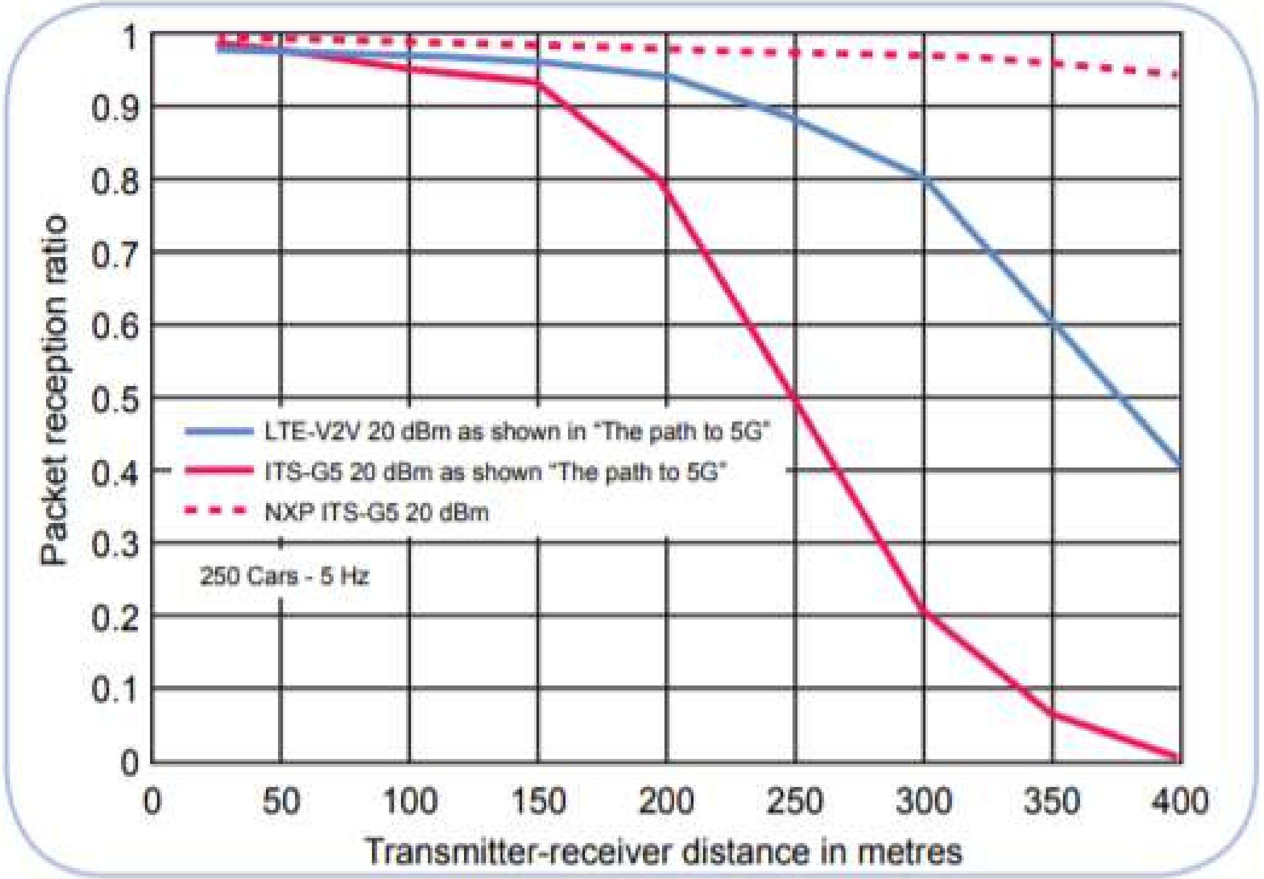
Tremendous traction across regions and broad industry sectors

From standards completion to independent field testing to early commercialization

Strong C-V2X momentum

- **Sep 2016** – 5GAA Founded
- **Jan 2017** – ConVeX trial in Germany announced
- **Feb 2017** – Towards 5G trial in France announced
- **Mar 2017** – 3GPP: Rel-14 C-V2X spec finalized
- **Sep 2017** – MDM 9150: First C-V2X chipset introduced
- **Oct 2017** – San Diego Regional C-V2X trial with:
- **Apr 2018** – First multi-OEM demo in D.C.
- **Jun 2018** – 1st US deployment in Denver
- **Jul 2018** – 5GAA: Europe's first multi-OEM demonstration In Paris
- **Oct 2018** – Multi-OEM performance evaluation of C-V2X
- **Oct 2018** – 5GAA: C-V2X functional and performance test report published
- **Nov 2018** – 5GAA Reaches 100 members
- **Nov 2018** – China-SAE ITS Stack Compatibility
- **Jan 2019** – Cooperative driving live interactive demos in Las Vegas:
- **Jan 2019** – Announcing C-V2X implementation in Las Vegas with:

Critics: C-V2X vs DSRC



https://www.nxp.com/docs/en/white-paper/CITSCOMPWP.pdf

Telecommunication

CAV Cybersecurity

A requirement: Cybersecurity

One of the big problems in telecommunications is vulnerability to external attacks.

For connected vehicles, the question of the integrity and confidentiality of information circulating on networks is critical.

The worst-case scenario that can be envisaged would be, for example, the remote control of a connected vehicle.

⇒ Cybersecurity is becoming a priority for transport manufacturers. Means of protection already exist, they must be integrated into the vehicle development process.

Cybersecurity solutions must ensure:

- firewall functions in the interfaces with external networks, the detection of intrusions and the installation of protections;
- securing internal communications, communications between the vehicle and information systems, or communications between vehicles, by encryption and signature;
- the “hardening” of on-board computers (data and program protection);

The complex stakeholder ecosystem

The CAV ecosystem is made up of a variety of interconnected stake- holders:

- Automotive- parts and software businesses,
- Academic institutions
- Standards organizations
- Industry associations
- Financial institutions

The CAV cybersecurity stakeholders have unique interactions with:

- regulators,
- policy makers, a
- economic development organizations. The stakeholders

Attack vectors

- LIDAR and radar systems (e.g., spoofing or saturation attacks)
- Servers
- Keyless entry
- On-Board Diagnostics (OBD) port
- OBD dongle
- Mobile app
- Infotainment
- Broadband network (e.g., cellular)
- V2X communication
- Wi-Fi
- Sensors
- USB port
- Bluetooth
- Telematics Control Unit (TCU)

The top attack vectors as of 2018, according to Upstream security report, were:

- Remote server attacks (21%)
- Keyless entry attacks (19%), where an individual enters a car without using a key for either the door or the ignition.
- Another 10% of attacks were through the OBD port
- 7% each were through mobile apps or infotainment systems.
- Wi-Fi and cellular network attacks made up just above 4% but ould grow in the context of increased connectivity and 5G coverage.
- 41% of Black Hat incidents involving back end servers in 2019, including breached OEM web servers

https://www.upstream.auto/upstream-security-global-automotive-cybersecurity-report-2020/

Threat vectors

Key threats impacting the CAV ecosystem

Insider Threats: Insiders are trusted, have knowledge and access to the organization's crown jewels. Insider's motivations may vary – they may steal data, commit fraud or cause physical harm or sabotage. Detecting insiders behaving normally, but with ulterior motives, can be challenging – highlighted by cases like the Levandowski trade secret trial between Waymo and Uber.

Cyberattacks into V2X Communications: With far more on-board software needing regular security and navigational updates, autonomous vehicles in the new mobility ecosystem will likely have communication lines back to the manufacturer for instant transmission of software-related patches. Vulnerabilities in the communication channels could result in a threat actor compromising the safety and security of the vehicles.

Hijacking Vehicle Sensors and Taking Over Physical Controls: The intersection of critical and noncritical vehicle sensors and the underlying busses can allow a message injector to pass unwanted data to devices in the vehicle by exploiting the weakest link. Advances in cognitive computing are creating new avenues to exploit the sensors and IoT devices used by CAVs as demonstrated by researchers in tricking the vehicle LIDARs to make inaccurate judgements, by using spoofing and saturation attacks. This can lead to physical CAV crashes or CAV thefts.

Dumpster Diving for Data: Just as flight data recorders collect information about what happens in a cockpit, connected vehicles absorb details about what their owners and passengers do, which can act as a honeypot for malicious actors. Furthermore, there have been reported cases where drivers of ride sharing apps have secretly recorded their passenger conversations, with privacy ramifications.

Supply Chain and 3rd Party Risks: The CAV ecosystem consists of a large variety of service and solution providers. Managing 3rd party risks across the value chain has been challenging for organizations due to the different maturity levels of the service providers, lack of visibility and control of data, and difficulties enforcing a common standard of security control requirements.

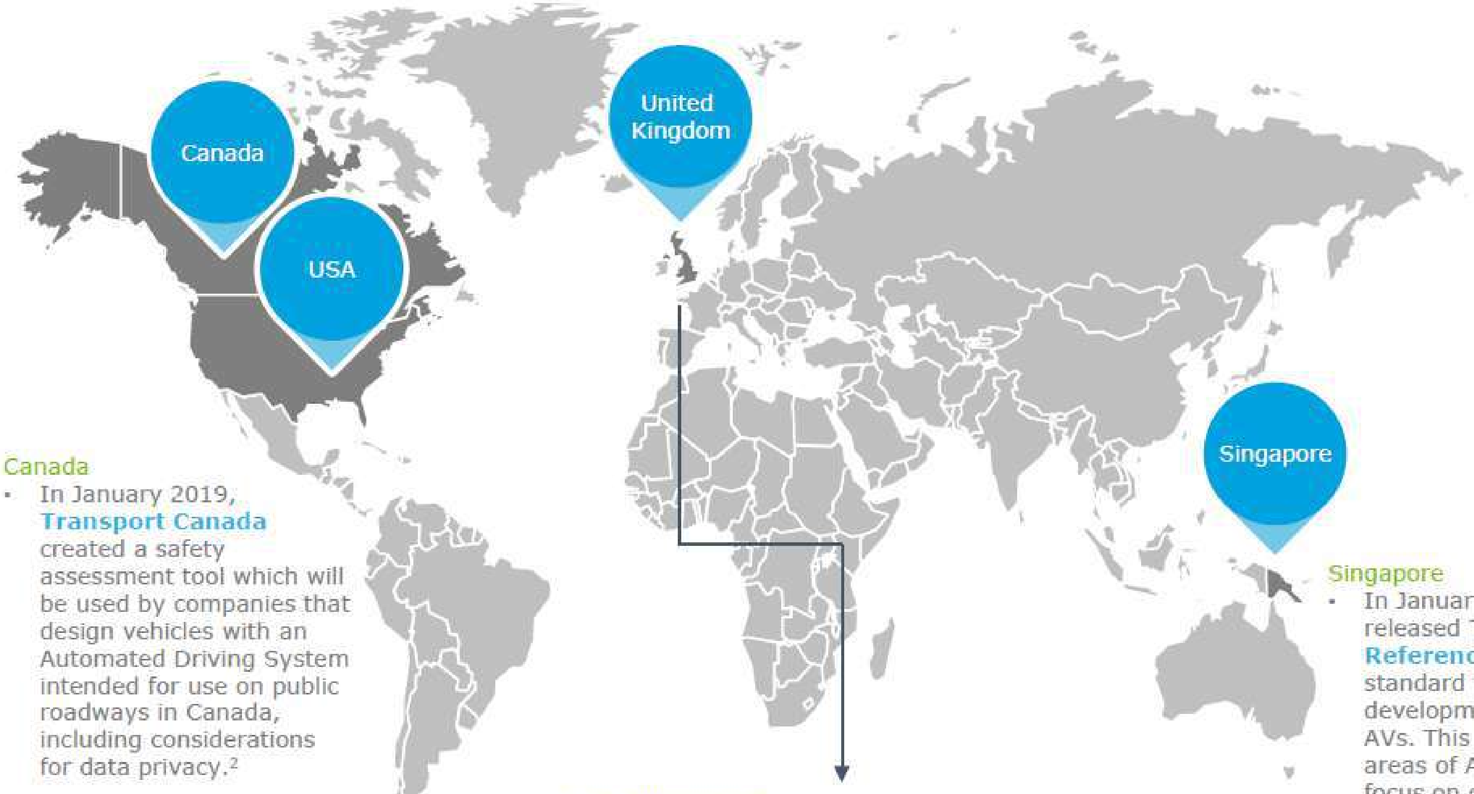
https://www2.deloitte.com/ca/en/pages/risk/articles/cyber-connected-autonomous.html

Organizational risks to the CAV ecosystem

A CAV is a combination of connected devices in a single moving device – with a large threat landscape. The complex CAV ecosystem contains some emerging challenges that are impacting the organizations operating in this sector.

- **Blending Realms of Physical and Cybersecurity:** In a dynamic and connected IoT environment, new and existing technology platforms can expose an organization to security risks of a converged nature.
- **Data Security and Privacy :**Protecting customer, employee, and organizational data requires advanced security controls while ensuring data integrity and privacy requirements are considered and designed at the outset.
- **Attacker Sophistication:** While the rapid growth in Artificial Intelligence (AI) has helped organizations, it has increased the capacity of threat actors, enabling higher effectiveness of attacks.
- **Collaboration:** With physical security becoming increasingly technology enabled, breaking silos and collaboration amongst the security teams can optimize threat management.
- **Risk Culture:** Having the right risk culture is one of the key success factors in preparing for and tackling new risks.
- **Talent :** Recruiting, training and retaining top cybersecurity talent.
- **Enterprise View:** Addressing risks using an enterprise lens provides a holistic view of risk which is needed to tackle today's emerging threats.
- **Regulation and Justice:** Understanding and updating the regulatory and justice framework is needed to ensure a safe and secure CAV ecosystem.

Global cybersecurity developments



cybersecurity legislation and requirements development around the world relevant to the CAV ecosystem

Canada

- In January 2019, **Transport Canada** created a safety assessment tool which will be used by companies that design vehicles with an Automated Driving System intended for use on public roadways in Canada, including considerations for data privacy.[2]

USA

- In October 2018, the US Department of Transportation (DOT) released the "Automated Vehicles 3.0: **Preparing for the future of transportation**". This release focuses on six automation principles identified by USDOT, and also provides private sector representatives with guidance, which includes "**Adopting cybersecurity best practices**".[22]

United Kingdom

- The **Key Principles of Cybersecurity for Connected and Autonomous Vehicles** were developed by the department for Transportation (DFT) in conjunction with Centre for the Protection of National Infrastructure (CPNI) for companies involved in the supply chain (such as manufacturing, technology etc.), towards the development, testing and deployment of CAVs.[23]
- **BSI Standard PAS 1885:2018** is meant to be read in conjunction with the Key Principles.[24]

Singapore

- In January 2019, Singapore released TR68 (**Transport Reference 68**),[25] a national standard to guide industries in the development and deployment of AVs. This standard covers four key areas of AV development with a focus on cybersecurity and the interoperability of data: **vehicle behaviour, vehicle functional safety, cybersecurity, and data formats**.

https://www2.deloitte.com/ca/en/pages/risk/articles/cyber-connected-autonomous.html

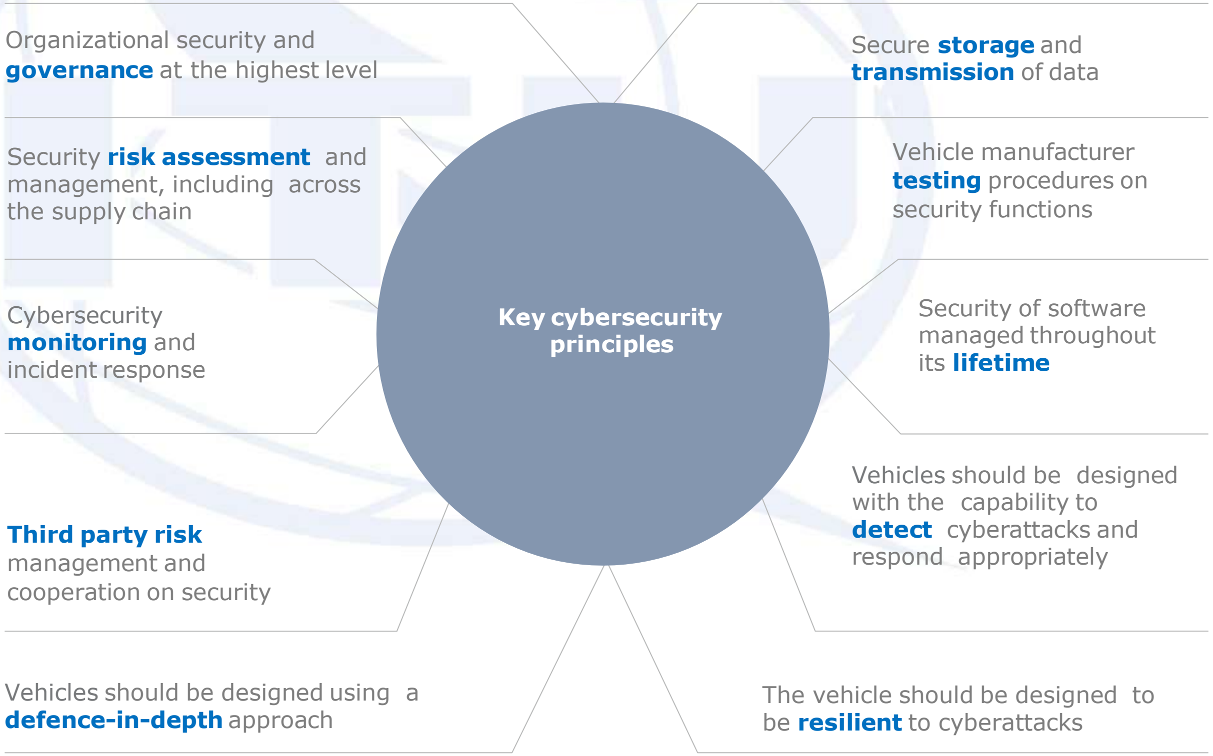
Societal, Legal and Economic Impacts

Regulation

Spotlight on proposed UN Regulation on CAV Cybersecurity (2018)

In support of the United Nations Economic Commission for Europe (UNECE) World Forum for Harmonization of Vehicle Regulations (WP29) Working Party on Automated/Autonomous and Connected Vehicles mandate, experts of the Task Force on Cyber Security and Over-the-air issues submitted a draft Regulation on CAV Cyber Security in November of 2018

The proposed UN Regulation develops uniform provisions concerning the approval of cybersecurity and includes requiring those Contracting Parties to have an Approval Authority or Technical Service assess and issue "Cyber Security Management System Certificates of Compliance".



https://www2.deloitte.com/ca/en/pages/risk/articles/cyber-connected-autonomous.html

UN Regulations 2021

More than 50 countries gathered at the United Nations Economic Commission for Europe's (UNECE) Global Forum for Harmonization of Vehicle Regulations have adopted new self-driving car regulations that will come into force in 2021.

Autonomous lane keeping systems (ALKS) will only be activated:

- On roads where pedestrians and cyclists are prohibited
- On roads equipped with a physical separation between the two directions of traffic
- Maximum speed limit at 60km / h
- Obligation of a driver availability recognition system
- Black box requirement: data storage system for automated driving

https://undocs.org/ECE/TRANS/WP.29/2020/81

Regulatory and legal challenges: situation

- Necessary evolution of the Vienna Convention, national highway codes and automobile regulations (ex ECE79).
- The March 2016 evolution allows advanced driving aids (level 2) but not the autonomous vehicle.
- Legal liability in the event of an accident to be dealt with, changes in insurance policies (Working group in progress within the PFA)
- Open road experiments launched

Concerns about the Deployment of Connected and Autonomous Cars

- The autonomous and connected vehicle is a system of great technological complexity,
- Large-scale deployment requires profound changes in the functioning of society, which will affect the organization of cities, the uses of transport, the civil liability of industrialists and mobility operators.
- The arrival of "robot vehicles" also raises ethical questions. the autonomous and connected vehicle concentrates a large part of the questions usually related to digital in society:
  - Concern for safety,
  - The problem of transfer of responsibility,
  - Decision making by artificial intelligences,
  - Securing communications,
  - Respect for privacy and personal data, etc.
- New economic models should be adopted as in the insurance sector
- Adapt and develop national and international regulations
- Resolve the legal and ethical question of liability

Ecosystem transformation

New challenges for the different players:

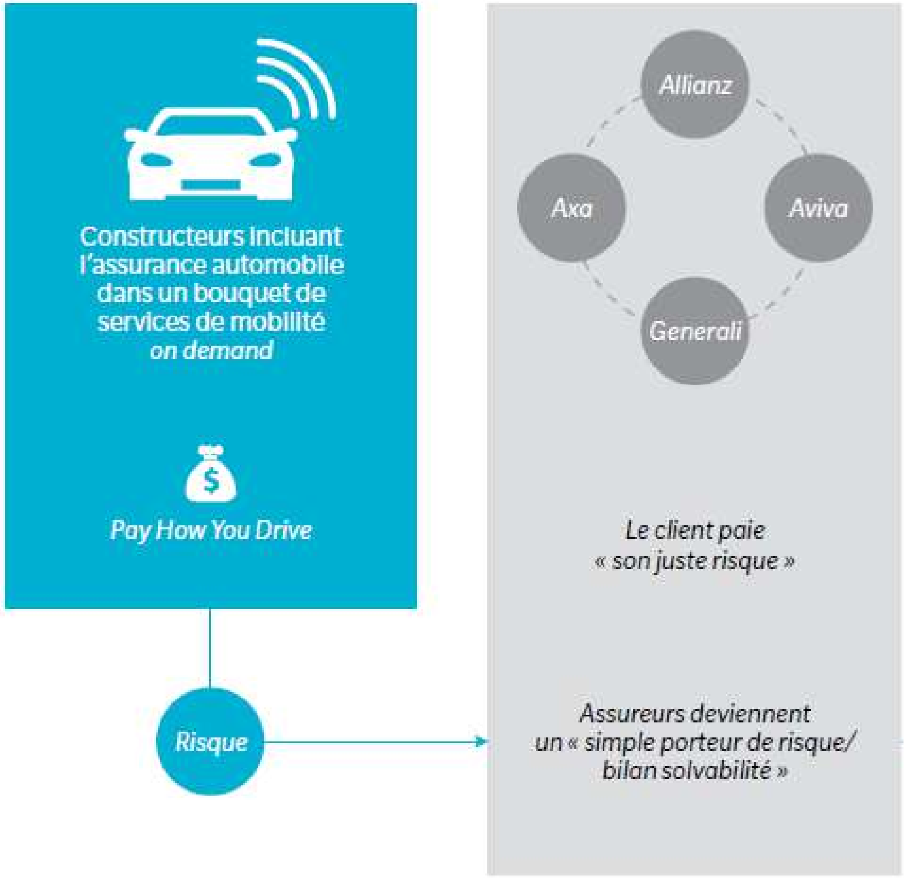
1. Insurance
2. The constructor
3. The consumer
4. Lawmakers and regulators
5. The society

Societal, Legal and Economic Impacts

Insurance

Insurance: shift of the economic model

- New players: Peugeot becomes an auto insurer and Tesla announced that it will be in 2020
- Insurers are losing customer relationships in automobile insurance,
- The insurance is built into the car sales contract.
- The manufacturer is the first to collect the data essential to the tariffication
- The insurer becomes a simple subcontractor of the constructor



Source Oliver Wyman

Insurance: New service Offers

- The insurers offer a “Pay as you drive” type contract: (kilometer insurance) is a type of automobile insurance allowing insurance pricing according to the actual use of the vehicle:
  - A GPS-type geolocation software linked to a mobile phone in the car of voluntary policyholders.
- The insurer then collects information related to the dates, times of circulation and movement of vehicles.
- Pricing is based on the usage of each customer.

Insurance: New service Offers

Axa (1st insurer in the world) offers a new "Pay how you drive" contract:

- Premium based on actual risk
- Driving style monitoring with telematics
- Driver control => better driver!
- Actual data in the event of an accident
- The protection of personal data (Facilitated by the GDPR)

Societal, Legal and Economic Impacts

Responsibility

Ethical and legal responsibility

In the event of an accident, who is responsible ?

In case of technical failure

… so no doubt

→ OEM

Else

Misuse driver

1. If not reasonably foreseeable
2. If clear operating instructions

→ Driver

Third party fault

1. Infrastructure manager (if standardized)
2. Other user

→ Tiers

Cyber criminality

Hacker responsibility

→ Tiers

Conclusion

- The autonomous car: why?

Market developments: customer expectations, road safety contribution.

- Technologies issues
- Major challenges in terms of performance and operating safety
- Legal and regulatory: Still many points to deal with

Thank you!

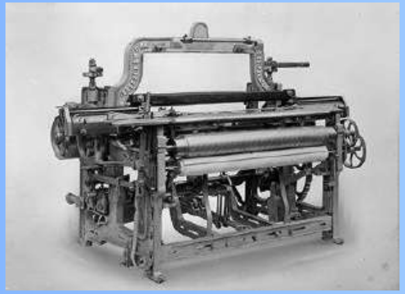
PRIDA Track 1 (T1)

Industry 4.0

11/09/2020

Industry 1.0
FIRST
Industrial Revolution

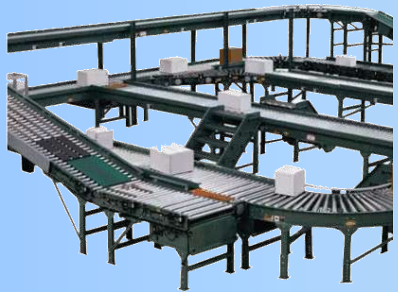
Key Change:
Introduction of Mechanical Production Equipment driven by Water and Stream Power



18th Century Mechanical Loom

Industry 2.0
SECOND
Industrial Revolution

Key Change:
Introduction of mass Manufacturing Production lines powered by Electric Energy



Vintage Electric Conveyor Belt

Industry 3.0
THIRD
Industrial Revolution

Key Change:
Introduction of Electronics, PLC Devices, Robots and IT to automate Production

PLC Driven Robots

Industry 4.0
FOURTH
Industrial Revolution

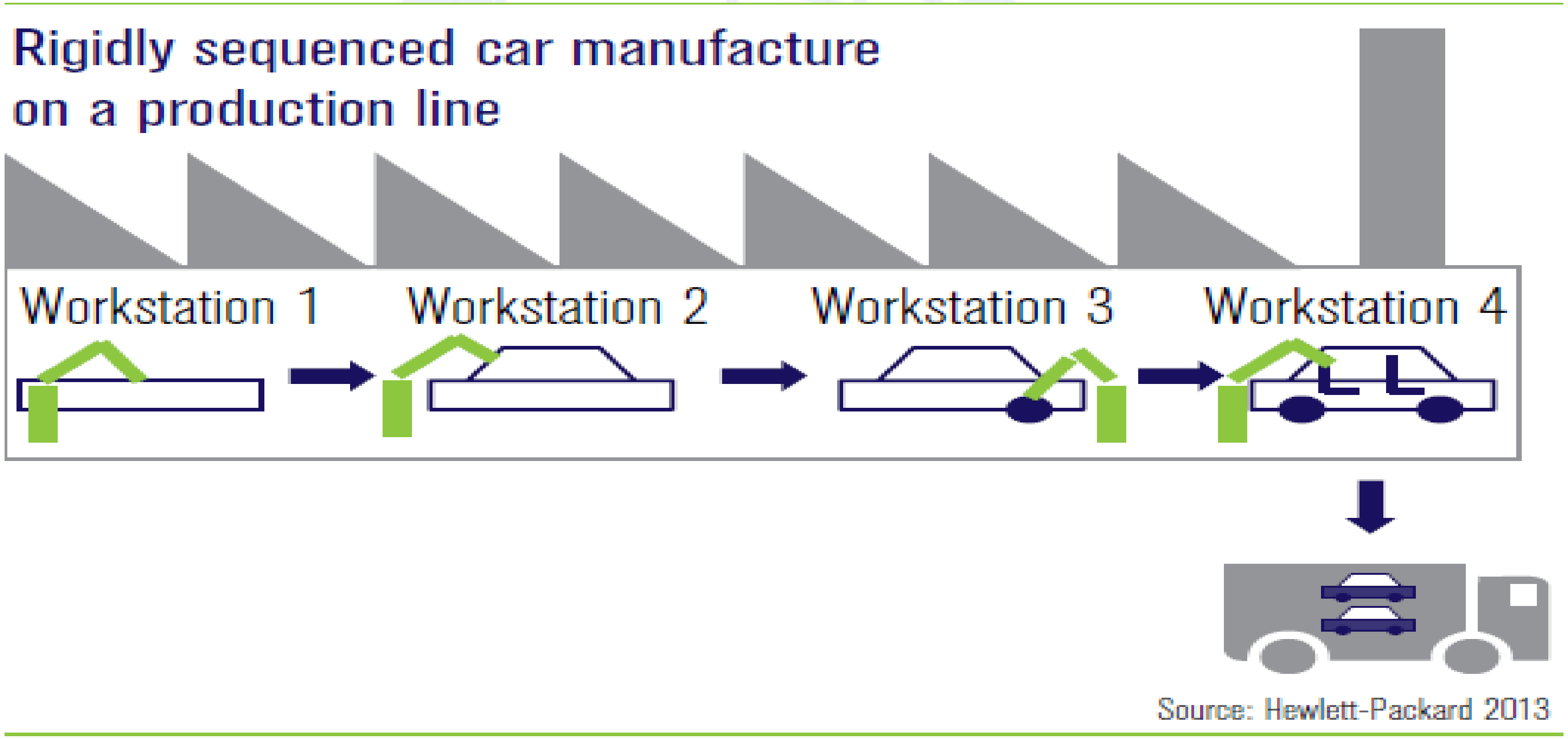
Key Change:
Introduction of IoT and Cyber-Physical Systems driven by Augmented Reality & Real Time Intelligence

Augmented Reality Driven CPS

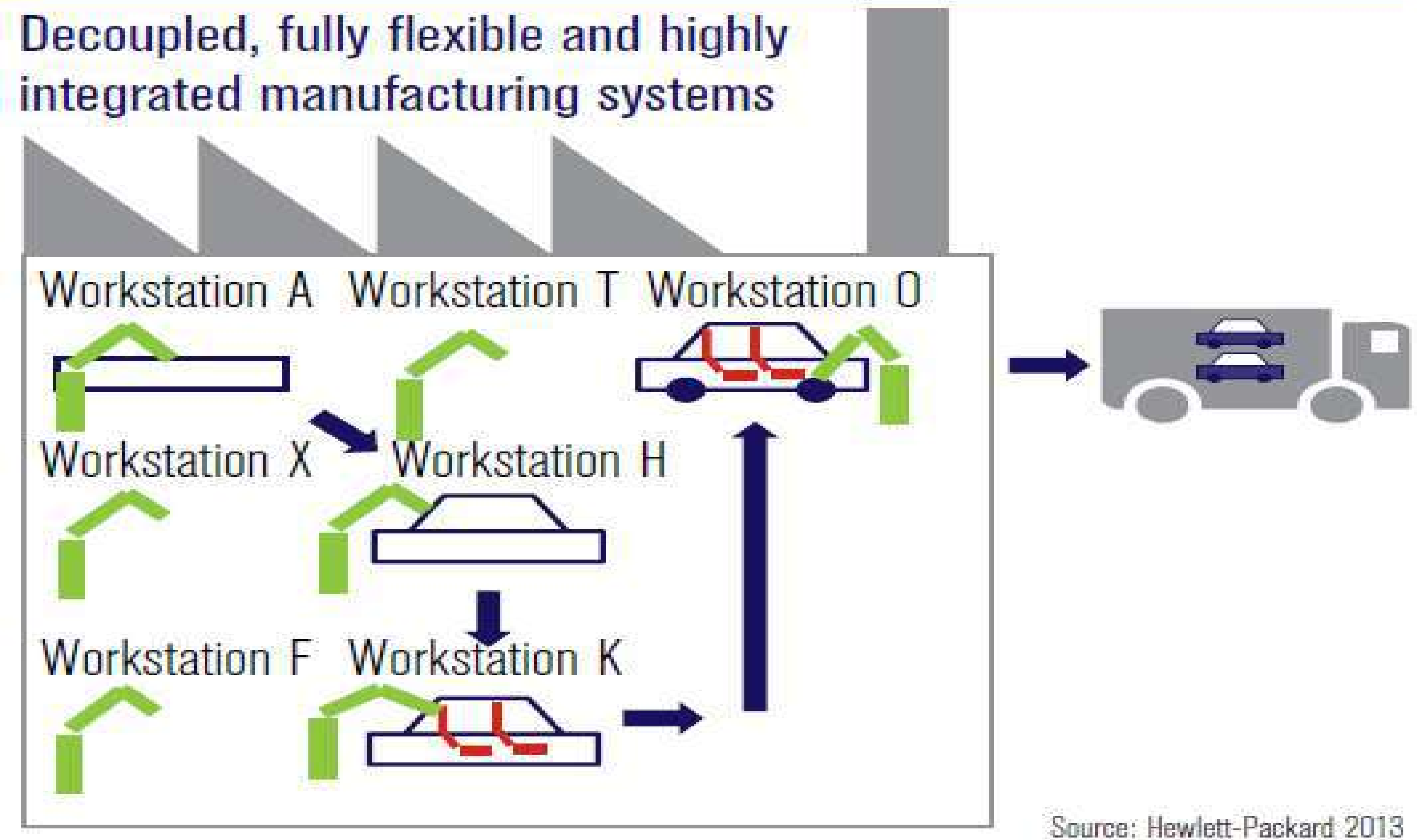
Level Of Complexity

End of 18th Century | End of 19th Century | Q4 of 20th Century | Start of 21st Century

Today’s Factory



Tomorrow's Factory



Source: Hewlett-Packard 2013

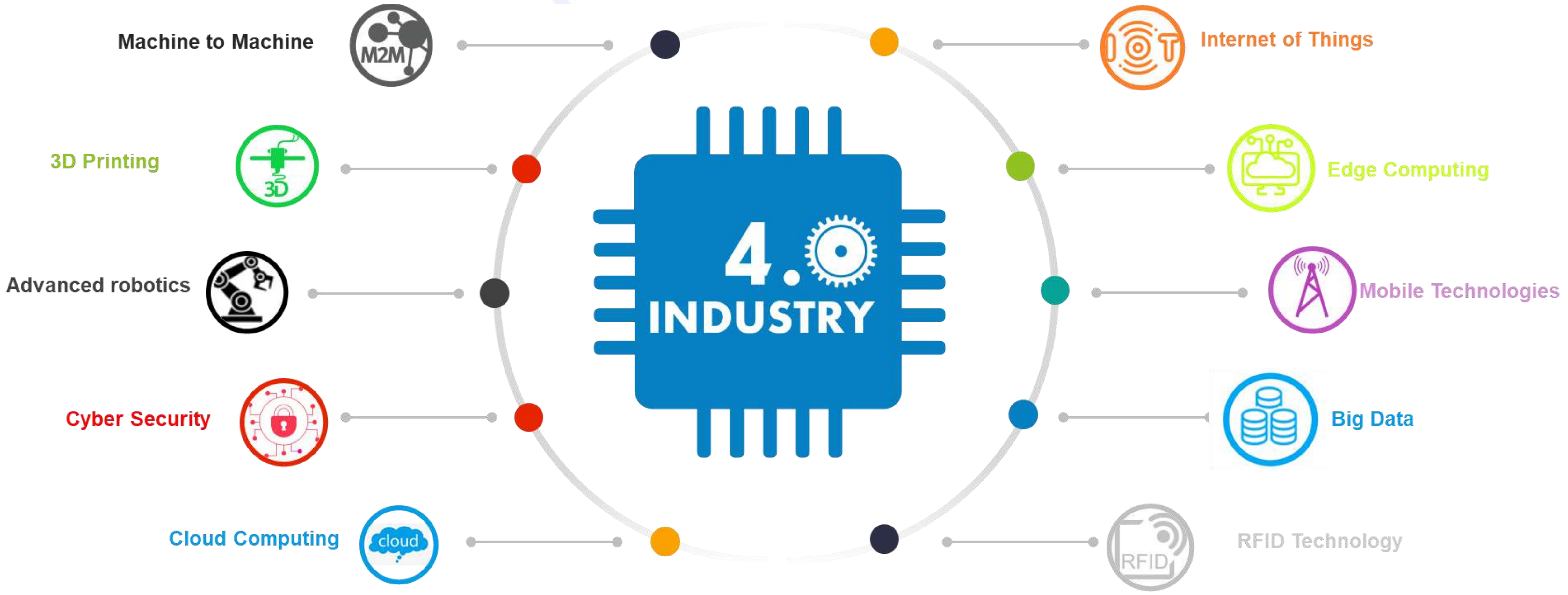
Industry 4.0 & IIoT Definition

IoT
3D printing
Internet of Things
Industry 4.0
Machine-to-Machine
Cloud Computing
Fourth Industrial Revolution
Smart manufacturing
Edge computing
Digital Transformation
Advanced Robotics
Mobile Technologies
Cognitive Computing
Smart Factory
Industrial Internet of Things
Sensors
Big Data
Cybersecurity
DCS
IIoT
Telecommunication
RFID Technology
Distributed Control System

Industry 4.0 : 6 Design principles

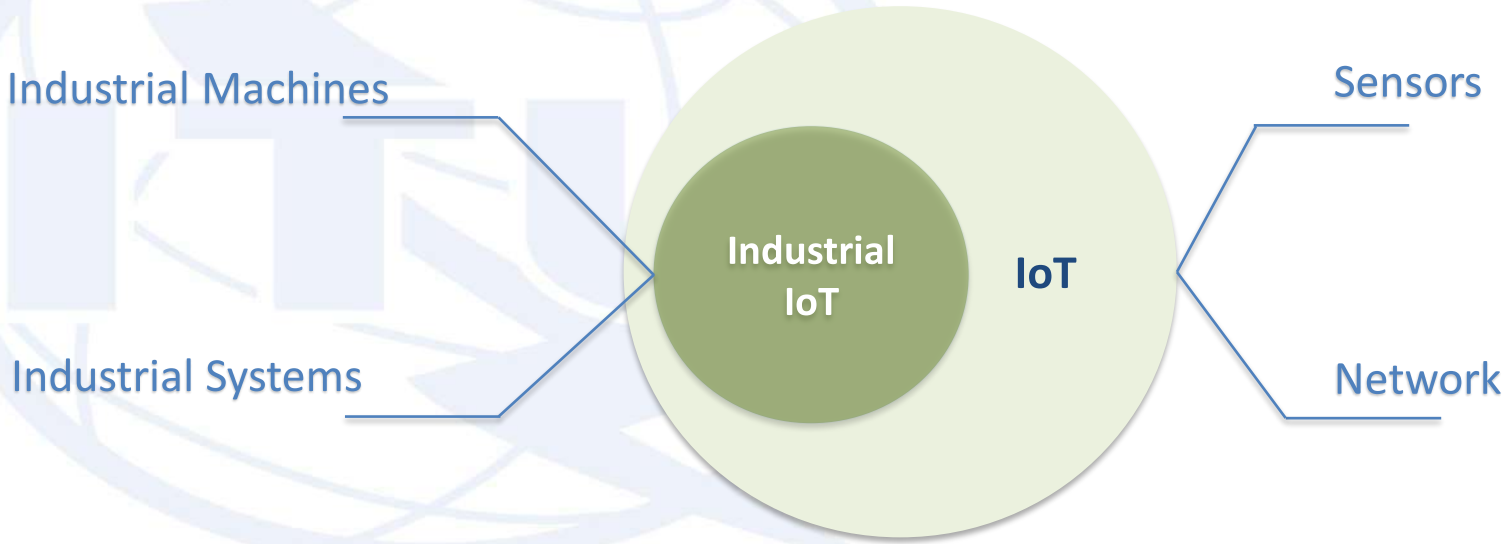
- **Interoperability**: the ability of **cyber-physical systems** (i.e. work piece carriers, assembly stations and products), humans and Smart Factories to connect and communicate with each other via the **Internet of Things** and the **Internet of Services**
- **Virtualization**: a virtual copy of the Smart Factory which is created by linking sensor data (from monitoring physical processes) with virtual plant models and simulation models
- **Decentralization**: the ability of **cyber-physical systems** within Smart Factories to make decisions on their own
- **Real-Time Capability**: the capability to collect and analyze data and provide the insights immediately
- **Service Orientation**: offering of services (of **cyber-physical systems**, humans and Smart Factories) via the **Internet of Services**
- **Modularity**: flexible adaptation of Smart Factories for changing requirements of individual modules

IIoT Enablers



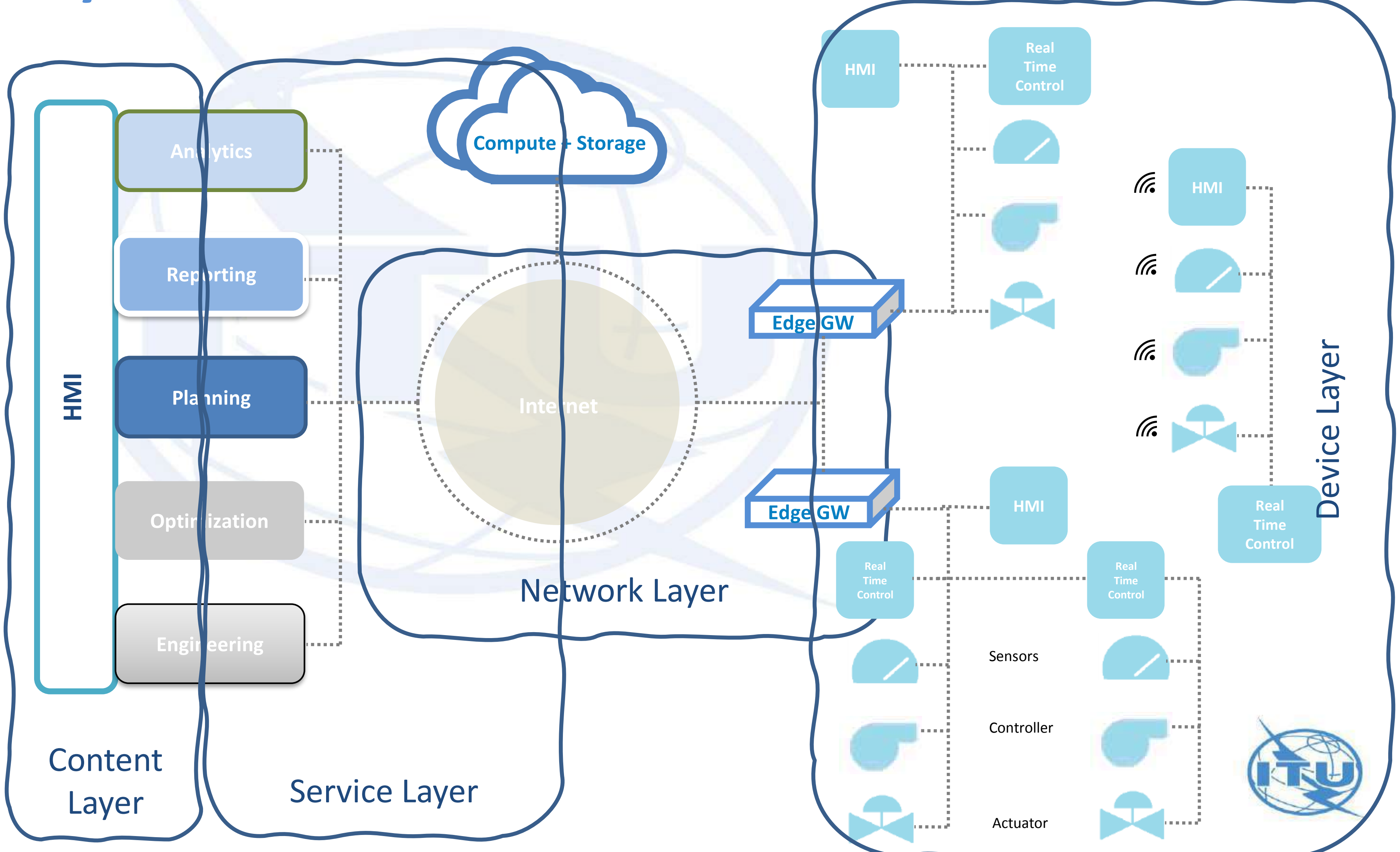
Industrial Internet of Things (IIoT)

- IIoT: Industrial Internet of Things
- Subset of IoT
- Combination of:
  - Software
  - Industrial Machines
  - Industrial Systems
  - Sensors
  - Network
  - Internet and Cloud

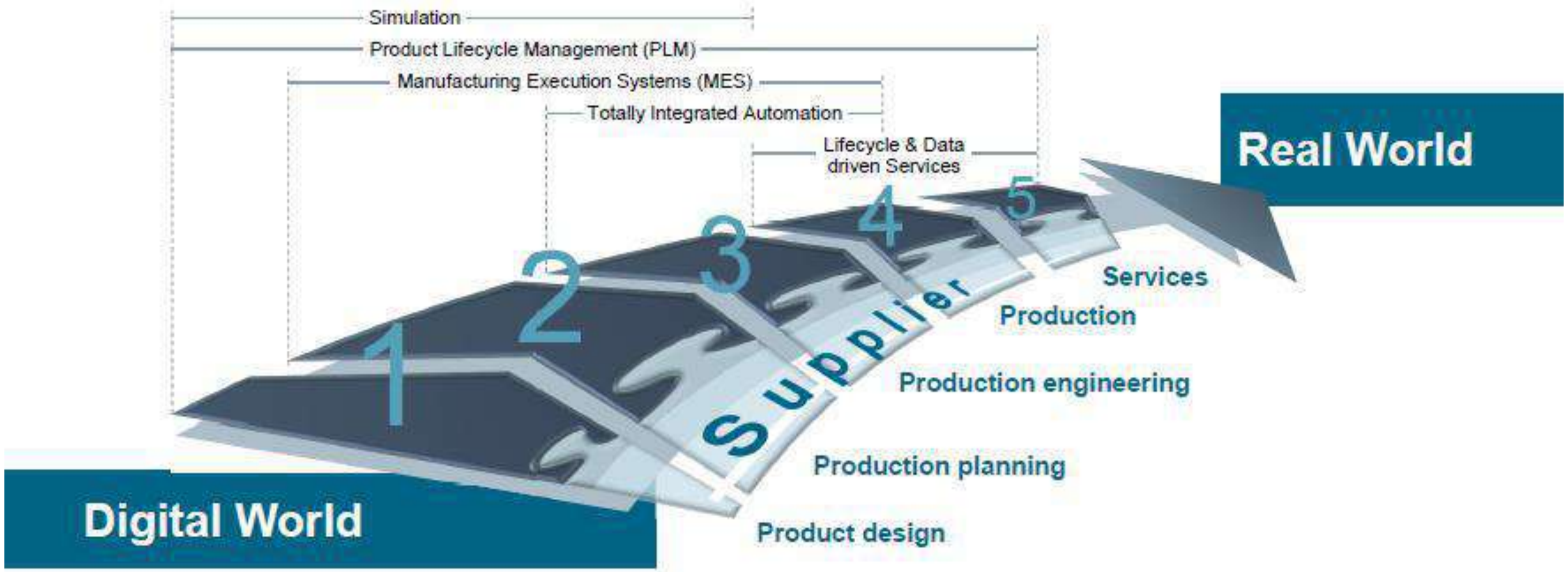


Layered Modular Architecture IIoT

Layered Modular Architecture IIoT	
Content layer	User interface devices (e.g. screens, tablets, smart glasses)
Service layer	Applications, software to analyze data and transform it into information
Network layer	Communications protocols, wifi, cloud computing
Device layer	Hardware: CPS, machines, sensors



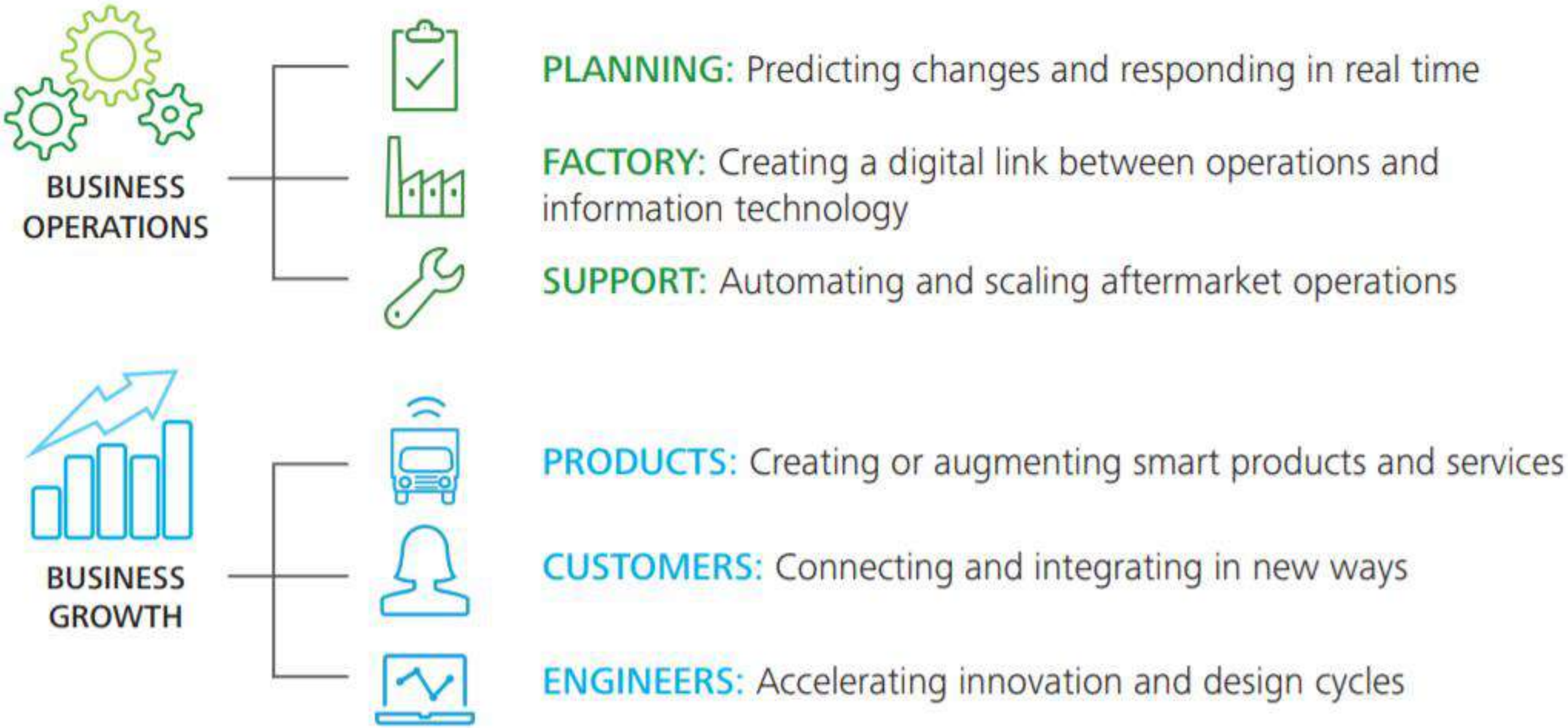
Digital Enterprise:
Entire value chain is digitized and integrated



Potential Implications

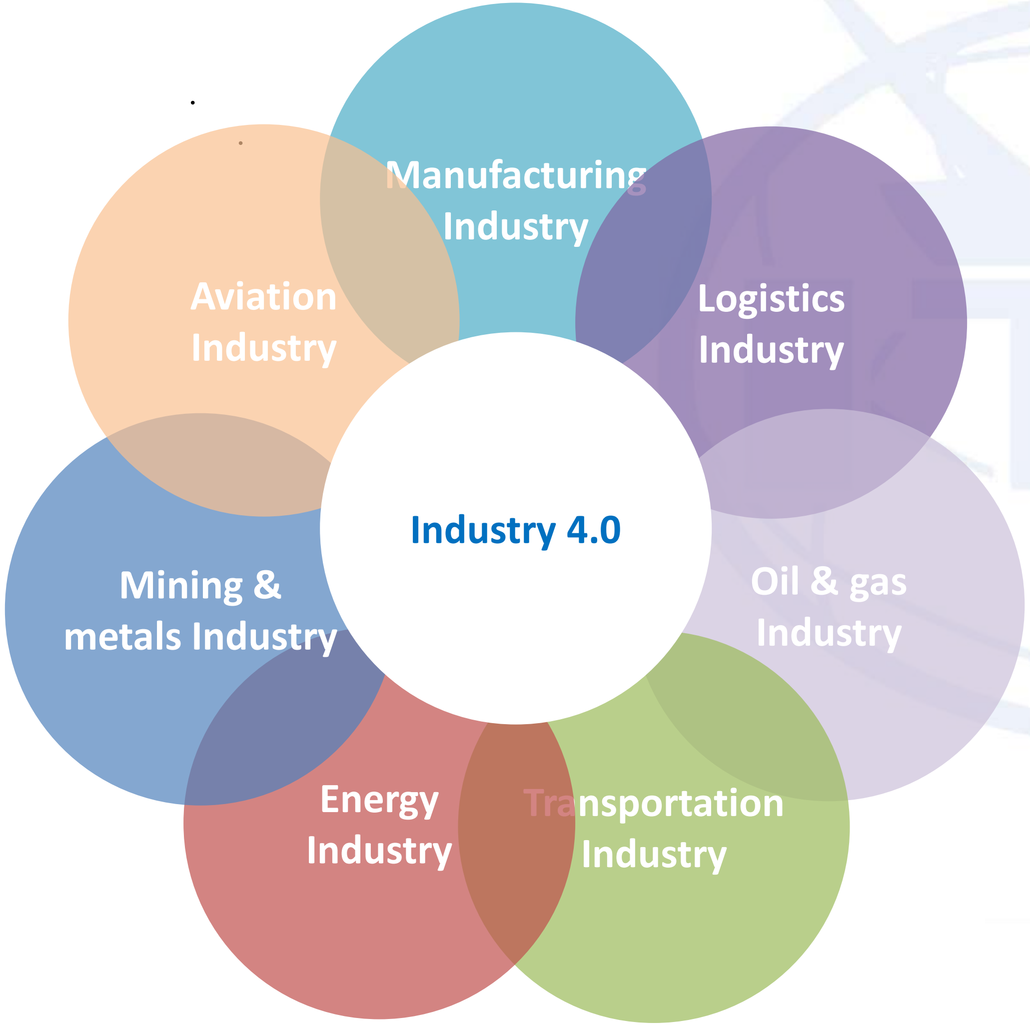
- Robot Assisted production
- Predictive Maintenance
- Additive manufacturing of complex parts
- Machines as a service
- Big data drive quality control
- Production line simulation
- Smart supply network

Business Operating and Growth



https://www2.deloitte.com/content/dam/Deloitte/za/Documents/energy-resources/ZA_Deloitte-Industry4.0-manufacturing-ecosystems-Jun16.pdf

Industries and Applications

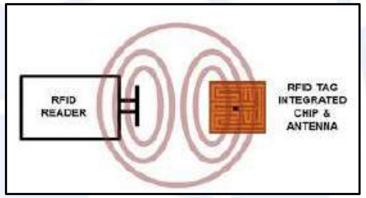


1. INVENTORY MANAGEMENT
2. SUPPLY CHAIN & LOGISTIC OPTIMIZATION
3. PRODUCTION FLOW MONITORING
4. AUTOMATED FACTORY SYSTEM
5. PACKAGING OPTIMIZATION
6. PLANT MONITORING
7. GOODS CARRIAGE WITHIN A PLANT AUTOMATED TRANSPORT SYSTEM
8. Quality Control in Manufacturing Plant
9. QUALITY CONTROL IN MANUFACTURING PLANT

Real World Examples

- BJC HealthCare adopts IoT for inventory and supply chain management
- Big Data decision-making at Bosch Automotive factory in China
- Volkswagen creates Automotive Cloud
- Fetch Robotics help DHL improve warehouse operations
- Racing to win with digital twins
- AR increases productivity at GE

BJC HealthCare Inventory and Supply Chain Management



Manual labor

Loss of stock

Use of RFID Tagging

-23% onsite stock

+ 5M$ /Year

Cost

Efficiency

Bosch Automotive factory: Big Data and Analytics

Big Data

- Too many data sources:
  - Production: equipment fitted with sensors
  - Databases from ERP, CRM and MES systems
- Data analysis
  - Convert data into business insights
  - Optimize the processes
  - Improve the yield

Bosch Automotive Diesel System factory in Wuxi:

- Connects all machinery => Monitor overall production process
- Embed sensors into the factory’s machines
- Collect data about the machines’ conditions and cycle time
- Process the data with advanced analytics tools in real time
- Alert workers of any bottlenecks in the production operations
- Predict equipment failures
- Enable maintenance operations scheduling
- Longer running operations and less equipment downtime
- More 10% output increase
- Delivery and customer satisfaction improve
- Better and faster decision making

Volkswagen Automotive Cloud

- Connected cars are a big new trend in the automotive industry
- Opportunity to offer digital added-value services for customers
- Joined with Microsoft to develop a cloud network, the “Volkswagen Automotive Cloud”
- Aims to add over 10 million Volkswagen per year
- 50 million vehicles with cloud connections within the space of five years

Volkswagen and Microsoft are developing the Volkswagen Automotive Cloud together.

Fetch Robotics DHL Warehouse Operations

Advanced Robotics

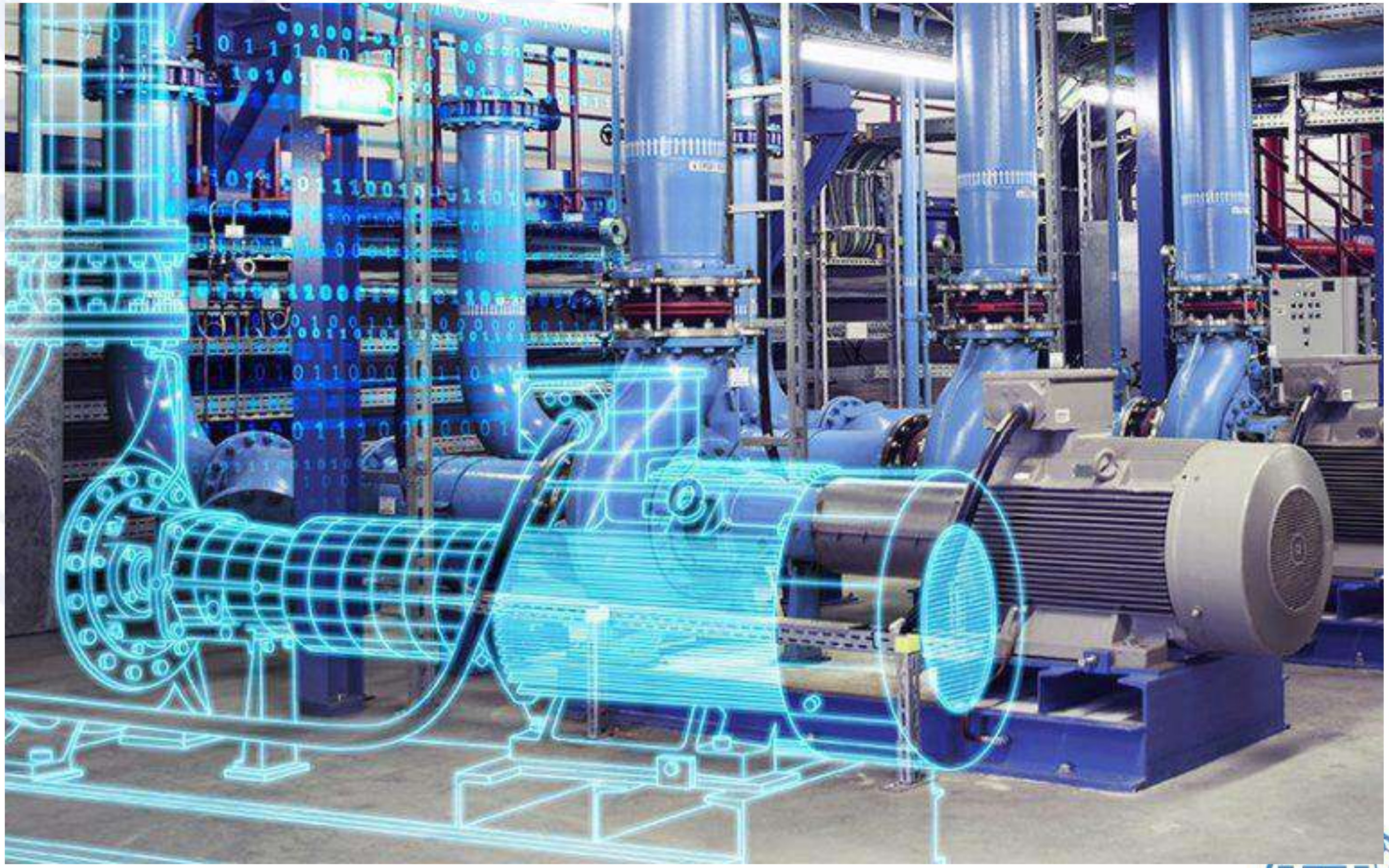
- Industry 4.0 has given new life to robotics => Advanced Robotics
- Advanced robots can recognize, analyze, act, collaborate and learn from human
- Collaborative robots (Cobots): working safely around people

Fetch Robotics

- Autonomous Mobile Robots (AMRs) developed by California-based Fetch Robotics to locating, tracking, and moving inventory in warehouse and logistics facilities
- **Reduce order cycle time by up to 50% and provide up to twice the picking productivity gain**

Digital Twins

- Global research firm, Gartner, predicts that by 2021, 50% of large industrial companies will be using digital twins to monitor and control their assets and processes
- A digital twin is a digital representation of a real-world product, machine, process, or system
- In contrast to engineering simulation: digital twin runs an online simulation (continuous simulation)
- Based on data received from sensors connected to a machine or other device



Siemen's Digital Twin technology can be used to create a virtual version of factory assets [Image credit: Siemens]

Racing to win with digital twins

Team Penske partnered with Siemens
to access to advanced digital design
and simulation solutions
including digital twins

- Speed up the race car development process
- Digital twins provides Team Penske engineers with a virtual test bed for innovating new parts, optimizing car performance before they ever touch the physical car
- A race car digital twin is based on sensors fitted onto a real car
- The Sensors collect data such as tire pressure, engine control and wind speed
- The collected data is converted into a virtual car model
- The model allows engineers to test different design configurations, making effective, data-driven design changes at a very rapid pace

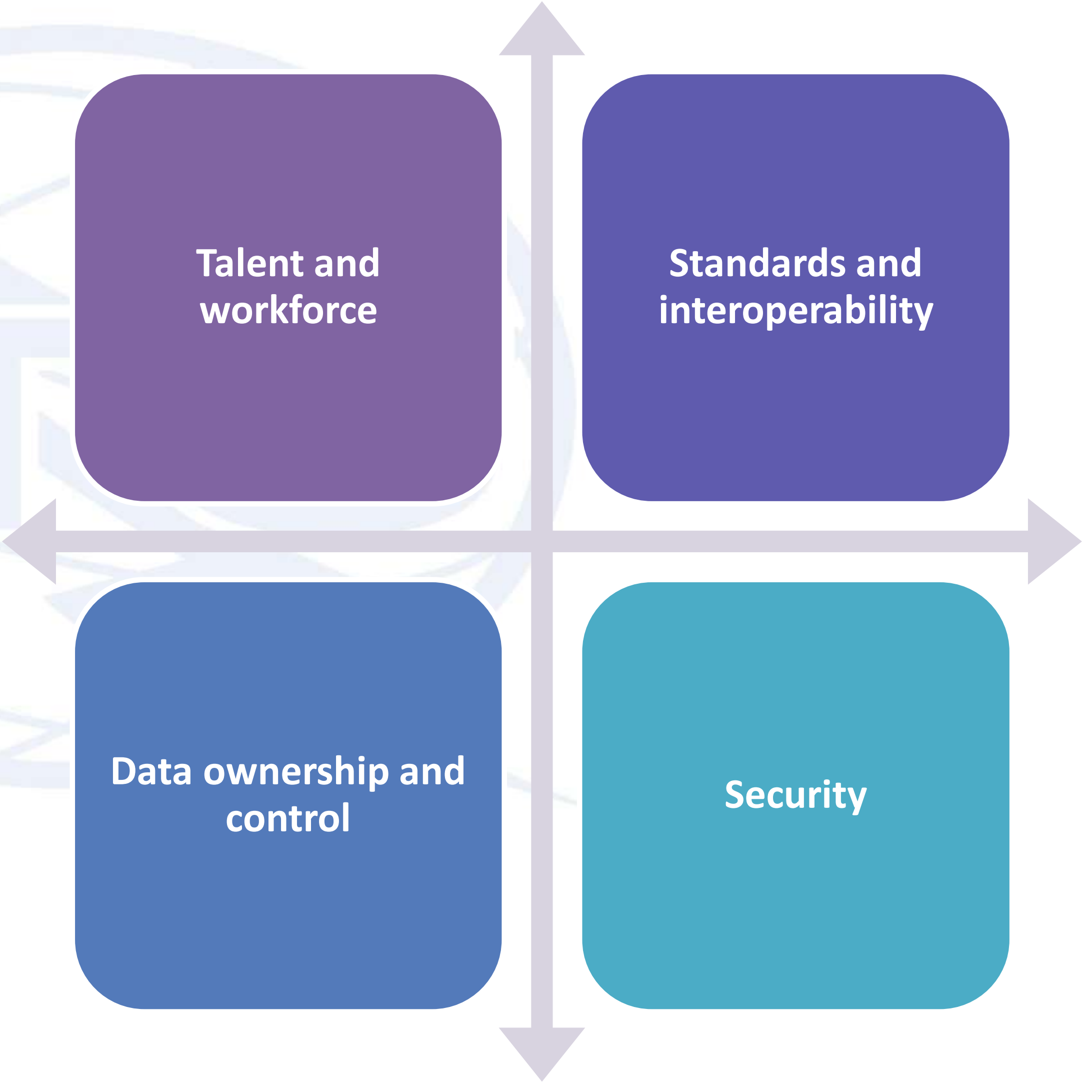
=> Cheaper, more resource-efficient product testing process and a way towards developing faster vehicles

Augmented Reality

- The manufacturing industry is just beginning to explore the benefits of Augmented Reality (AR) technology..
- Augmented reality bridges the gap between the digital and physical worlds by superimposing virtual images or data onto a physical object.
- AR-capable devices, such as smartphones, tablets and smart glasses.
- AR could enable workers to speed up the assembly process and improve decision-making.
- For example, AR glasses could be used to project data, such as layouts, assembly guidelines, sites of possible malfunction, or a serial number of components, on the real part, facilitating faster and easier work procedures.

Industry 4.0 Challenges

Companies implementing or planning to implement Industry 4.0 practices can face several challenges that relate to the management and integration of IT and OT. While some have an organization-level impact, other challenges exist at the broader, ecosystem level. These challenges are heightened as connected technologies evolve at a rapid pace.



Challenges : Talent and workforce

1. Shortage of talented workforce : Need of very high talented workers to plan, execute, and maintain new systems.
2. Change Resistance of leaders: With vast experience in conventional manufacturing, many leaders feel uncomfortable with advanced manufacturing practices
3. Need for a flow of workers: Industrials may include partnering with high schools, technical colleges, and universities to develop an ongoing flow of workers versed in and attracted to advanced digital and physical manufacturing technologies

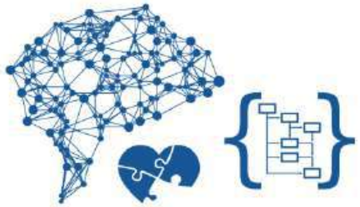
Top 10 Skills to be relevant in Industry 4.0

in 2020

1. Complex Problem Solving
2. Critical Thinking
3. Creativity
4. People Management
5. Coordinating with Others
6. Emotional Intelligence
7. Judgment and Decision Making
8. Service Orientation
9. Negotiation
10. Cognitive Flexibility

in 2015

1. Complex Problem Solving
2. Coordinating with Others
3. People Management
4. Critical Thinking
5. Negotiation
6. Quality Control
7. Service Orientation
8. Judgment and Decision Making
9. Active Listening
10. Creativity



Source: Future of Jobs Report, World Economic Forum

Challenges: Standards & Interoperability

- Wide variety of Systems underly Industry 4.0: Robotics, IoT, Sensors, Cloud, …
- Proprietary systems
- Many competing set of standards
- Integration and interoperability challenges
- Unclear situation: which standard will prevail ?

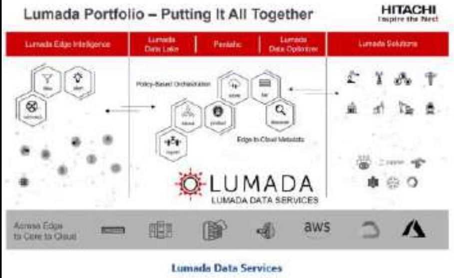
Challenges: Data ownership & control

- More connected stakeholders => Who owns the data ?!
- How to ensure : appropriate privacy, control, and security ?
- Potential claims on the data generated in a particular sphere
- Data ownership and access issues
- Opportunities: Identifying and controlling bottlenecks in the flow of data

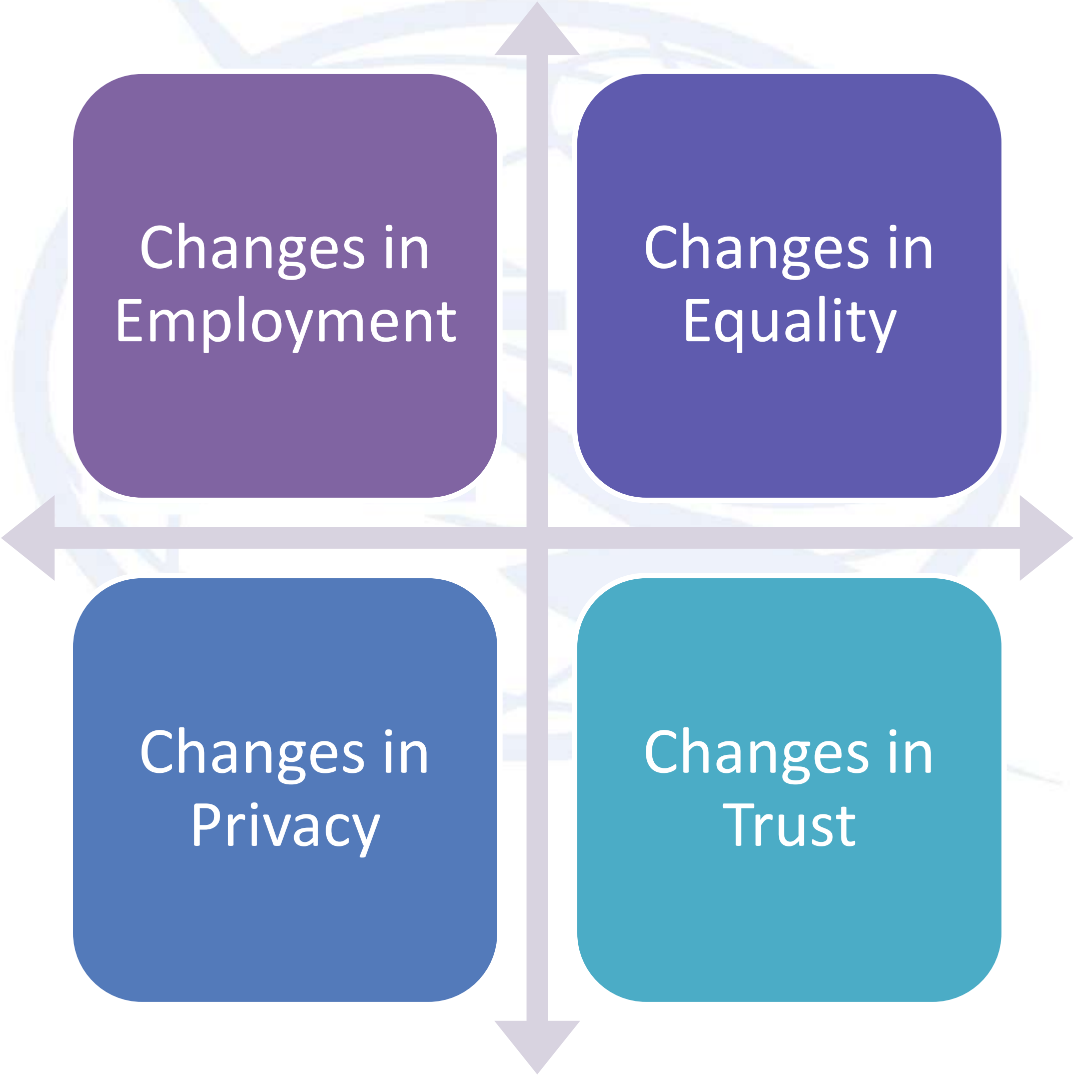
Challenges: Security

- Complex cryptographic algorithms
  - → Improve the security
  - → Higher power consumption
- Retrofitting old systems => increase risks
- More resilient systems and processes
- Proactive cybersecurity plans and solutions

IIoT Platforms

Atos Codex		IBM Watson	ThingWorx A PTC Business
Microsoft Azure IOT			
IoT at Google Cloud Google Cloud Platform	MindSphere by SIEMENS	software AG Cumulocity	AWS IoT

Impact on Society & Individuals



Changes in Employment

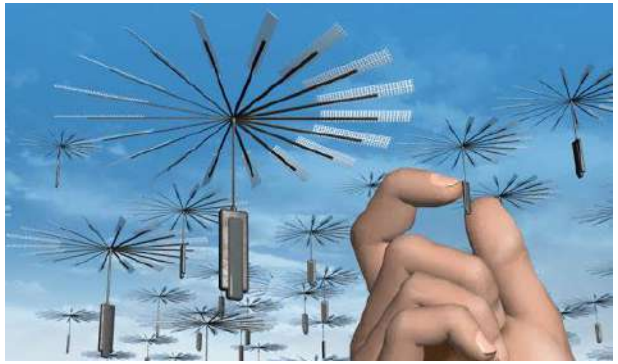
- Artificial Intelligence => More Tasks Automatization
  - → Higher productivity
  - → Employment loss
- New kind of Jobs for human:
  - – More Creative & Collaborative Tasks
  - – More complex problem-solving tasks
- Disadvantage under skilled or under-educated people
  - → Need for continuous training/lifelong learning

Changes in Equality

- Risk of more disparities:
  - →Economic benefits are more concentrated among a small group
  - → Lead to political polarization, social fragmentation, and lack of trust in institutions
- Recommendations
  - →More inclusive development
  - →Equitable growth to lift all people

Challenges in Privacy

- Billions of 3D-printed cameras and sensors:
  - → Traffic reports
  - → Natural disasters
  - → Human activities monitoring
- Consumers loyalty to Product and business with:
  - – Transparent data collection practices
  - – Priority to consumer privacy



Challenges in Trust

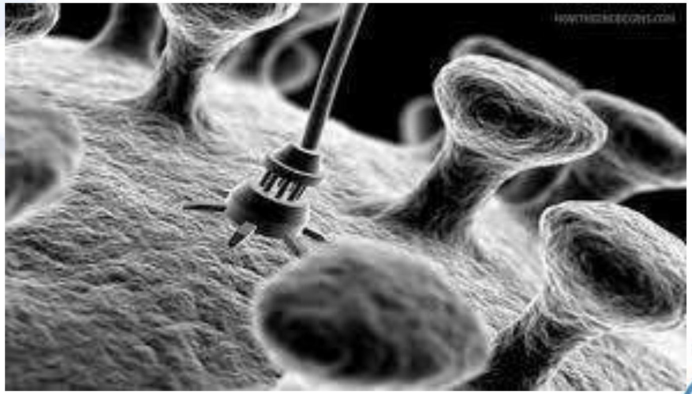
- Public trust is falling :
  - In Business
  - In government
  - In the media
  - In technology
- Technologies are neutral => Problems are in application
- All contributors must collaborate to achieve common objectives:
  - More transparency
  - Security models

Case study: Smart Dust

MicroelEctroMechanical Systems (MEMS) or **Motes**

- Small as grain of salt and has:
  - Sensors
  - Camera
  - Communication mechanisms
- Suspended in whatever environment like a grain of dust and can
  - Collect data including acceleration, stress, pressure, humidity, sound and more from sensors
  - Process the data with what amounts to an onboard computer system
  - Store the data in memory
  - Wirelessly communicate the data to the cloud, a base or other MEMs

Practical Applications of Smart Dust



- To monitor crops to determine watering, fertilization and pest-control needs.
- To monitor equipment to facilitate more timely maintenance.
- To Identify weaknesses and corrosion prior to a system failure.
- To enable wireless monitoring of people and products for security purposes.
- To measure anything that can be measured nearly anywhere.
- To enhance inventory control to track products from manufacturing facility shelves to boxes to palettes to shipping vessels to trucks to retail shelves.
- In healthcare industry : from diagnostic procedures without surgery to monitoring devices that help people with disabilities interact with tools that help them live independently.

Disadvantages of smart dust

Privacy concerns

- Record anything
- Very small => difficult to detect
- Hacking, military, terrorism

Control

- Billion of Mems deployed in one area
- Problem to retrieve or capture
- Problem to detect them
- Challenge to the authorities to control

Cost

- Still in conceptual stage
- Miniaturization cost still high
- Technology out of reach for many

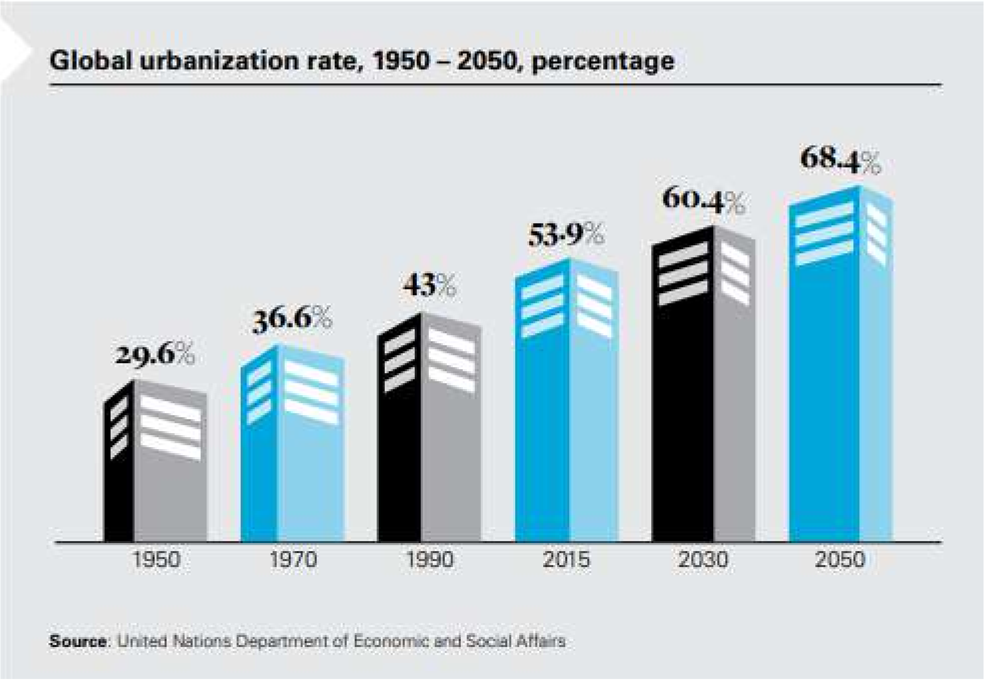
Thank you!

PRIDA Track 1 (T1)

Smart cities and IoT applications

09/10/2020

Increase of urbanisation



Increase of urbanisation

Among the current 28 mega-cities, 16 are located in Asia, 4 in Latin America, 3 in Africa and Europe and 2 in North America.

In 2030, the world is expected to have 41 mega-cities of more than 10 million inhabitants each.

Tokyo
Population 2030:
37 million

Delhi
Population 2030:
36 million

Mexico City
Population 2025:
24.6 million

Source: United Nations, Department of Economic and Social Affairs Statistics, Frost & Sullivan and other regional and country level statistics bureau

Smart city drivers

Various urban problems caused by urbanization	ICT & IoT development	Higher Expectation for Cities
		
Urban problems caused by urbanization and overcrowding (e.g. pollution, congestion, crime, natural disasters, etc)	Technological convergence in various fields such as construction, energy, construction, transportation, etc	Demand for cities with decent living conditions (e.g. sustainable cities, human-oriented cities)
Housing insecurity and regional imbalance hinders urban growth and accelerates decline	Increasing use of the ICT across industries	Demand for eco-friendly cities that harmonize human, nature, and technology

So what solutions for these challenges?

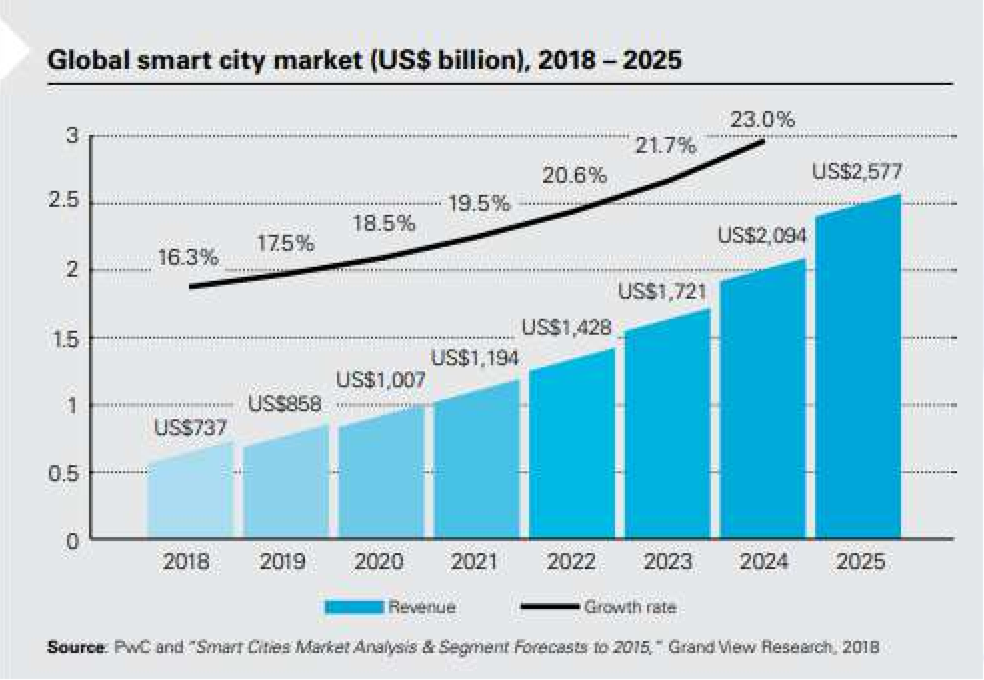
The smart city is a step towards a better living environment for Citizen and better sustainability for the city and for the planet.

Definition - ITU

“ A smart and sustainable city is an innovative city that uses communication and information technologies (ICT) and other means to improve the quality of life, the efficiency of urban operations and services, and competitiveness, while ensuring that needs of present and future generations in terms of concerns economic, social and environmental ".

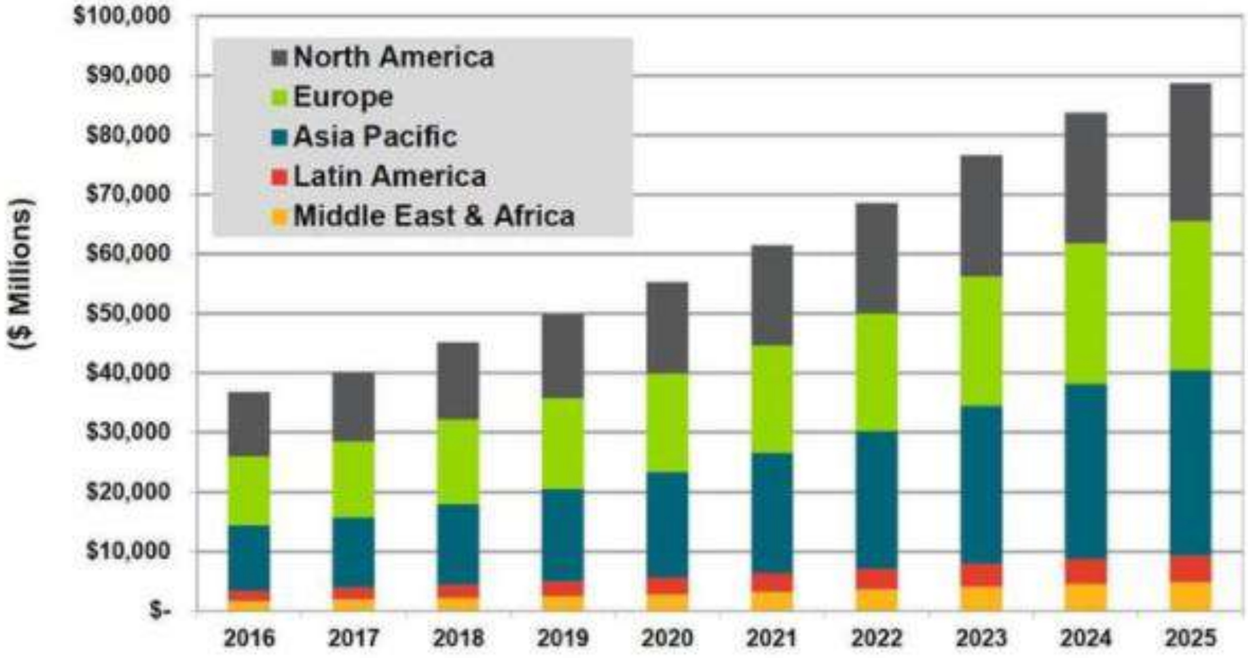
Enabling technologies

Global smart city market



Smart city revenue by region

Chart 1.1 *Annual Smart City Revenue by Region, World Markets: 2016-2025*



(Source: Navigant Research)

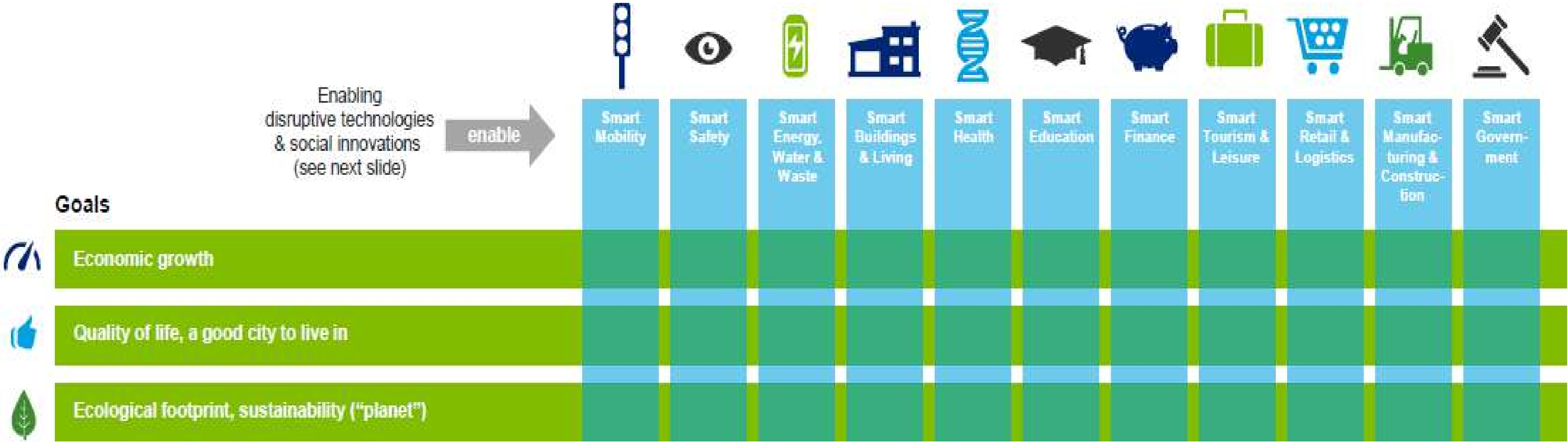
Some examples of smart cities benefits

- Transport
  - Reduction of congestion and pollution thanks to an optimal use of transport infrastructure (roads, car parks)
- Energy
  - Energy savings through real-time insight in energy usage.
  - Energy savings through real-time insight in energy usage, combined with gamification concepts.
  - Transformation of waste into energy.
  - Analysis of data provided by sensors in the water distribution network identifies leakages and allow fast repairs.

Some examples of the benefits of smart cities

- Safety and security of the city
  - Faster reaction to public safety threats by real-time analysis of sensor and surveillance camera video data
- Health
  - Better diagnostics and personalized treatment through artificial intelligence on massive volumes of patient data
  - People who need care can live in their own home longer through advanced sensoring and health care robotics
- Transportation
  - Lower congestion and pollution through optimal use of transportation infrastructure (roads, parking places)
- Governance
  - Dynamic groups of citizens organize themselves to work together on collective interests.
  - Co-creation and decision-making, new forms of digital democracy, and participatory government.
  - Data-driven policy making.

Smart cities emerge as the result of many smart solutions across all sectors of society



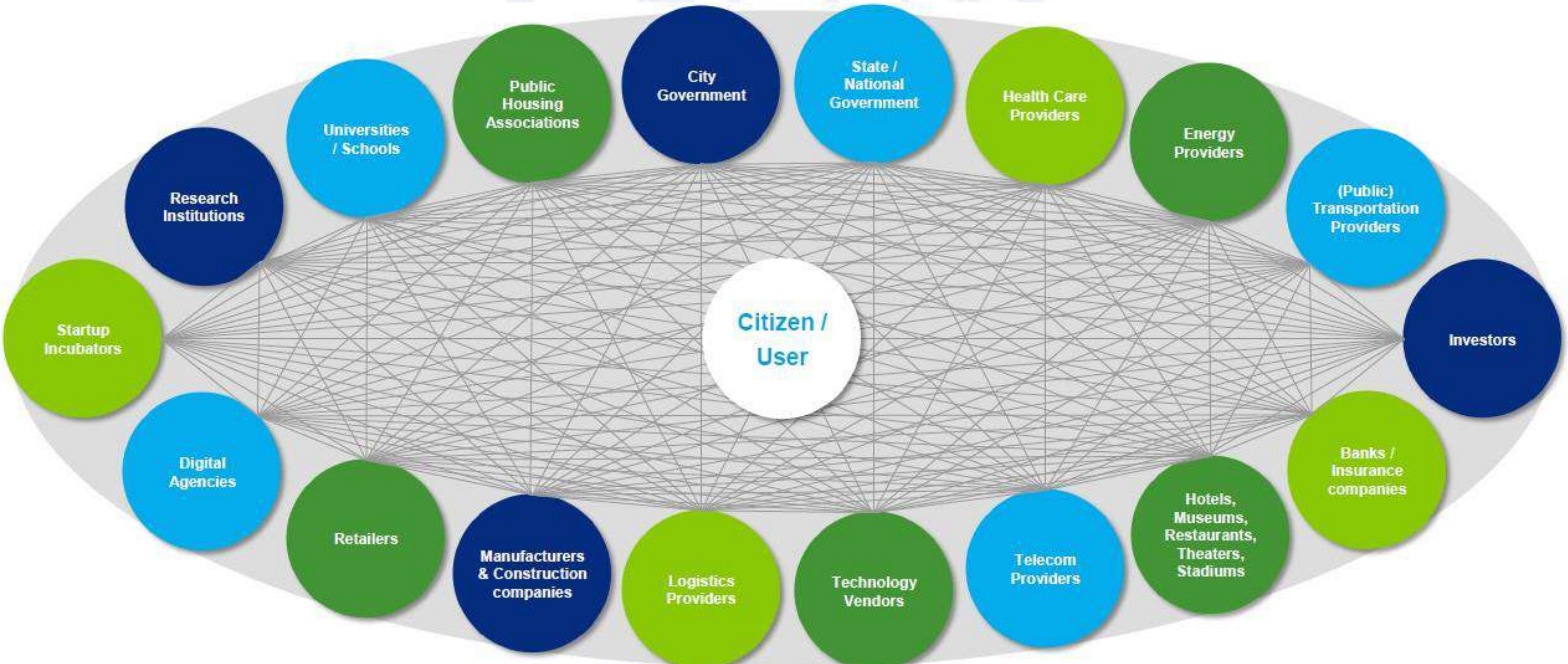
Dimensions of a smart city

Smart infrastructure (competitiveness)	Intelligent individuals (capital social and human)	Smart Gouvernance (participation)
• Safe and innovative • Availability of ICT infrastructure • Productivity • Processing capacity	• Qualification level • Flexibility • Creativity • Competitiveness • Open mind • Participation in public life	• Participation in decision making • Transparent governance • Public and social services
Smart mobility (transport and ICT)	**Intelligent environment (natural resources)**	**Smart lifestyle (quality of life)**
• Local accessibility • Availability of ICT infrastructure • A sustainable, safe and innovative transport system	• Sustainable management of resources • Protection of the environment	• Improved conditions sanitary • Educational facilities • Cultural facilities

Dimensions of a smart city

Intelligent services (reliability)	Intelligent security (safety)	Smart connectivity (price affordable)
• Availability of services • Optimization of resource performance • Timely information real • Prevention of loss of utility	• Safety of women, children and tourists in the city	• Participation in decision making • Availability of online services anywhere in the city • Local accessibility

Smart city stackeholders



Smart city ecosystem

- The smart city ecosystem is complex due to the multiplicity of stakeholders involved in:
  - Government : Mayor, City Council, Municipality, utility authorities, service providers, etc.
  - Investors
  - Citizens
- A smart city is the result of the efforts of many stakeholders, that working together in different forms of partnership.
- The citizen user is at the center of the map, indicating that successful smart cities are always user-centric.

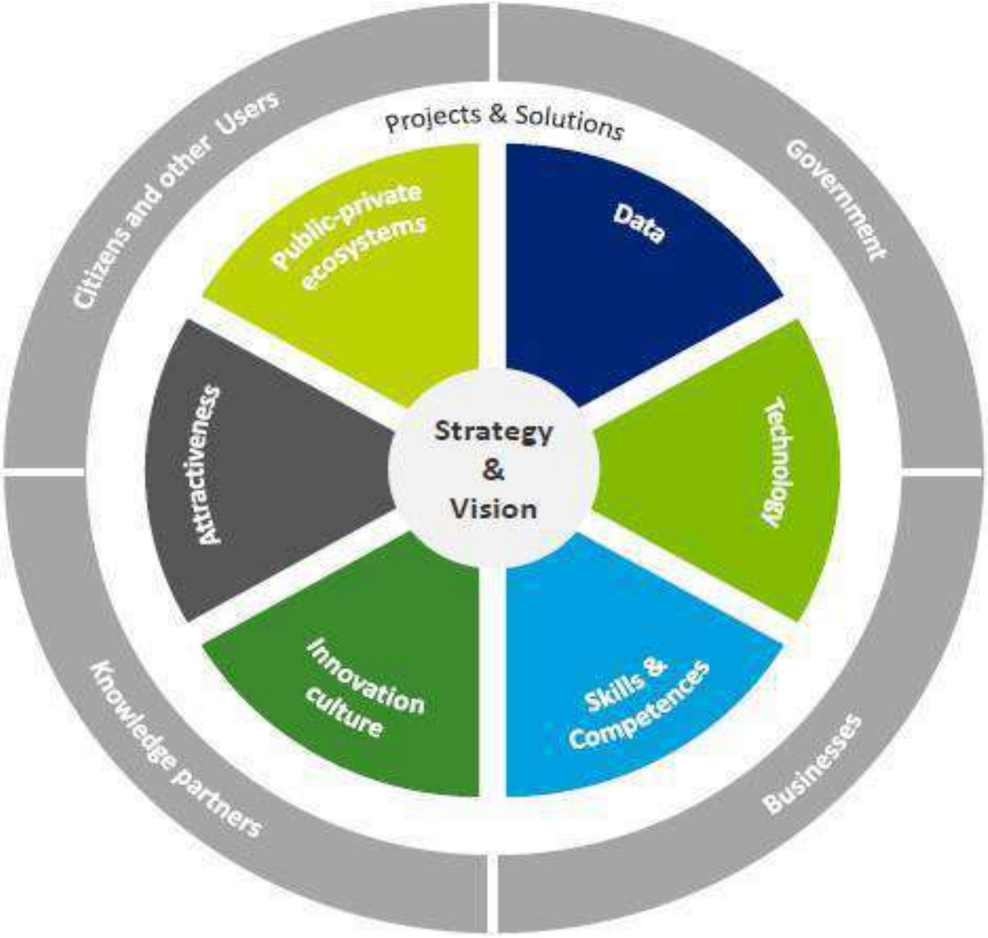
Role of government

- Defines a clear vision of the city to be built, the strategy to achieve it as well as the associated action and investment plans.
- Creates or adapts laws and regulations to enable new business models while protecting the interests of citizens and city users.
- Bring together the actors of the smart city ecosystem to offer new creative solutions and innovative business models.
- Stimulate the development of innovative solutions by acting as a launch customer.
- Secure transport infrastructure, energy networks and communication networks and ensure that the necessary measures are taken to make these infrastructures resilient and secure.
- Create an environment conducive to innovation; for example by providing “open data” and by supporting the development of startups.

Role of the citizen

- The citizen is at the heart of the smart city. He engages with the city government in different roles:
  - He pays the taxes and expects the government to spend tax money wisely.
  - The citizen as a partner expects to be involved in the process of making policy and making judicious choices in land use planning, economic development, social services and education.
  - The citizen as a voter expects to be represented by elected politicians, who have a clear vision and keep their promises.
  - The citizen as a local resident expects their living environment to have a certain quality: clean, ecological, and accessible.
  - The citizen as a resident expects their city to be secure and resilient.

Capacities of a smart city



Capacities of a smart city: Vision and strategy

- Smart cities should have a clear vision of what they want to be and a strategy to achieve that ambition.
- Each city has its own strengths, challenges and opportunities.
- A smart city harnesses the power of technology and social innovations to leverage existing strengths, address challenges, and create new opportunities.
- Having a clear vision allows a city to focus its energy and resources on what brings the most value to the city, not only in the short term but also in the long term.

Capacities of a smart city: Vision and strategy

- The development of smart cities is often motivated by three strategic objectives:
  - Societal: Improving the quality of life of citizens.
  - Economic: Country's economic growth and attractiveness.
  - Environmental: Protection of the environment.

Source: https://ant.cerema.fr/sites/ant/files/fichiers/2018/09/rapport_cgdd_villes_intelligentes_smart_agiles_-__copy.pdf

Capacities of a smart city

- Data - A true smart city emerges when data is combined from multiple sources.
- Skills and competences - The use of disruptive technologies for innovation requires new skills and competences in the city, particularly in the “data scientist”.
- Openness to innovation and new ideas - Achieving a smart city requires openness to new creative ideas, the willingness to experiment and take risks. This requires trying new types of collaboration between different government departments, investors, research institutions.

Capacities of a smart city

- Attractiveness of investors and talents - cities must have an active policy to attract investors and businesses. They must also create a climate in which startups can develop.
- Private-public ecosystems - Smart cities require public-private ecosystems to co-create smart and creative solutions.
- Projects and solutions - Technological innovations must be combined with social innovations to create solutions. Examples of such social innovations are: co-creation and the sharing economy.

Development strategy of a smart city

Source: PWC Smart Cities Development Strategy, 2020

Institutional strategy

- The Smart City Program needs an institutional and governance structure to balance both top-down and bottom-up governance approaches.
- It is important to manage a good balance of governance at the municipal and national levels in order to break down the silos between the different government services and to take advantage of the synergy between the different stakeholders (such as universities, the private sector, civil society and local and municipal governments).
- Example: creation of a National Smart Cities Coordinating Committee which has to overcome barriers and obstacles and ensure that successes can be replicated.

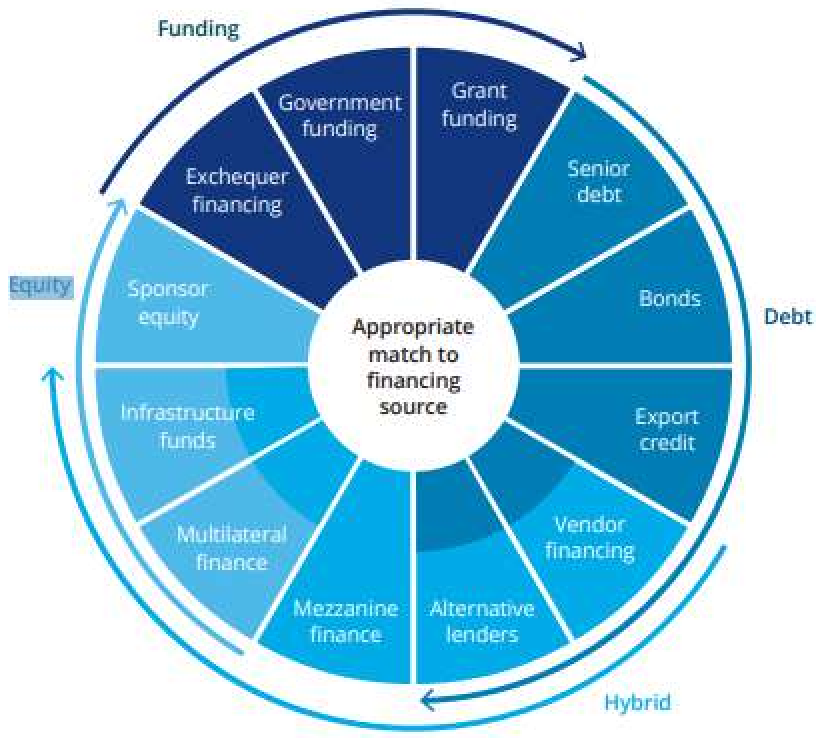
Funding strategy

- Smart city projects will require long-term investment for the development of infrastructure and services based on information technology.

- Municipal governments are unlikely to have the resources to fund and manage smart city projects independently.

- It is therefore the responsibility of the national government to ensure a substantial and dedicated revenue stream for smart city projects, as these projects will create infrastructure for public interest.

Financing options for developing economies



Programs & Projects Strategy

Project start

- Team setup
- Preparation of detailed project report

Call for tender

- Publication of he call for tenders
- Evaluation of offers
- Selection of suppliers

Execution of Project

- Field study
- implementation

Monitoring of Project Progress

- Progress material
- Financial progress

Process of resolution

- Research of consensus
- Innovation

Common framework

- Guidelines & Designs policies public

Commitment of communities

- Feedback & Suggestions during the designs & execution

Evaluation

- Evaluation external

Case study

- Documentation
- Seminars
- Learning

Completion of project

- On-line
- Setting Surgery & Maintenance
- Diffusion & Promotion

Ad hoc structure

Municipal municipalities

National Coordination Committee

Source: PWC Smart Cities Development Strategy, 2020

Action plan

- Collaborate: Cities must respond to the needs of all sectors of society and work with communities, NGOs, universities and the private sector; thus, they can become sustainable, citizen-centered, economically dynamic, accessible, resilient, responsive and well governed.

- Cultivate and encourage innovation: Cities need to experiment and adopt new technologies and new business models.

- Create an environment conducive to business: It is clear that municipal governments will need the support of the private sector to develop cities. Municipal governments will need to understand and respond to the needs of the private sector and create projects that balance risks and benefits

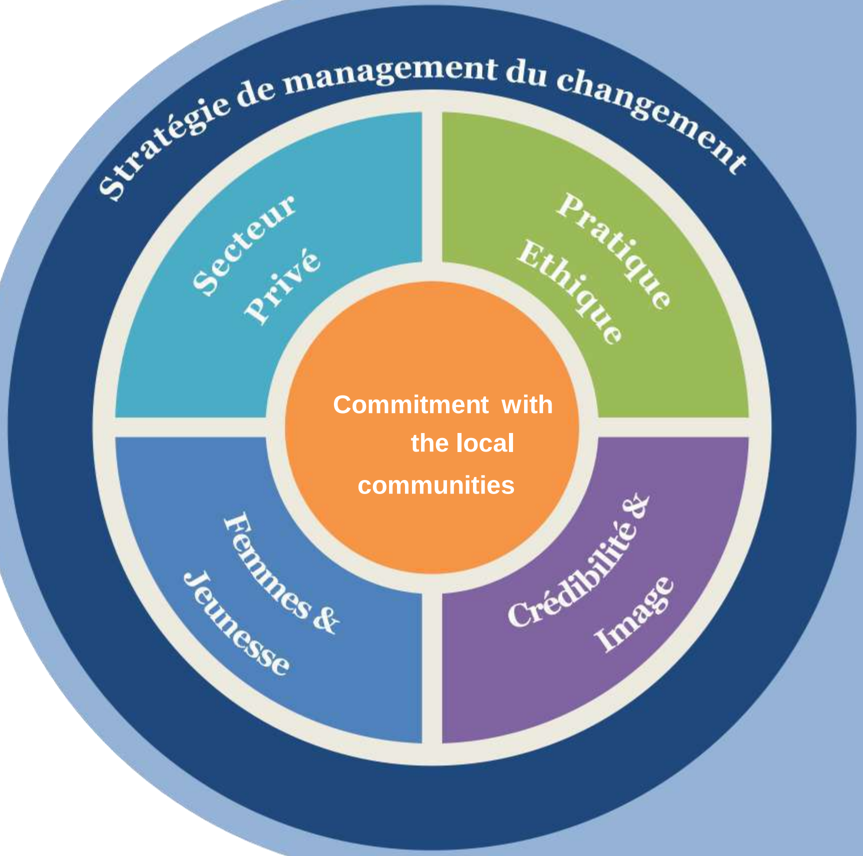
- Show leadership: City leaders must be both visionary and pragmatic to advance the desired transformation. They will need to take calculated and well-informed risks and refrain from assuming the default position of risk aversion.

Action plan

1 Identification de la ville	2 Identification des défis principaux	3 Développement d'une Vision Partagée	4 Identification et Priorisation des Objectifs	5 Développement des Programmes
Chaque ville possède un ensemble unique de caractéristiques économiques et sociales. Il est important qu'une ville identifie ses caractéristiques uniques et s'appuie sur celles-ci.	Sur la base de la préparation du profil de la ville et grâce à l'engagement des parties prenantes, identifier les principaux défis auxquels la ville est confrontée. Une fois ces défis identifiés, établir un ordre de priorité.	Une ville doit développer une vision à long terme pour renforcer ses caractéristiques clés et surmonter les défis urbains.	Les priorités dépendront de facteurs tels que l'impact du défi, l'ampleur du défi, la transformation souhaitée, la capacité à conduire le changement, l'importance dans la vision globale, etc.	Lorsque les villes élaborent des programmes pour atteindre leurs objectifs, l'accent doit être mis sur les résultats des projets. La conception des solutions doit être laissée au secteur privé afin que des solutions innovantes puissent être introduites.

6 Révision des Régulations	7 Développement des Capacités	8 Financing et Funding	9 Objectifs de Quick Wins	10 Gestion des avantages et Suivi
Au moment où les villes se lancent dans le renouvellement urbain, elles tireront parti de modèles d'activités disruptives qui ne s'intègrent pas parfaitement dans le cadre réglementaire traditionnel.	Les capacités techniques et de gestion devront être renforcées par un soutien externe dans les cas où les capacités internes ne peuvent être développées en même temps.	Les villes devraient concevoir des programmes de renouvellement urbain qui sont financièrement viables.	Les méthodes agiles de développement de projets ou les projets pilotes peuvent aider à présenter des résultats intermédiaires. Ces résultats peuvent servir à attirer des investissements, des ressources humaines et des solutions innovantes.	Les projets doivent être suivis régulièrement pour s'assurer que les dépassements de coûts et de délais soient réduits au minimum et que la qualité souhaitée soit atteinte.

Change management city



Engagement with local communities
Consulting the community from the planning stage will take into account local their and improve project design.

Engagement with the private sector
Private companies should promote constructive dialogue with the public sector to build trust and guarantee their commitment.

Focus on Women & Youth
Social inclusion in the smart city relies on awareness of and access to ICTs, especially among women and youth.

Ethical Practice
Unethical behavior is not only unacceptable, but also poses a great risk to the success of Smart City program.

Image, Credibility & Positioning
Smart city projects are developed in a city and have an impact on its image and credibility. A poor ranking or a negative impression can lead to changes in its positioning in public opinion.

Key Success Factors of Smart City program

Leadership & Governance	• Level of Leadership Commitment • Effective City Mgt.- learning form best practices • Strategic and transformational mind-set for smart initiatives
Stakeholder Engagement and Citizen Focus	• Stakeholder engagement and citizen/customer focus • Support business, community & academic smart city activities • Social inclusion
Effective Use of Data	• Openness and sharing of data based on agreed regularity policies • Data interoperability (use of common standards)+ Availability of City data analytics • Data privacy and data security based on standard policies and processes
Integrated ICT Infrastructure	• Reliable ICT resource mapping and management • Progress in developing a city-wide ICT architecture • IOT Integration and Cloud computing
Levels of Smartness	• Smart core infrastructure smart management of water, gas, ICT, waste and energy • Smart Facilities and buildings • Smart core services (education, health, legal, safty,..)Environment

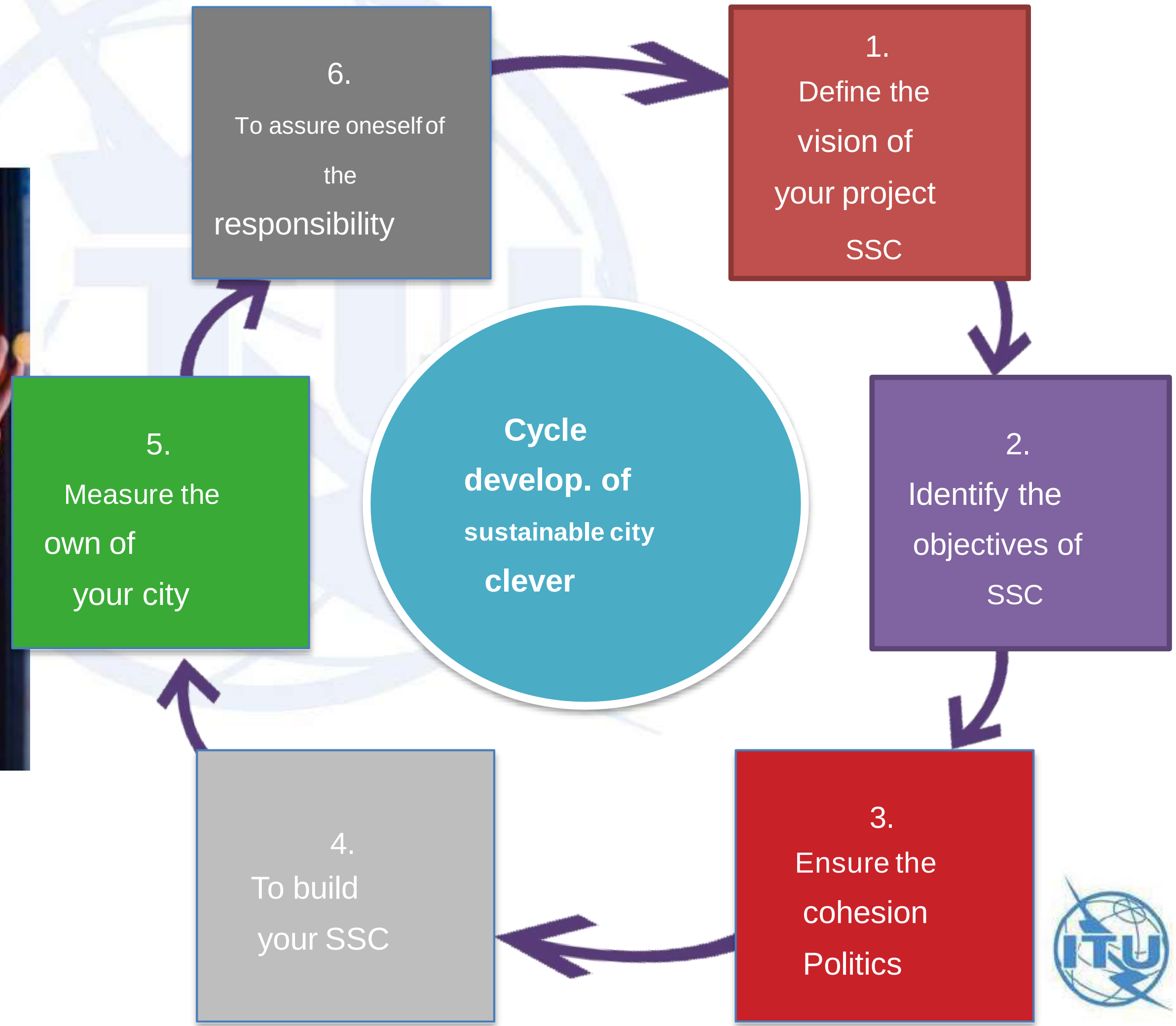
Joint ITU-UN KPI for Smart Sustainable Cities

ITU-T Recommendation

Y.4903 / L.1603


How do we shape
Smarter and More
Sustainable cities
10

ITU KPI for SSK - Path to smart and sustainable cities



Why KPIs for SSC?

How? 'Or' What do we know that our city is smart and sustainable?

KEY PERFORMANCE INDICATORS FOR SSC

3 Technical specifications and 1 Technical report on KPIs for SSC

ITU's Smart Sustainable Cities KPI Project

Dubai

Singapore

& other cities..

Measure the success

Guidelines and recommendations of policies

Global index cities intelligent and durable

These key performance indicators (KPIs) are international standards

IFP structure

54 basic indicators + 37 leading indicators

20 intelligent + 32 structural + 39 sustainable

132 data collection points

Dimension

- Economy
- Environment
- Company and culture

Category

Economy
- ICT infrastructure
- Water and sanitation
- Drainage
- Supply of electricity
- Transport
- Public sector
- Innovation
- Employment
- Waste
- Buildings
- Town planning

Environment
- Air quality
- Water and sanitation
- Waste
- Quality environmental
- Public space and nature
- Energy

Company and culture
- Education
- Health
- Culture
- Housing
- Social inclusion
- Safety
- Food Safety

Indicators base: 22

Indicators advanced: 16

Indicators base: 19

Indicators advanced: 7

Indicators base: 9

Indicators advanced: 16

Structures and properties of KPIs

- Simplicity: the concept of each indicator should be simple and easy to understand by stakeholders.
- Measurable: KPIs should be quantitative, and historical and current data should be available or easy to collect.
- Comprehensiveness: The set of indicators should cover all aspects of CSS.
- Relevant: KPIs should give a better overview of the city's performance in achieving its strategy

Prepared By Mohamed Abdelghader Morsi

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Internet of Things

IOT

- **The** term "Internet of Things" has come to describe a number of technologies and research disciplines that enable the Internet to reach out into the real world of physical objects.

Benefits

- This shift in area of focus from internal to external naturally changes the benefits expected out of IoT from a bottom-line focus for improving the utilization and eventually cost reduction to a top-line focus for improving revenue and to implement new revenue streams. The top rated benefit is "for implementing new revenue streams," by 22% of CIOs. Implementing new revenue streams by itself requires that a transformation should happen to the business and its model of working and cannot be just an incremental improvement on existing systems and processes.

Smart Waste Management System

Feature	Requirement	Comment
Network Area	Wide area	
Spectrum	shared	2.4 GHz
Connectivity cost	Medium	
Module cost	Average	
Bandwidth	High	
Connection technologies	Cellular and Wide area technology	The authority at the central office conveys this notification to the garbage collecting van through the GSM module. GSM is interfaced with ARM microcontroller through MAX232 chip that checks compatibility between the GSM modem and ARM microcontroller.

Analysis of Smart Waste

GSM

cloud service provider.

Architecture OF **Smart Waste Management**

- 1) Level sensor: The level sensor will provide continuous information of level of dustbin filled. On reaching a threshold, an alert needs to be generated for the collection of garbage.
- 2) Humidity sensor: The humidity sensor will provide information related to the presence of wet waste in the dry waste bin.
- 3) Load cell: The load cell will provide information related to the weight of the garbage in the dustbin.
- 4) On checking for two of the parameters- level sensor and load cell, the error rate of false alarm will greatly reduce. The micro-controller used will be Raspberry-pi 3, which has an inbuilt Wi-Fi module. The information from master bins will be continuously streamed to the cloud using Wi-Fi module.

1- **Ultrasonic sensor**: Ultrasonic sensor will be used to detect the level of garbage filled in the dustbin. The level of garbage will be depicted in terms of distance between the sensor and garbage in dustbin. This module has 4 pins- VCC (5V), Trig, Echo and GND. Trig have to be used to send out an ultrasonic high level pulse for at least 10μs and the Echo pin will then automatically detect the returning pulse. Sensor will calculate the time interval between sending the signal and receiving the echo to determine the distance. Working frequency of ultrasonic sensor is 40Hz. Max range and min range is 4m and 2cm and measuring angle is 15 degree.

2- Humidity sensor: The temperature and humidity sensor have to be used to distinguish between dry and wet waste. For this purpose DHT11 sensor will be used. Depending upon the output temperature, dry and wet waste would be differentiated. The DHT11 is a high precision digital humidity and temperature sensor. It uses a capacitive humidity sensor and a thermostat to measure the surrounding air, and spits out a digital signal on the data pin. Sensor will only get new data from it once every 2 seconds. It will be good for 0-100% humidity readings with 2-5% accuracy and for -40 to 80°C temperature readings ±0.5°C accuracy

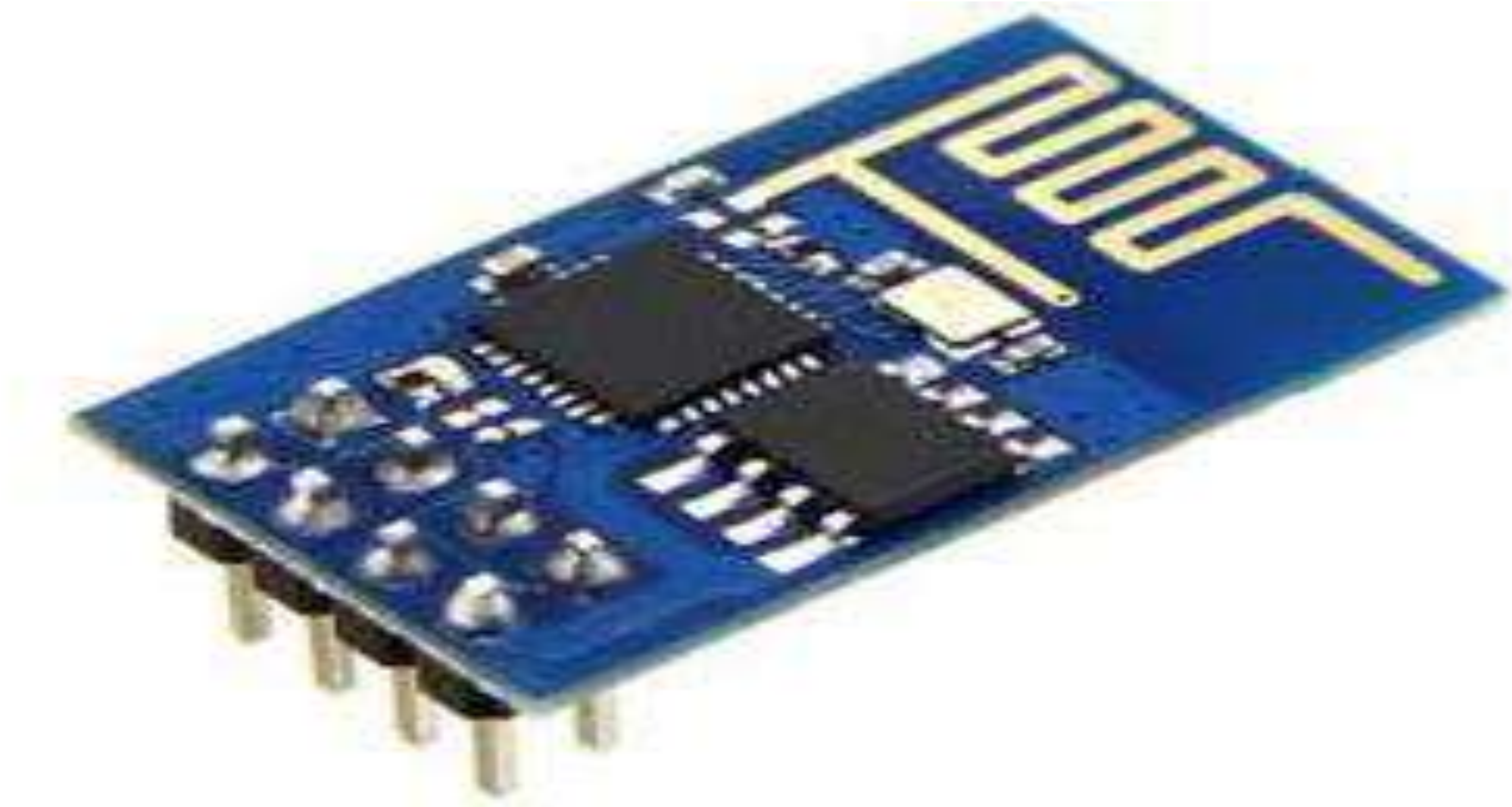
- **Load Cell:** The load cell needs to be used to weigh dustbin. A load cell is a transducer that creates an electrical signal whose magnitude is directly proportional to the force being measured. The load cell ranges from few grams to 200 kg. The electrical signal output will be typically in the order of a few mill volts and will require amplification before it can be used. The HX711 load cell amplifier has to be used to get measurable data out from a load cell

- **Raspberry pi**: The information collected by sensor will be processed by micro-controller. For this purpose raspberry pi 3 model B needs to be used. Raspberry-pi 3 is based on Broad-com BCM2837 SoC with a 1.2 GHz 64-bit quad-core ARM Cortex-A53 processor

Raspberry Pi 3

- **Serial Wi-Fi wireless transceiver module: ESP8266**
- is a chip which is wireless network micro-controller
- module. It will be a system-on-a-chip (SoC) with
- capabilities for 2.4 GHz Wi-Fi, general-purpose
- input/output etc.

ESP8266



How Use IOT to Management of Waste

- garbage bins will be classified as master dustbins and slave dustbins. Master dustbins will be
  equipped with Raspberry Pi and slaves with IoT module.
- A database will be maintained containing the information about which dustbin to be
  placed in which area by their corresponding ids.
- apply noise removal algorithm and send data to server using Wi-Fi.

- The message has to be sent to server by raspberry-pi 3 about levels of garbage in a bin, wet and dry waste segregation levels along with dustbin id.
- Server matches ids with database of dustbins, and will find levels of dustbins located in different areas of city.
- Different IoT protocols can be used for data transmission like MQTT or COaP
- The collected data in cloud will be analyzed by using analytic tool like Hadoop or Storm, and useful information regarding waste management will be extracted.

- From the collected the data, user will get to know about real-time garbage level, and the garbage collection van can find optimized route for collection of garbage.
- garbage level crosses threshold level, the alert will be generated for urgent collection of garbage.
- The data of wet and dry segregation level will help in evaluating the current garbage management plans and also to refine the plans for increasing the efficiency.

Architecture

- system assures the collection of garbage soon when the garbage level reaches its maximum level. The system will thus provide accurate reports, increasing the efficiency of the system. The real-time monitoring of the garbage level with the help of sensors and wireless communication will reduce the total number of trips required of GCV and thus, will reduce the total expenditure associated with the garbage collection. Thus, the dustbins will be cleared as and when filled, giving way to cleaner city, better infrastructure and increased hygiene.

PRIDA Track 1 (T1)

Connected and Autonomous Car

11/09/2020

Agenda

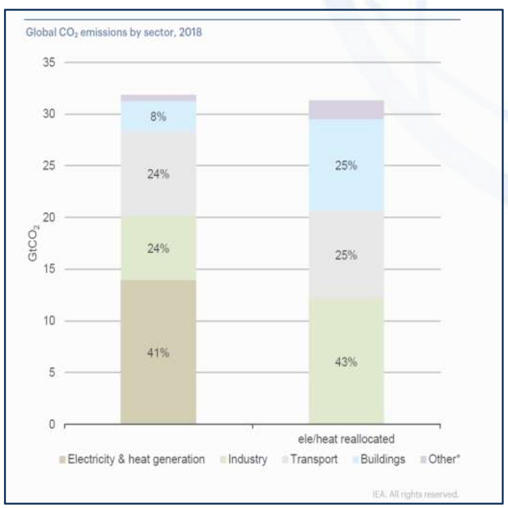
- Introduction
  - Key facts
  - Mobility needs and challenges
  - Connected car definition
- Presentation of the autonomous car
  - Definition
  - Technical challenges
- Communication protocols
- Societal, legal and economic impact
  - Regulations
  - Insurance
  - Responsibility
- Conclusion

Introduction

Mobility: new needs and Challenges

Economic, social and environmental issues

Key facts



33.5 GtCO2

in 2018

http://wds.iea.org/wds/pdf/Worldco2_Documentation.pd

1 300 000 dead

50 000 000 Injured

500 Billions

World

Africa

90% of accidents are due to human error

Assistance
Automatisation
Autonomy

Peden M. et al., eds. Rapport mondial sur la prévention des traumatismes dus aux accidents de la circulation. Genève, Organisation mondiale de la Santé.


Hello car
Hi Sir,
Following the detection of a mechanical failure , I looked in your calendar and I booked an appointment with the mechanic for 3pm, it will cost you € 300
What ?! You know car, Since you know how to do everything, go payit by

Connected Car

Connected Car: Definition

A connected vehicle integrates wireless telecommunications systems that allow it to:

- Collect, record and process information
- Exchange information with: Other vehicles, Road users (pedestrians, bicycles, etc.) and Road infrastructure.

The data collected by the vehicle are numerous and various :

- Driving, such as Information on the distance to another vehicle (measured by radar) and geolocation data.
- Life on board; for example, the transfer of music stored on a smartphone or a movie ... And The state of comfort inside the car

Since 2017, by decision of the EU, all new vehicles must be connected in order to automatically make an emergency call in the event of an accident: this is the e-Call service. It is estimated that 80% of the vehicle fleet is already connected in 2020 (Statistica, 2017)

The connectivity: Why?

Connectivity makes it possible to offer more new services for the benefit of :

- Driver
- Passenger
- Manufacturer
- Authorities, ….

These new services improve :

- Road safety
- Traffic efficiency
- Energy savings
- Passenger comfort

Connected Car services

1. Commercial offers: Data sent from a connected vehicle to servers can form the basis for many services:
   - Predictive maintenance
   - Scheduling maintenance or tire changes, etc.
   - New insurance methods (towards individualization according to the type of driving)
   - Other administrative or commercial services.
2. Navigation assistance and driving optimization: The data received by the vehicle can take into account the state of the traffic dynamically, in order to:
   - To avoid traffic jams ...
   - To define automated driving profiles (speeds, driving styles, etc.) for the comfort of passengers who adapt to: the topology of the terrain, the state of traffic and the driving modes of other road users .

Connected Car services

3. Passive safety: The vehicle receives information indicating the problems:
   - Visibility (fog ...)
   - Grip
   - Blocked road
   - Presence of objects of people on the road, work areas
   - Arrival of an oncoming vehicle

   It automatically emits a distress signal in case of accident.
4. Active safety: Vehicle connectivity paves the way for assistive functions:
   - Overtaking and collision avoidance,
   - Management of intersections (warning and braking in the event of a hidden obstacle, non-compliance with a traffic light, etc.),
   - Cooperative Adaptive Cruise Control (CACC).
5. Cooperative and coordinated driving: Coordination between vehicles allows:
   - better management of track occupancy,
   - optimal fire management and the avoidance of bottlenecks.
   - the construction of dynamic local maps becomes possible, thanks to the sharing of information captured by each vehicle.

Autonomous Car

Definition

An autonomous vehicle is capable of driving, on an open road, without the intervention of a driver. The concept aims to develop and produce a vehicle that can circulate on public roads without human intervention in all situations.

Otherwise an autonomous car is:

- Intelligent
- Connected

SAE international's J3016

SAE level	Name	Narrative Definition	Execution of Steering and Acceleration/ Deceleration	*Monitoring* of Driving Environment	Fallback Performance of *Dynamic Driving Task*	System Capability *(Driving Modes)*
***Human driver* monitors the driving environment**						
0	**No Automation**	the full-time performance by the *human driver* of all aspects of the *dynamic driving task*, even when enhanced by warning or intervention systems	Human driver	Human driver	Human driver	n/a
1	**Driver Assistance**	the *driving mode*-specific execution by a driver assistance system of either steering or acceleration/deceleration using information about the driving environment and with the expectation that the *human driver* perform all remaining aspects of the *dynamic driving task*	Human driver and system	Human driver	Human driver	Some driving modes
2	**Partial Automation**	the *driving mode*-specific execution by one or more driver assistance systems of both steering and acceleration/ deceleration using information about the driving environment and with the expectation that the *human driver* perform all remaining aspects of the *dynamic driving task*	**System**	Human driver	Human driver	Some driving modes
***Automated driving system* ("system") monitors the driving environment**						
3	**Conditional Automation**	the *driving mode*-specific performance by an *automated driving system* of all aspects of the dynamic driving task with the expectation that the *human driver* will respond appropriately to a *request to intervene*	System	**System**	Human driver	Some driving modes
4	**High Automation**	the *driving mode*-specific performance by an automated driving system of all aspects of the *dynamic driving task*, even if a *human driver* does not respond appropriately to a *request to intervene*	System	System	**System**	Some driving modes
5	**Full Automation**	the full-time performance by an *automated driving system* of all aspects of the *dynamic driving task* under all roadway and environmental conditions that can be managed by a *human driver*	System	System	System	**All driving modes**

Deployment Challenges & Conditions

- Achieve a level of technological maturity that meets security requirements
- Guarantee the interoperability of different systems, through cooperative infrastructures, standards and norms, certification procedures, maintenance networks, etc.
- Offer new mobility services
- Guarantee their economic viability
- Enter a defined legal and regulatory framework, nationally and internationally

Technical Challenges

Autonomous navigation & decision-making autonomy	• Algorithms and functions necessary for decision-making and navigation, from sensor to locomotion;
Integration - connected and intelligent systems	• Aspects related to the practical integration of software, reliability and functional and hardware architectures and real time but also connectivity and cybersecurity;
Modeling & large-scale integration	• Traffic modeling and VAC-user interactions. Data collection and mining, remote diagnosis, large-scale simulation, intelligent mobility offers, etc.

Technical Challenges

Autonomous Navigation

Autonomous Navigation

Scene interpretation

- Analyze and interpret the received data

Multi sensors perception

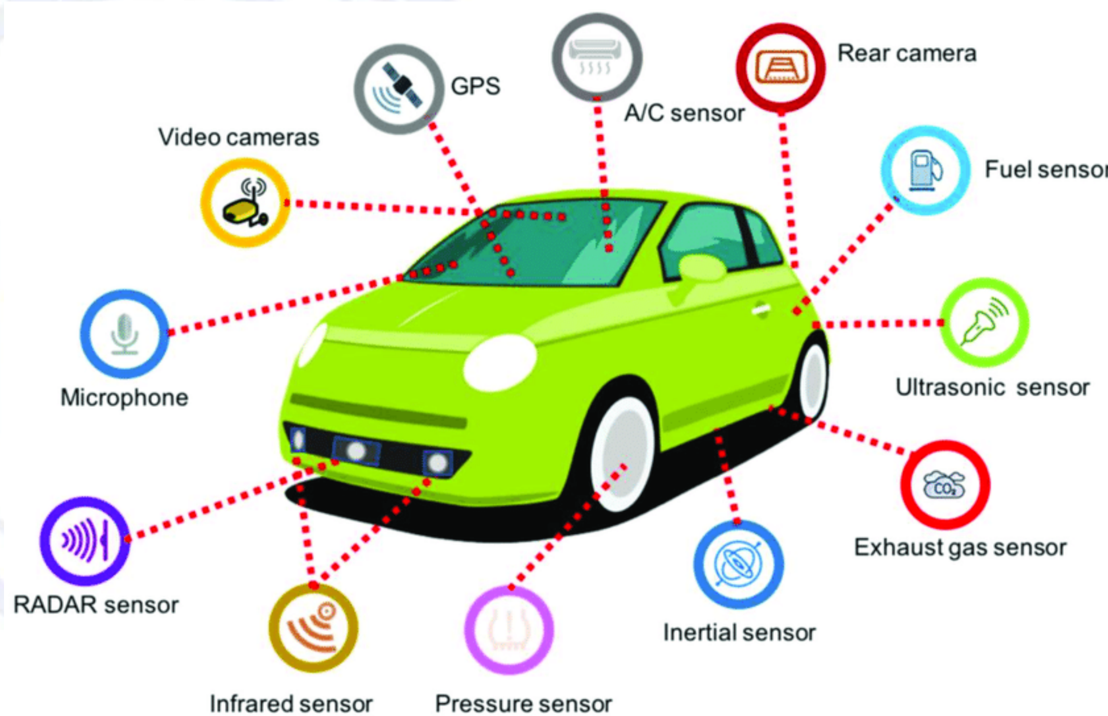
- Perceive the environment using multiple sensors

Decisional Autonomy

- Make decisions about how to drive the vehicle

Multi-sensors Perception

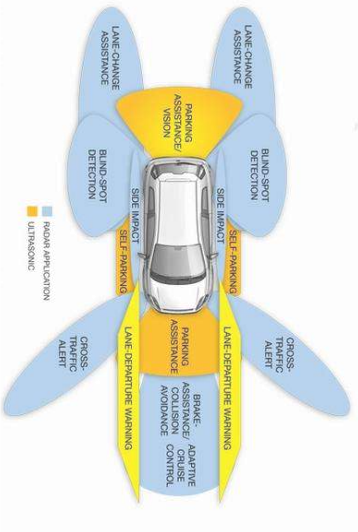
Multi-Sensors



https://www.researchgate.net/publication/324552482_Sensor_Technologies_for_Intelligent_Transportation_Systems

Sensors Categories

Category	Description	Example
Safety	Form the basis of safety systems and focus on recognizing accident hazards and events almost in real-time.	Micro-mechanical oscillators, speed sensors, cameras, radars and laser beams, inertial sensors, ultrasonic sensors, proximity sensors, night vision sensors, haptic.
Diagnostic	Focus on gathering data for providing real-time information about status and performance of the vehicle for detecting any malfunction of the vehicle.	Position sensor, chemical sensors, temperature sensors, gas composition sensors, pressure sensor, airbag sensor.
Traffic	Monitor the traffic conditions in specific zones, gathering data that improves the traffic management.	Cameras, radars, ultrasonic, proximity.
Assistance	Responsible for gathering data that provide support for comfort and convenience applications.	Gas composition sensor, humidity sensors, temperature sensors, position sensors, torque sensors, image sensors, rain sensors, fogging prevention sensors, distance sensors.
Environment	Monitor the environment conditions, offering drivers and passengers alert and warning services that are used to enhance their trips.	Pressure sensors, temperature sensors, distance sensors, cameras, weather conditions.
User	Focus on gathering data that support the detection of abnormal health conditions and behavior of the driver that can deteriorate the driver's performance.	Cameras, thermistors, Electrocardiogram (ECG) sensors, Electroencephalogram (EEG). sensors, heart rate sensor.



http://tpe-voiture-autonome.kazeo.com/les-principaux-capteurs-dune-voiture-autonome-a123093210

Sensor fusion: Examples

1. For obstacle detection and tracking, data from a laser sensor and a camera, or from a radar and a camera, are merged
2. The global location of the vehicle involves a fusion of data from GNSS (satellite location), INS (inertial navigation) and odometry (measurement of wheel displacement).

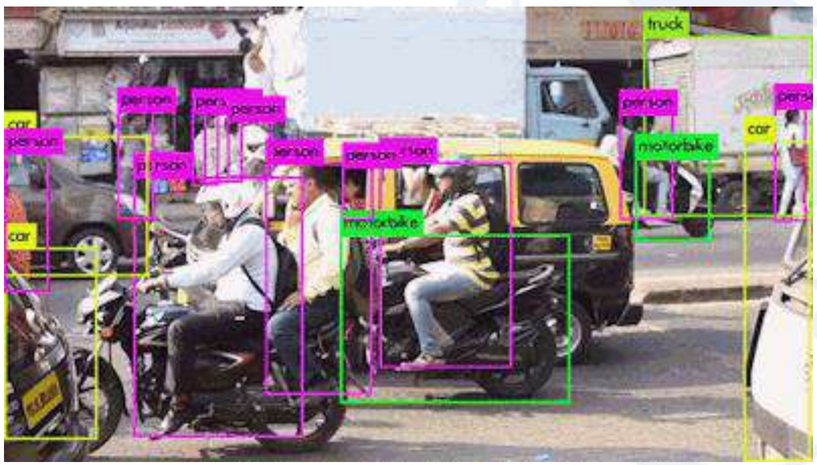
The requirements of Euro NCAP (an international assessment body) will push manufacturers to develop sensor fusion systems to qualify their driver assistance systems (ADAS).

Sensors: In-Vehicle Applications

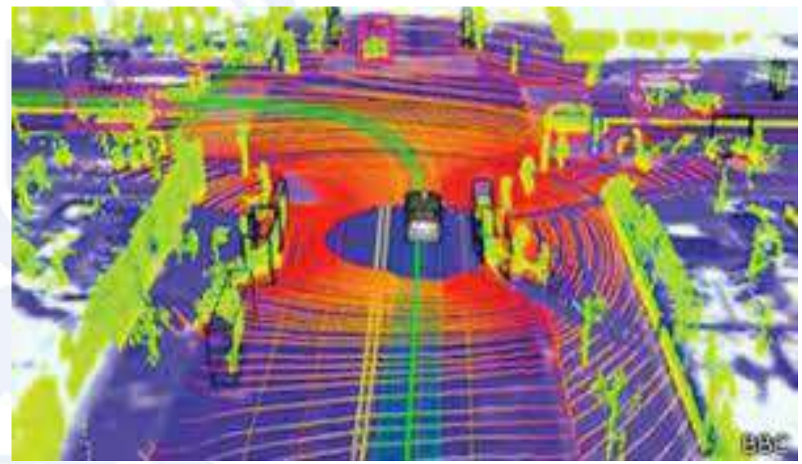
- Tire pressure monitoring
- Parking assistance
- Obstacle detection
- Collision Anticipation
- Navigation system
- Self-piloting
- Night vision assist

Scene Interpretation

Object and Obstacle Detection



Local and Global Localization



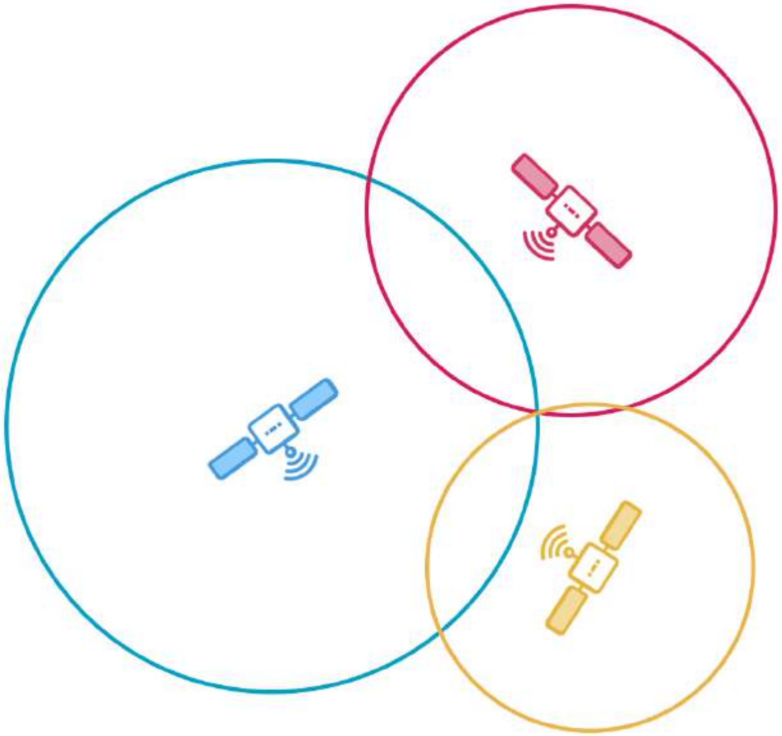
Object & Obstacle Detection

To understand its environment, the autonomous vehicle must first know how to recognize objects and obstacles, whatever the objects to be detected: (pedestrians, vehicles, signs, etc.)

=> Machine learning techniques are currently working the best. Deep learning is considered very promising, provided you have a sufficiently large learning base.
Numerous databases already exist for various types of objects and in particular vehicles, pedestrians and pedestrians, road signs ...
Among the bases dedicated to pedestrians and pedestrians, we find that of:

- Daimler (Daimler Pedestrian Detection Benchmark): http://www.gavrila.net/Datasets/Daimler_Pedestrian_Benchmark_D/daimler_pedestrian_benchmark_d.html
- Caltech: http://www.vision.caltech.edu/Image_Datasets/CaltechPedestrians/
- Inria: https://dbcollection.readthedocs.io/en/latest/datasets/inria_ped.html

Global localization



Global positioning techniques are based on the satellite positioning system (GNSS)

Based on a set of satellites to provide to a user (via a GPS receiver):

- Its 3D position, (longitude, latitude and height)
- Its 3D speed
- The date and time

Local localization

Sensors that allow the position to be determined locally (without referring to a global external system)

1. The inertial unit: it is an instrument used in navigation, capable of integrating the movements to estimate:
   – its orientation,
   – its linear speed
   – its position. The position estimate is relative to the starting point

2. Odometry: is a device that measures the distance traveled by the car

3. The magnetic compass

Technical Challenges

Decisional Autonomy

Decisional Autonomy

The autonomy of a car is its ability to:

- Plan itinerary
- Plan maneuvers
- Interact with its users

The decisive autonomy is based mainly on the use of artificial intelligence technics: machine learning and deep learning.

Itinerary Planning

Itinerary planning is based on well-mastered optimal path search algorithms.

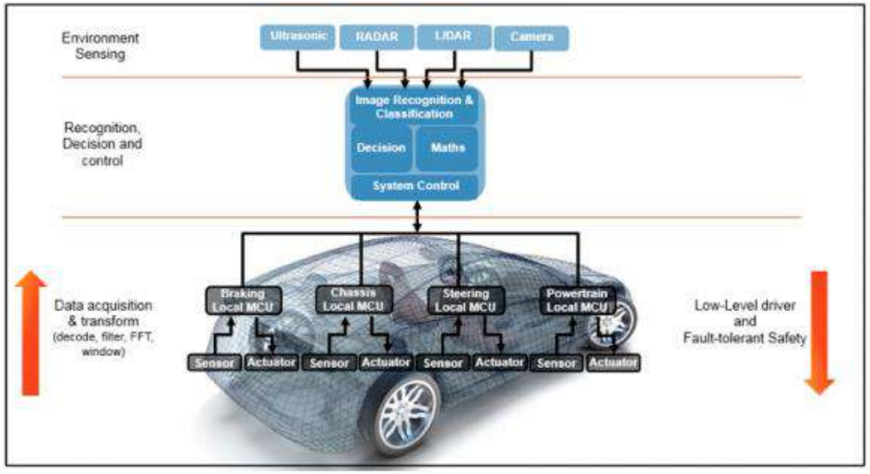
It is necessary to consider new optimization criteria:

- The traffic model, for better estimation time travel
- The consumption of each vehicle according to the topology of each segment of the route and the traffic conditions, in order to optimize energy consumption and pollutant emission;
- The comfort of passengers, for example by minimizing traffic in places "at risk", on rough roads, or with many intersections and roundabouts.

Command System for Autonomous Car

An autonomous car is considered as a mobile robot.
The control-command methods, inspired by those developed for mobile robots, are applicable to model the autonomous vehicle control systems which must optimally ensure:

- The stability of the vehicle;
- The passenger comfort, with constraints on longitudinal and lateral acceleration;
- The slips avoidance or recovery , control the skating control .



Telecommunications Protocols

Protocols for connected and autonomous vehicles

Telecommunications and Cybersecurity

- Ensure reliable communication between vehicles and their environment
- One requirement: cybersecurity

Road safety requires a highly responsive and reliable exchange of information between neighboring vehicles, under any traffic density condition.

V2X Advantages

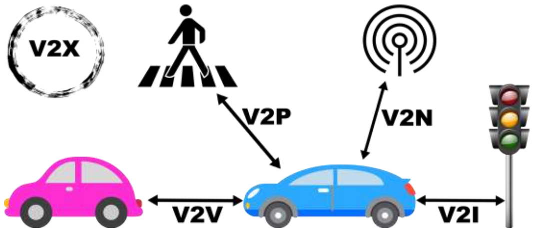
The main advantages of V2X are:

- Road safety
- Traffic efficiency
- Energy savings

The US NHTSA estimates a reduction of at least 13% in traffic accidents if a V2V system were implemented, which would result in 439,000 fewer accidents per year.

Protocols de communication V2X: Véhicule to everything

- V2V (Vehicle-to-Vehicle): vehicles that support this type of communication can exchange messages (location, speed, state).
- V2I (Vehicle-to-Infrastructure): messages are exchanged between the vehicle and the infrastructure
- V2N (Vehicle-to-Network): messages are exchanged with the application server which supports V2N communication.
- V2P (Vehicle-to-Pedestrian): messages are exchanged between pedestrians (vulnerable users) and vehicles. The difference compared to previous types; A V2P device may not have the capabilities (battery capacity, radio sensitivity) to send / receive messages with the same periodicity



, https://commons.wikimedia.org/w/index.php?curid=85867846

V2X: Technologies

There are several wireless networking technologies that could be used to connect a car.

Currently only 2 remain in very tough competition:

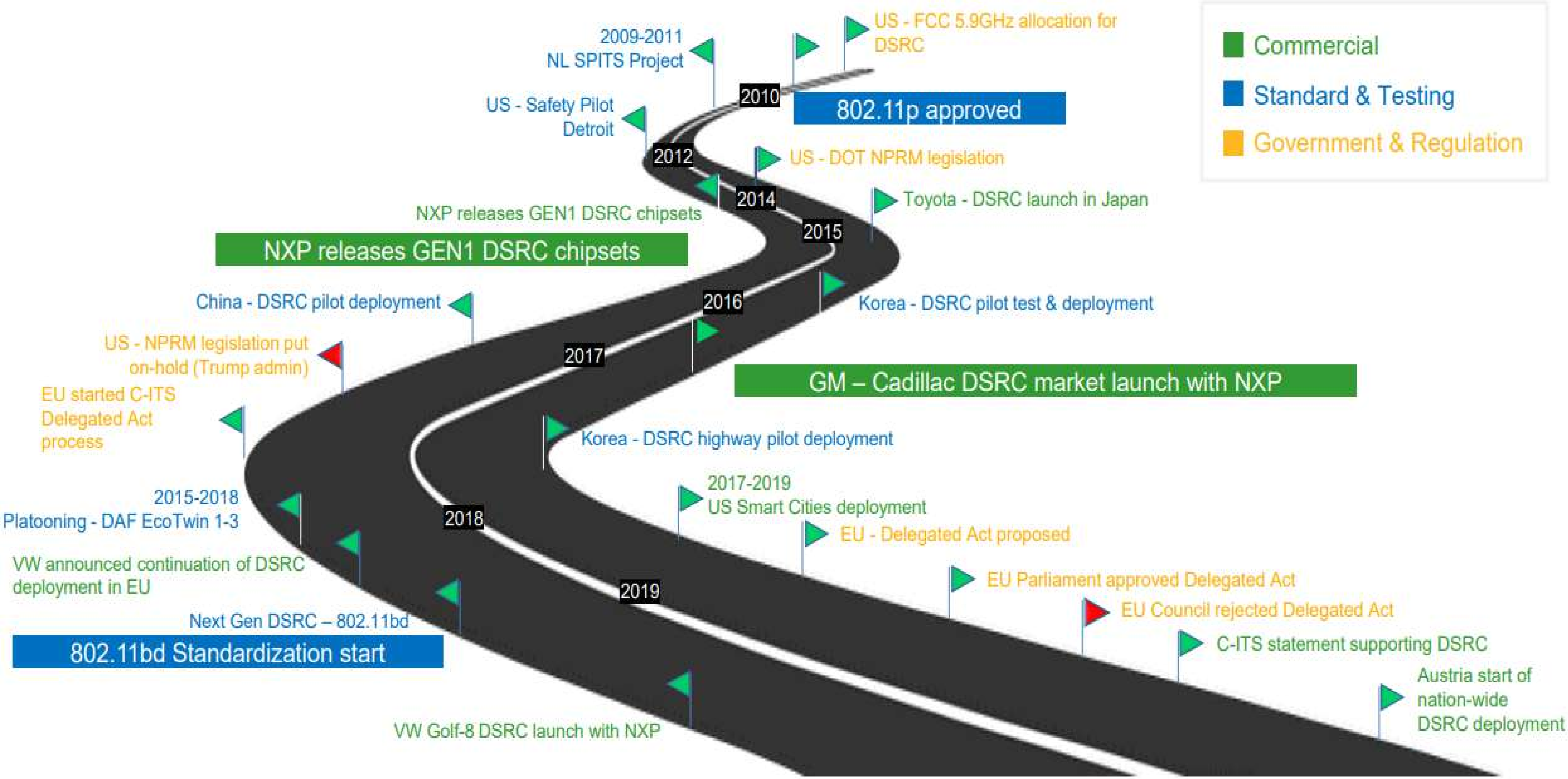
- WLAN-based: Wi-Fi (IEEE 802.11p)
- Cellular based: C-V2X

Caractéristiques de la liaison sans fil	Technologie			
	802.11 p WAVE	***1.0.1.a - Wi -fi***	**Cellulaire**	**Infrarouge**
Débit de données	3-27 Mb/s	6-54 Mb/s	< 2 Mb/s	< 1 Mb/s < 2 Mb/s
Portée de communication*	< 1000 m	< 100 m	< 15 km	< 100 m(CALM IR)
Puissance d'émission (max)	760 mW (US) 2 W EIRP (EU)	100 mW	2000 mW (GSM) 380 mW (UMTS)	12800 W/Sr pulse peak
Bande passante	10 MHz 20 MHz	1-40 MHz	25 MHz (GSM) 60 MHz (UMTS)	N/A
Spectre alloué	75 MHz (US) 30 MHz (EU)	50 MHz@2.5 GHz 300 MHz@5 GHz	Dépend de l'opérateur	N/A
Aptitude à la mobilité	Haute	Basse	Haute	Moyenne
Bande de fréquences	5.86-5.92 GHz	2.4, 5.2 GHz	800 MHz, 900 MHz, 1800 MHz,	835-1035 nm

Wi-Fi (IEEE 802.11p)

- V2X based on Wi-Fi (IEEE 802.11p)
  - The IEEE first published specifications for this technology in 2012. It supports direct vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communication.
  - This technique is also known as Dedicated Short-Range Communications (DSRC) which is part of the IEEE 802.11 WLAN family of standards and is known in the United States as Wireless Access in Vehicle Environments (WAVE) and in Europe as ITS -G5.
- IEEE 802.11p (DSRC) technology is currently deployed in the United States, Europe and Japan

DSRC Journey



C-V2X

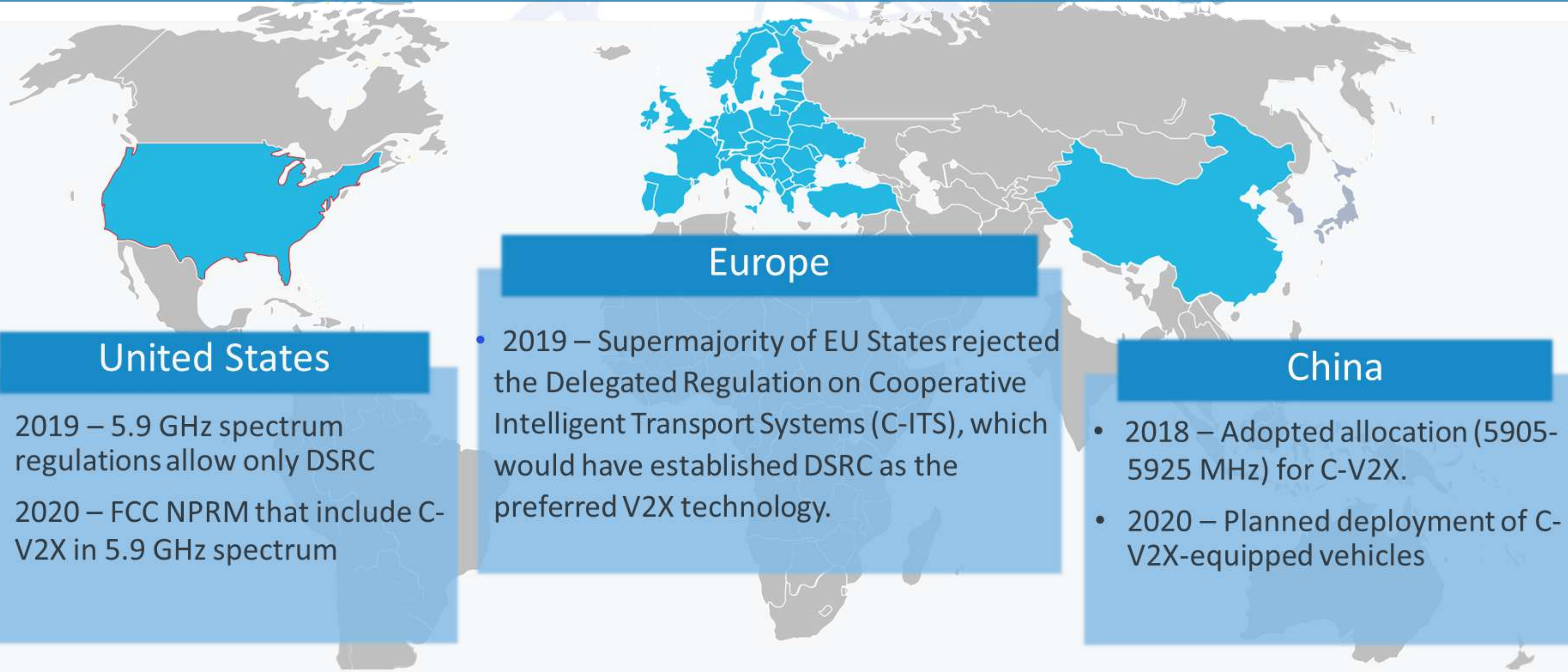
- C-V2X is based on the Cellular network 
- In 2017, 3GPP released V2X specifications based on LTE as the underlying technology. It is generally referred to as "cellular V2X" (C-V2X) to differentiate itself from V2X technology based on 802.11p. In addition to direct communication (V2V, V2I), the C-V2X also supports extended communications over a cellular network (V2N).
- the evaluation prepared by 5GAA (5G Automotive Association) shows that the C-V2X has better functionality over IEEE 802.11p, while using solutions compatible with both technologies.

5GAA Vision


Precise positioning
Lane-level accuracy anywhere, anytime
Bluetooth
For high quality voice and audio
Wi-Fi
For in-car experiences and car OEM services
4G/5G
For car OEM services
4G/5G
For driver and passengers
C-V2X Direct Communications
For car-to-infrastructure communication
C-V2X Direct Communications
For car-to-car communication
Car connectivity in the 5G era
Heterogeneous connectivity
Secure, virtualized wireless links
Advanced Positioning
Multi-environment implementation
4G/5G is referring to C-V2X network communications (i.e. V2N); C-V2X Direct Communications is referring to V2V, V2I, V2P

C-V2X Adoption

Global Stakeholders Are Increasingly Recognizing the Benefits of C-V2X



United States

- 2019 – 5.9 GHz spectrum regulations allow only DSRC
- 2020 – FCC NPRM that include C-V2X in 5.9 GHz spectrum

Europe

- 2019 – Supermajority of EU States rejected the Delegated Regulation on Cooperative Intelligent Transport Systems (C-ITS), which would have established DSRC as the preferred V2X technology.

China

- 2018 – Adopted allocation (5905-5925 MHz) for C-V2X.
- 2020 – Planned deployment of C-V2X-equipped vehicles

5GAA Automotive Association

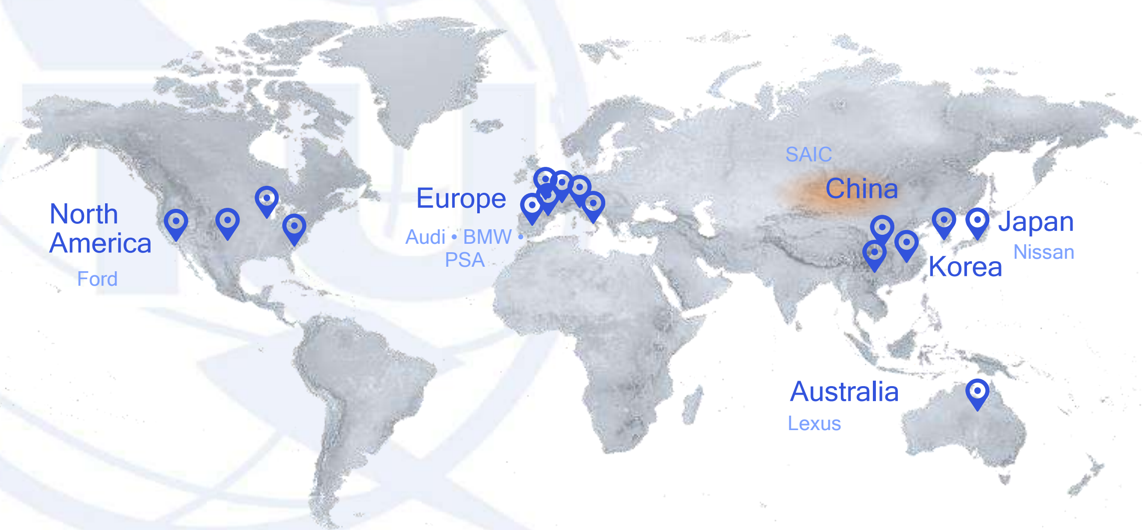
Airgain • Alpine Electronics • Analog Devices • Anritsu EMEA Ltd
AT&T • Audi BAIC • Beijing University • Bell Mobility • BMW • Bosch
CATT • Cetecom • China Transinfo • China Unicom • CMCC
Continental Daimler • Danlaw • DEKRA Denso • Deutsche Telekom
Ericsson • FEV • Ficosa • Ford • Fraunhofer Gemalto Hirschman Car
Hitachi Automotive US • Honda • Huawei Infineon • Intel Interdigital
Jaguar Land Rover • Juniper • KDDI • Keysight • KT • Laird Tech • LG
Murata • Nissan • Nokia • NTT DoCoMo • OKI • Orange • P3 Group
Panasonic • Proximus • PSA • Qualcomm • Rohde & Schwarz Rohm
SAIC • Samsung • Savari • SIAC • SK Telecom • Skyworks Softbank
Sumitomo • Telefonica • Telekom Austria • Telstra • TÜV • Valeo
Veniam • Verizon • Viavi • Vodafone • Volkswagen • ZF • ZTE

Key participants

driving global C-V2X activities with Qualcomm Technologies

Ford	ZTE	Kapsch
PSA	Quectel	SWARCO
BMW	Lear	Genvict
Daimler	Valeo	Nebula
SAIC	WNC	R&S
China Domestic OEMs	CMCC	Datang
Continental	AT&T	Ficosa
Bosch	DoCoMo	And more …
LG	CMRI	
	McCain	

Driving C-V2X global presence



Tremendous traction across regions and broad industry sectors

From standards completion to independent field testing to early commercialization

Strong C-V2X momentum

Sep 2016
5GAA Founded

Jan 2017
ConVeX trial in Germany announced

Feb 2017
Towards 5G trial in France announced

Mar 2017
3GPP
Rel-14 C-V2X spec finalized

Sep 2017
MDM 9150
First C-V2X chipset introduced

Oct 2017
San Diego Regional C-V2X trial with:
at&t, Ford, NOKIA, McCain

Apr 2018
Ford, Audi
First multi-OEM demo in D.C.

Jun 2018
1st US deployment in Denver
Panasonic, kapsch, Ford, FICOSA, WNC, SAVARI

Jul 2018
5GAA
Europe's first multi-OEM demonstration
In Paris

Oct 2018
Multi-OEM performance evaluation of C-V2X

Oct 2018
5GAA
C-V2X functional and performance test report published

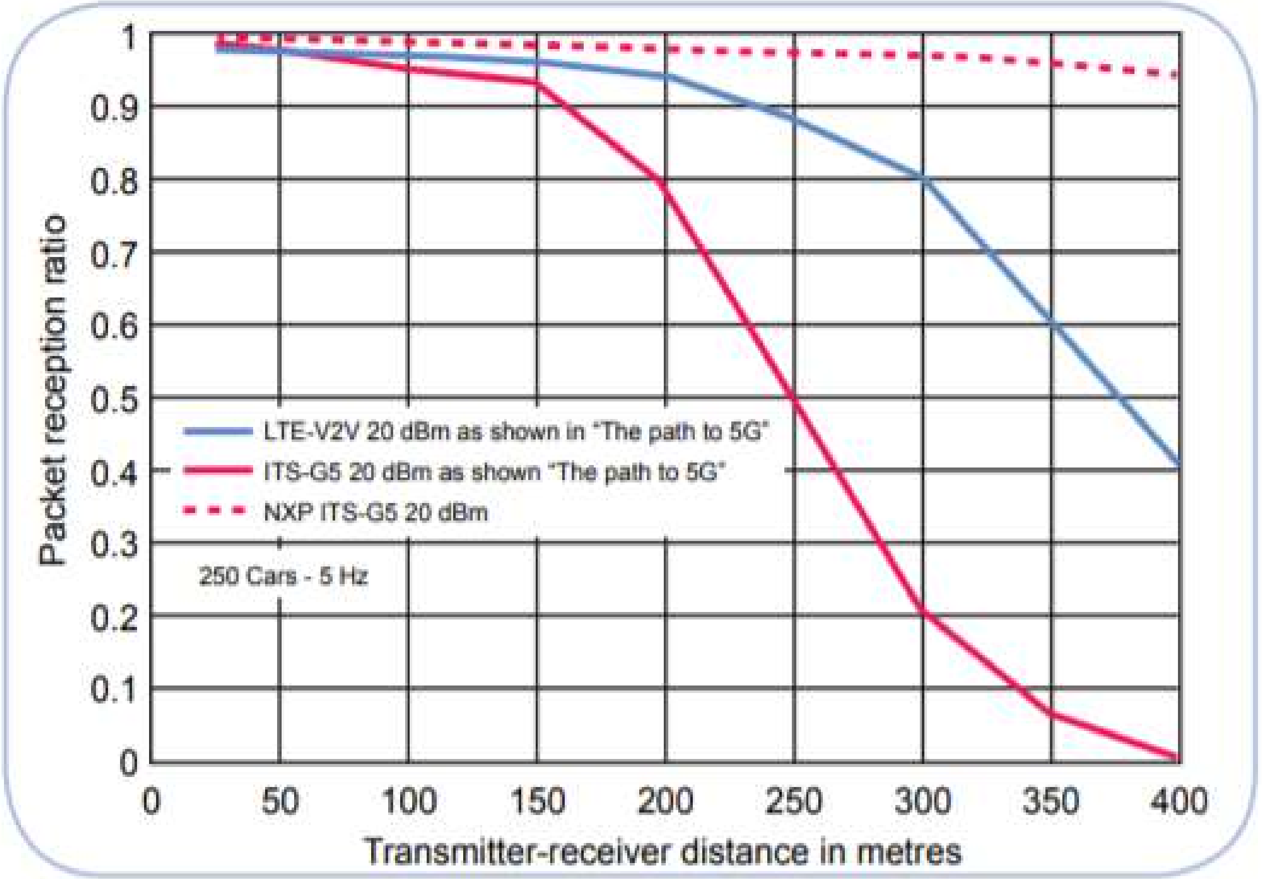
Nov 2018
5GAA Reaches 100 members

Nov 2018
China-SAE ITS Stack Compatibility

Jan 2019
Cooperative driving live interactive demos in Las Vegas:
Audi, Ford, Ducati

Jan 2019
Announcing C-V2X implementation in Las Vegas with:
RTC, commsignia

Critics: C-V2X vs DSRC



https://www.nxp.com/docs/en/white-paper/CITSCOMPWP.pdf

Telecommunication

CAV Cybersecurity

A requirement: Cybersecurity

One of the big problems in telecommunications is vulnerability to external attacks.

For connected vehicles, the question of the integrity and confidentiality of information circulation networks is critical.

The worst-case scenario that can be envisaged would be, for example, the remote control of a connected vehicle.

⇒ Cybersecurity is becoming a priority for transport manufacturers. Means of protection already exist, they must be integrated into the vehicle development process.

Cybersecurity solutions must ensure:

- firewall functions in the interfaces with external networks, the detection of intrusions and the installation of protections;
- securing internal communications, communications between the vehicle and information systems, or communications between vehicles, by encryption and signature;
- the "hardening" of on-board computers (data and program protection);
- more generally, securing the information systems involved in the movement of autonomous and connected vehicles.

The complex stakeholder ecosystem

The CAV ecosystem is made up of a variety of interconnected stake-holders, including automotive-parts and software businesses, academic institutions, standards organizations, industry associations, and financial institutions.

The CAV cybersecurity stakeholders have unique interactions with regulators, policy makers, and economic development organizations across the CAV sector. The stakeholders included within this report span several sectors and sub-sectors, and many stakeholders have multiple roles.

Attack vectors

- LIDAR and radar systems (e.g., spoofing or saturation attacks)
- Servers
- Keyless entry
- On-Board Diagnostics (OBD) port
- OBD dongle
- Mobile app
- Infotainment
- Broadband network (e.g., cellular)
- V2X communication
- Wi-Fi
- Sensors
- USB port
- Bluetooth
- Telematics Control Unit (TCU)

The top attack vectors as of 2018, according to an Upstream Security report,17 were remote server attacks (21%) and keyless entry attacks (19%), where an individual enters a car without using a key for either the door or the ignition. Another 10% of attacks were through the OBD port and 7% each were through mobile apps or infotainment systems.

Wi-Fi and cellular network attacks made up just above 4% each but could grow in the context of increased connectivity and 5G coverage. With 41% of Black Hat incidents involving back end servers in 2019, including breached OEM web servers, there is a need not only for device security and safety, but also for a full ecosystem, strategic approach to threats.

Risk vectors

Key threats impacting the CAV ecosystem

Insider Threats: Insiders are trusted, have knowledge and access to the organization's crown jewels. Insider's motivations may vary – they may steal data, commit fraud or cause physical harm or sabotage. Detecting insiders behaving normally, but with ulterior motives, can be challenging – highlighted by cases like the Levandowski trade secret trial between Waymo and Uber.

Cyberattacks into V2X Communications: With far more on-board software needing regular security and navigational updates, autonomous vehicles in the new mobility ecosystem will likely have communication lines back to the manufacturer for instant transmission of software-related patches. Vulnerabilities in the communication channels could result in a threat actor compromising the safety and security of the vehicles.

Hijacking Vehicle Sensors and Taking Over Physical Controls: The intersection of critical and noncritical vehicle sensors and the underlying busses can allow a message injector to pass unwanted data to devices in the vehicle by exploiting the weakest link. Advances in cognitive computing are creating new avenues to exploit the sensors and IoT devices used by CAVs as demonstrated by researchers in tricking the vehicle LIDARs to make inaccurate judgements, by using spoofing and saturation attacks. This can lead to physical CAV crashes or CAV thefts.

Dumpster Diving for Data: Just as flight data recorders collect information about what happens in a cockpit, connected vehicles absorb details about what their owners and passengers do, which can act as a honeypot for malicious actors. Furthermore, there have been reported cases where drivers of ride sharing apps have secretly recorded their passenger conversations, with privacy ramifications.

Supply Chain and 3rd Party Risks: The CAV ecosystem consists of a large variety of service and solution providers. Managing 3rd party risks across the value chain has been challenging for organizations due to the different maturity levels of the service providers, lack of visibility and control of data, and difficulties enforcing a common standard of security control requirements.

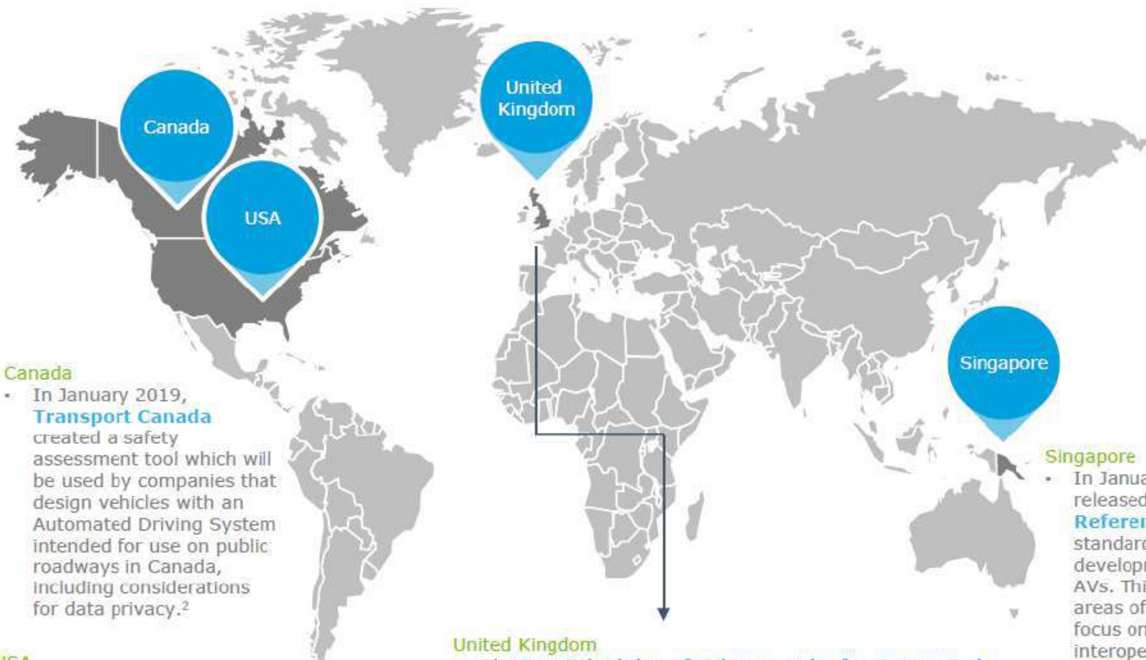
https://www2.deloitte.com/ca/en/pages/risk/articles/cyber-connected-autonomous.html

Organizational risks to the CAV ecosystem

A CAV is a combination of connected devices in a single moving device – with a large threat landscape. The complex CAV ecosystem contains some emerging challenges that are impacting the organizations operating in this sector.

- **Blending Realms of Physical and Cybersecurity:** In a dynamic and connected IoT environment, new and existing technology platforms can expose an organization to security risks of a converged nature.
- **Data Security and Privacy :**Protecting customer, employee, and organizational data requires advanced security controls while ensuring data integrity and privacy requirements are considered and designed at the outset.
- **Attacker Sophistication:** While the rapid growth in Artificial Intelligence (AI) has helped organizations, it has increased the capacity of threat actors, enabling higher effectiveness of attacks.
- **Collaboration:** With physical security becoming increasingly technology enabled, breaking silos and collaboration amongst the security teams can optimize threat management.
- **Risk Culture:** Having the right risk culture is one of the key success factors in preparing for and tackling new risks.
- **Talent :** Recruiting, training and retaining top cybersecurity talent.
- **Enterprise View:** Addressing risks using an enterprise lens provides a holistic view of risk which is needed to tackle today's emerging threats.
- **Regulation and Justice:** Understanding and updating the regulatory and justice framework is needed to ensure a safe and secure CAV ecosystem.

Global cybersecurity developments



cybersecurity legislation and requirements development around the world relevant to the CAV ecosystem

Canada

- In January 2019, **Transport Canada** created a safety assessment tool which will be used by companies that design vehicles with an Automated Driving System intended for use on public roadways in Canada, including considerations for data privacy.[2]

USA

- In October 2018, the US Department of Transportation (DOT) released the "Automated Vehicles 3.0: **Preparing for the future of transportation**". This release focuses on six automation principles identified by USDOT, and also provides private sector representatives with guidance, which includes "**Adopting cybersecurity best practices**".[22]

United Kingdom

- The **Key Principles of Cybersecurity for Connected and Autonomous Vehicles** were developed by the department for Transportation (DFT) in conjunction with Centre for the Protection of National Infrastructure (CPNI) for companies involved in the supply chain (such as manufacturing, technology etc.), towards the development, testing and deployment of CAVs.[23]
- **BSI Standard PAS 1885:2018** is meant to be read in conjunction with the Key Principles.[24]

Singapore

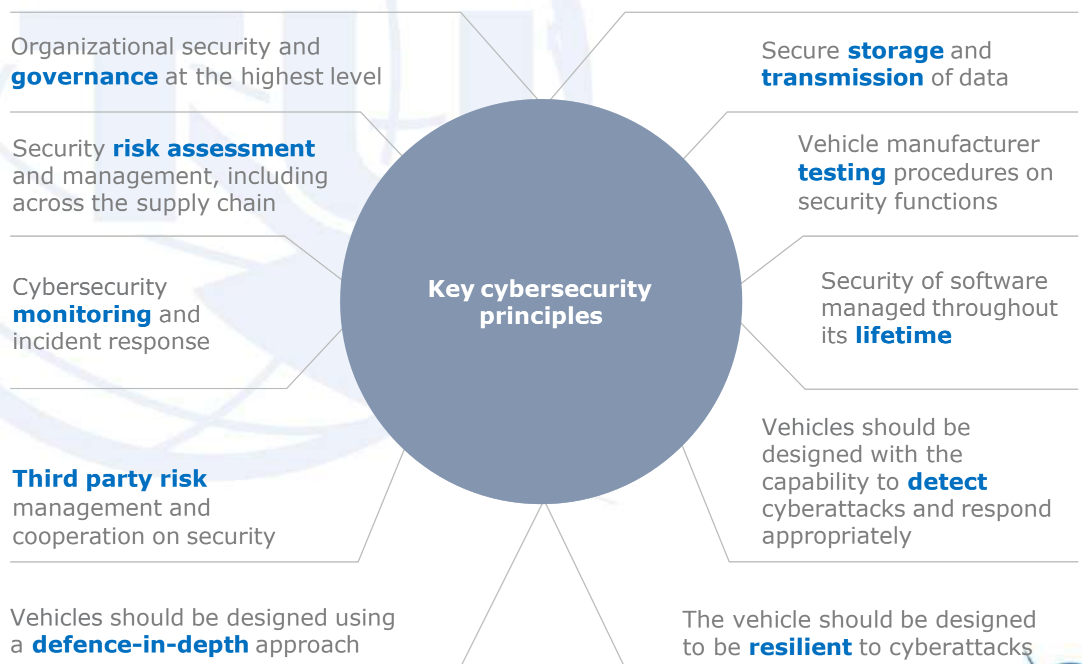
- In January 2019, Singapore released TR68 (**Transport Reference 68**),[25] a national standard to guide industries in the development and deployment of AVs. This standard covers four key areas of AV development with a focus on cybersecurity and the interoperability of data: **vehicle behaviour, vehicle functional safety, cybersecurity, and data formats.**

https://www2.deloitte.com/ca/en/pages/risk/articles/cyber-connected-autonomous.html

Spotlight on proposed UN Regulation on CAV Cybersecurity

In support of the United Nations Economic Commission for Europe (UNECE) World Forum for Harmonization of Vehicle Regulations (WP29) Working Party on Automated/Autonomous and Connected Vehicles mandate, experts of the Task Force on Cyber Security and Over-the-air issues submitted a new draft Regulation on CAV Cyber Security in November of 2018

The proposed UN Regulation develops uniform provisions concerning the approval of cybersecurity, and includes requiring those Contracting Parties to have an Approval Authority or Technical Service assess and issue "Cyber Security Management System Certificates of Compliance".



https://www2.deloitte.com/ca/en/pages/risk/articles/cyber-connected-autonomous.html

Societal, Legal and Economic Impacts

Regulation

Regulatory and legal challenges

- Necessary evolution of the Vienna Convention, national highway codes and automobile regulations (ex ECE79).
- The March 2016 evolution allows advanced driving aids (level 2) but not the autonomous vehicle.
- Legal liability in the event of an accident to be dealt with, changes in insurance policies (Working group in progress within the PFA)
- Open road experiments launched

UN Regulations

More than 50 countries gathered at the United Nations Economic Commission for Europe's (UNECE) Global Forum for Harmonization of Vehicle Regulations have adopted new self-driving car regulations that will come into force in 2021.

Autonomous lane keeping systems (ALKS) will only be activated:

- On roads where pedestrians and cyclists are prohibited
- On roads equipped with a physical separation between the two directions of traffic
- Maximum speed limit at 60km / h
- Obligation of a driver availability recognition system
- Black box requirement: data storage system for automated driving

https://undocs.org/ECE/TRANS/WP.29/2020/81

Concerns about the deployment of connected and Autonomous Cars

- The autonomous and connected vehicle is a system of great technological complexity,
- Large-scale deployment requires profound changes in the functioning of society, which will affect the organization of cities, the uses of transport, the civil liability of industrialists and mobility operators.
- The arrival the autonomous and connected vehicle raises ethical questions and concerns:
  - Concern for safety,
  - The problem of transfer of responsibility,
  - Decision making by artificial intelligences,
  - Securing communications,
  - Respect for privacy and personal data, etc.
- New economic models should be adopted as in the insurance sector
- Adapt and develop national and international regulations
- Resolve the legal and ethical question of liability

Ecosystem transformation

New challenges for the different players:

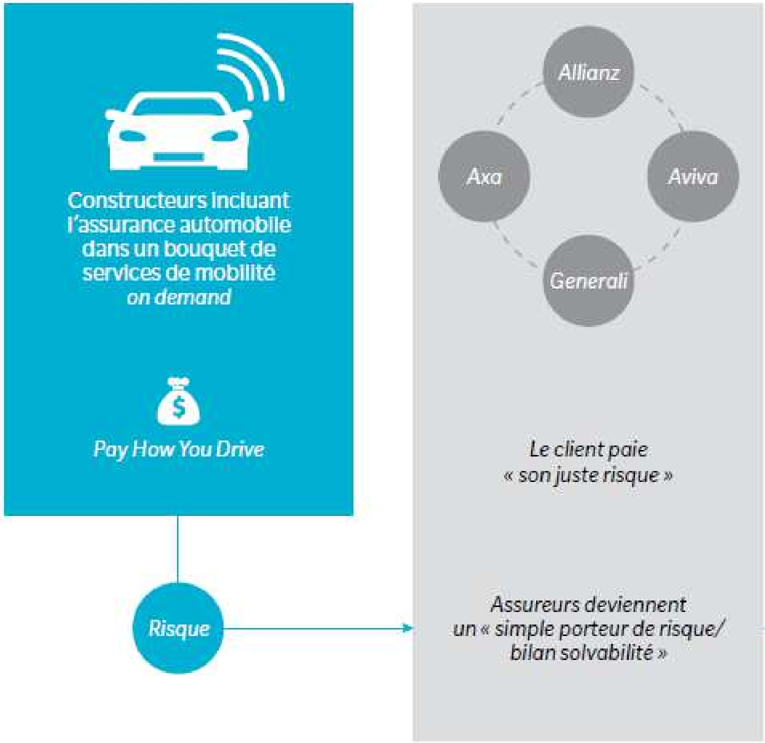
- Insurance
- The constructor
- The consumer
- Lawmakers and regulators
- The society

Societal, Legal and Economic Impacts

Insurance

Insurance: shift of the economic model

- New players: Peugeot becomes an auto insurer and Tesla announced that it will be in 2020
- Insurers are losing customer relationships in automobile insurance,
- The insurance is built into the car sales contract.
- The manufacturer is the first to collect the data essential to the tariffication
- The insurer becomes a simple subcontractor of the constructor



Source Oliver Wyman

Insurance: New service Offers

- The insurers offer a "Pay as you drive" type contract: (kilometer insurance) is a type of automobile insurance allowing insurance pricing according to the actual use of the vehicle:
  - A GPS-type geolocation software linked to a mobile phone in the car of voluntary policyholders.
- The insurer then collects information related to the dates, times of circulation and movement of vehicles.
- Pricing is based on the usage of each customer.

Insurance: New service Offers

Axa (1st insurer in the world) offers a new "Pay how you drive" contract:

- Premium based on actual risk
- Driving style monitoring with telematics
- Driver control => better driver!
- Actual data in the event of an accident
- The protection of personal data (Facilitated by the GDPR)

Societal, Legal and Economic Impacts

Responsibility

Ethical and legal responsibility

In the event of an accident, who is responsible ?

In case of technical failure

… so no doubt

→ OEM

Else

Misuse driver

1. If not reasonably foreseeable
2. If clear operating instructions

→ Driver

Third party fault

1. Infrastructure manager (if standardized)
2. Other user

→ Tiers

Cyber criminality

Hacker responsibility

→ Tiers

Conclusion

- The autonomous car: why?

Market developments: customer expectations, road safety contribution.

- Technologies issues
- Major challenges in terms of performance and operating safety
- Legal and regulatory: Still many points to deal with

Thank you!

PRIDA Track 1

Capacity building workshop on Internet of Things (IoT) and digital services

On-line English workshop. 7th to 11th September 2020

The Internet of Things (IoTs)

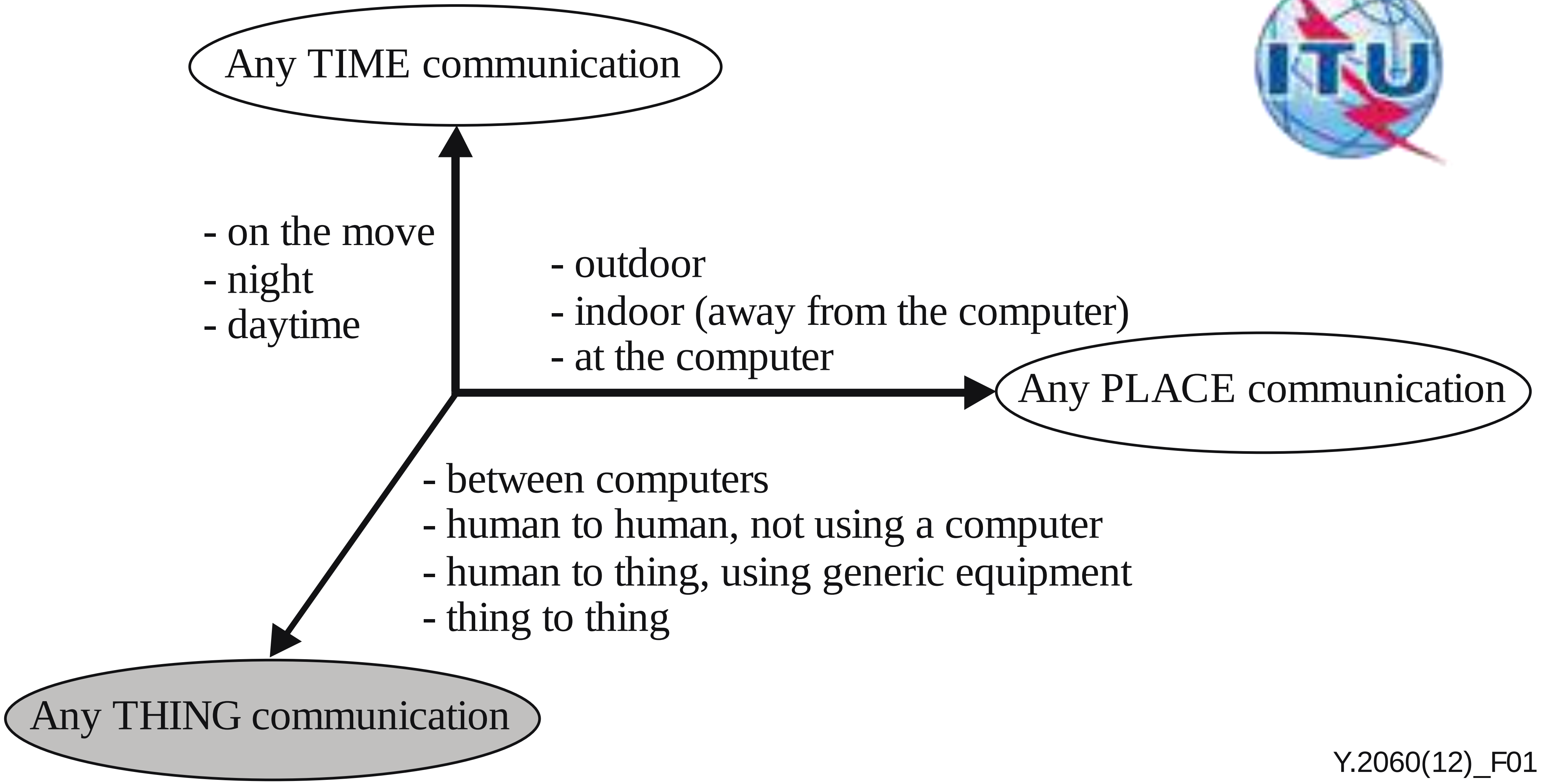
IoT ecosystem and business models

By Desire Karyabwite, Senior IP Coordinator, ITU

Geneva, 7th to 11th September 2020

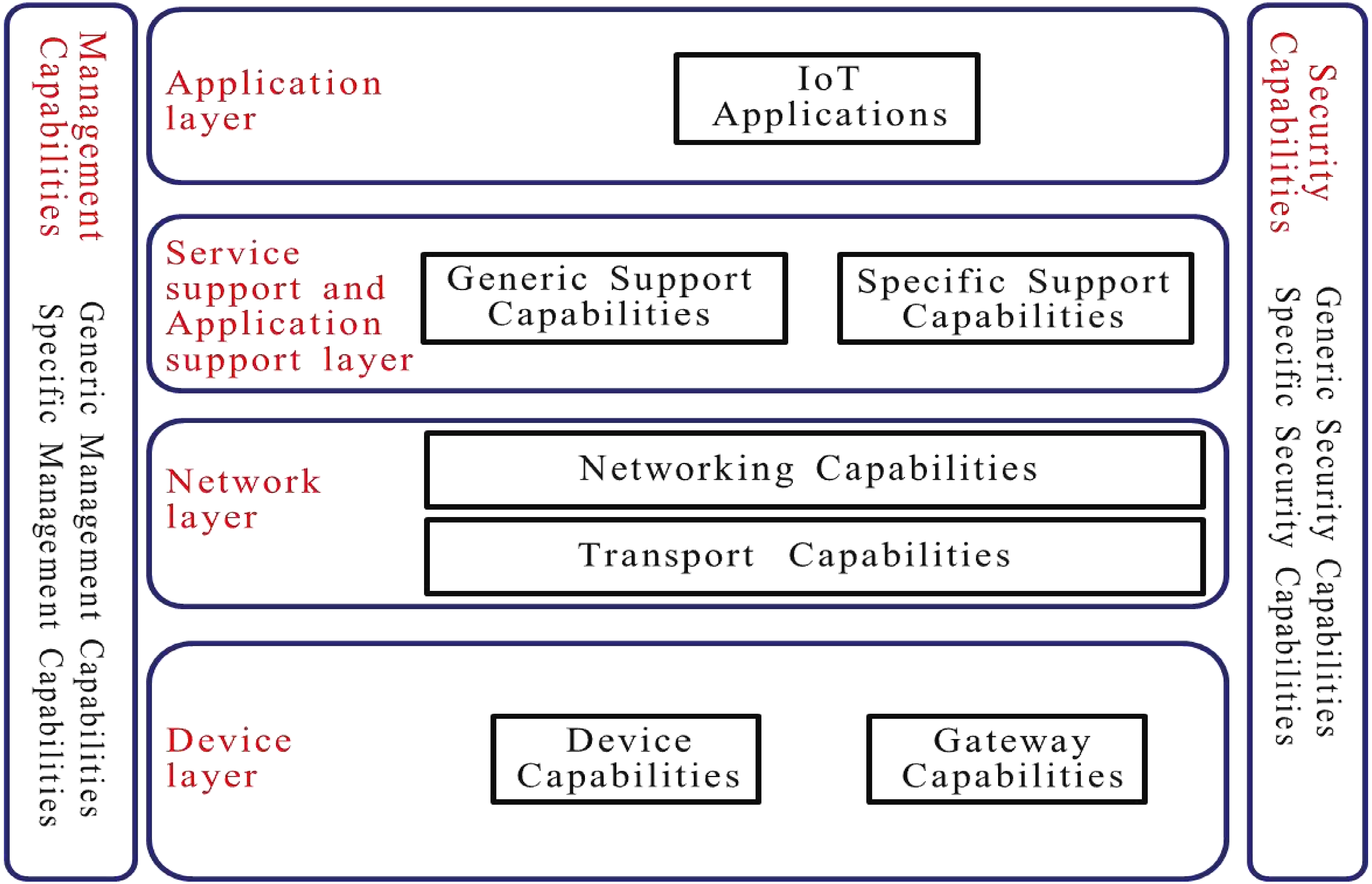
ITU-T	Y.2060
TELECOMMUNICATION STANDARDIZATION SECTOR OF ITU	(06/2012)

Internet of things (IoT): A global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on existing and evolving interoperable information and communication technologies



The new dimension introduced in the Internet of things

IoT reference model



ITU-T	Y.4416
TELECOMMUNICATION STANDARDIZATION SECTOR OF ITU	**(06/2018)**

Architecture of the Internet of things based on next generation network evolution

ITU-T	Y.4806
TELECOMMUNICATION STANDARDIZATION SECTOR OF ITU	**(11/2017)**

Recommendation ITU-T Y.4806 provides a classification of the security issues for the Internet of things (IoT) and examines how the security threats may affect safety, in order to determine which security capabilities specified in Recommendation ITU-T Y.4401/Y.2068 support safe execution of the Internet of things.

The appendices of this Recommendation consider how the joint analysis of threats and security capabilities mentioned herein may be used to establish security requirements for the different applications of the Internet of things

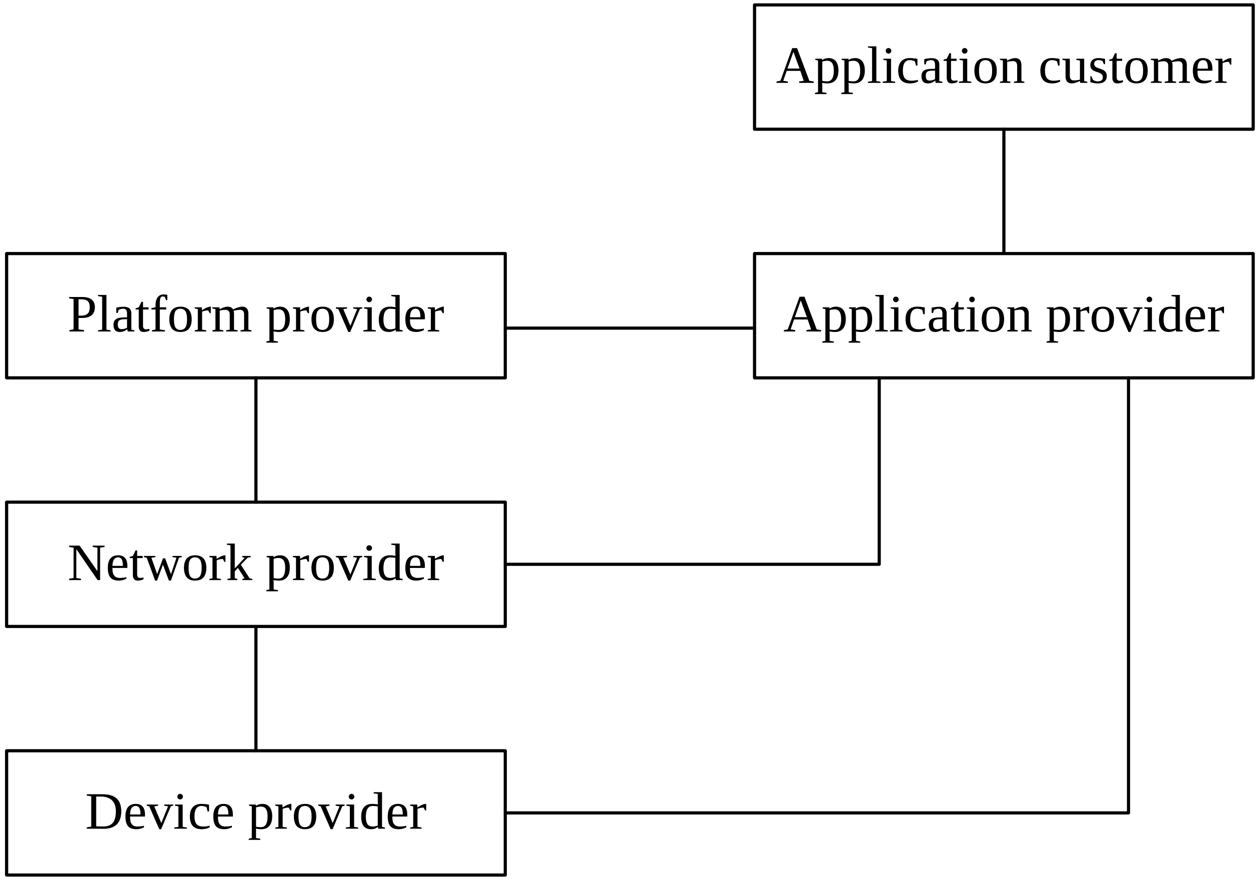
2019 ITU-T SG20 approved two Recommendations:

- *ITU-T Y.4556 "Requirements and functional architecture of smart residential community",* which presents the key components and specifies requirements and the functional architecture of smart residential community (SRC).
- *ITU-T Y.4904 "Smart sustainable cities maturity model"* which contains a maturity model for smart sustainable cities. This maturity model helps identify the goals, levels and key measures that are recommended for cities to effectively examine their current situation and determine critical capabilities needed to progress toward the long-term goal of becoming SSCs.

SG20 also consented to 12 draft Recommendations (under approval):

- *ITU-T Y.4208 "IoT requirements for support of edge computing"*: This Recommendation provides an overview on related challenges faced by the IoT and describes how the IoT supporting edge computing may address these challenges. From the edge computing deployment perspective, service requirements for support of edge computing capabilities in the IoT are identified as well as related functional requirements.
- *ITU-T Y.4209 "Requirements for interoperation of the smart port with the smart city",* which provides the requirements for Smart Port interoperation with Smart Cities and other smart elements. Additionally, these requirements are the foundation that enables the provision of enhanced smart services by the Smart Port.
- *ITU-T Y.4459 "Digital entity architecture for IoT interoperability*", This Recommendation defines an architecture framework for information-oriented services that makes use of existing infrastructures, including the Internet infrastructure, to enhance, secure and manage information sharing over a distributed networking environment. This Recommendation can be used with different identification and addressing protocols (e.g. IP and/or non IP based networks).
- *ITU-T Y.4461 "Framework of open data in smart cities",* which defines a framework of open data in smart cities. It clarifies the concept of open data in smart cities, analyses the benefits of open data in smart cities, identifies the key phases, key roles and activities of open data in smart cities and describes the framework and general requirements of open data in smart cities.

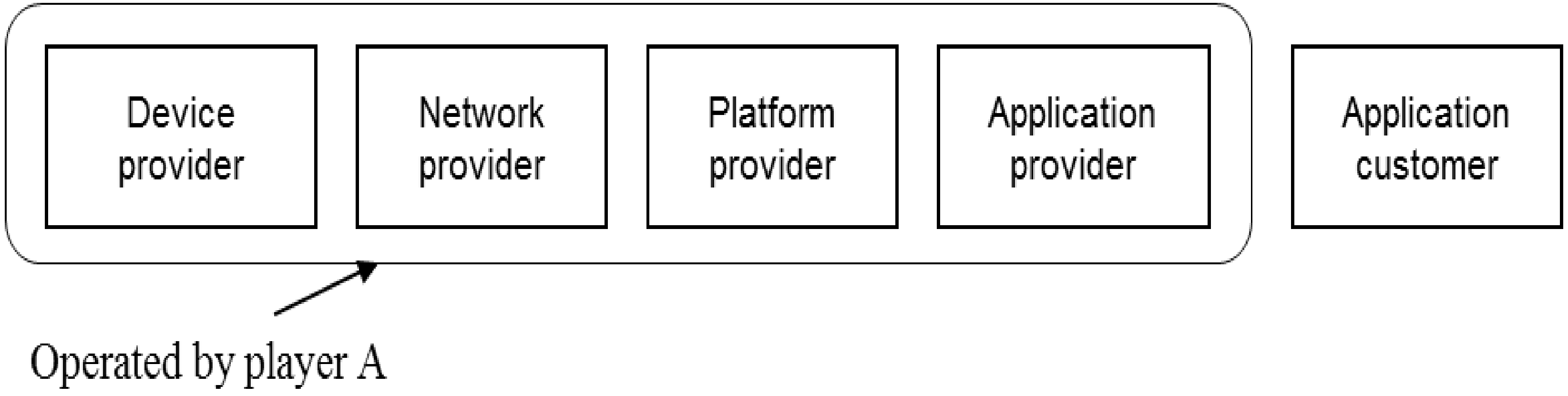
IoT ecosystem and business models



IoT ecosystem

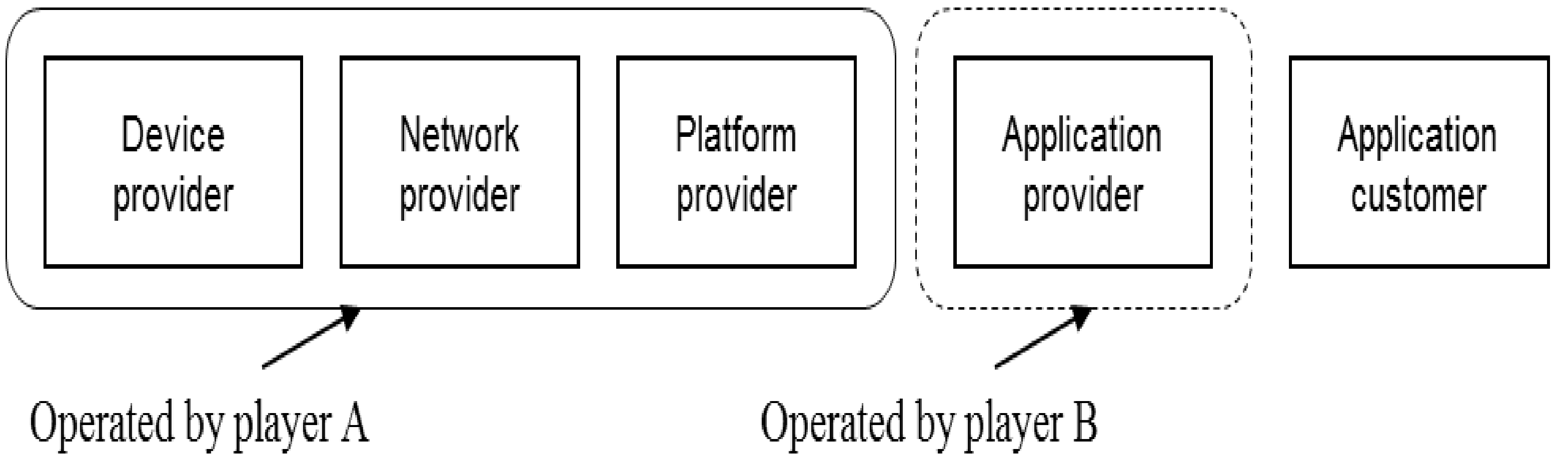
IoT Business models

IoT Business Model 1



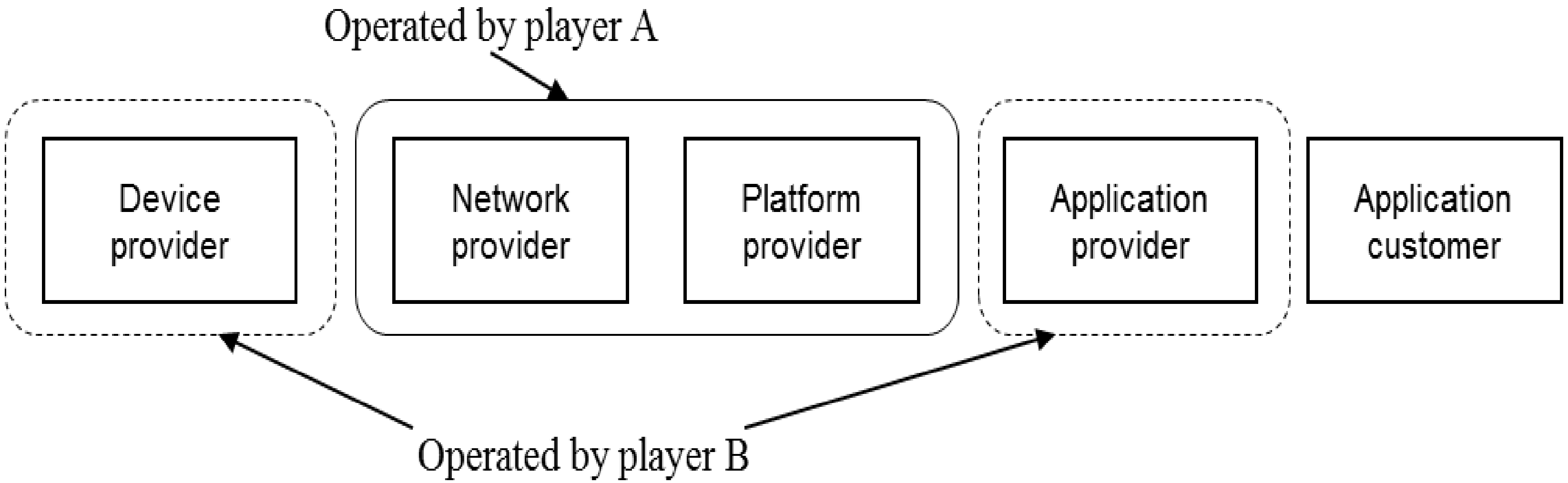
Telecom operators and some vertically integrated businesses (such as smart grid and intelligent transport systems (ITS) businesses) act as player A in model 1.

IoT Business Model 2



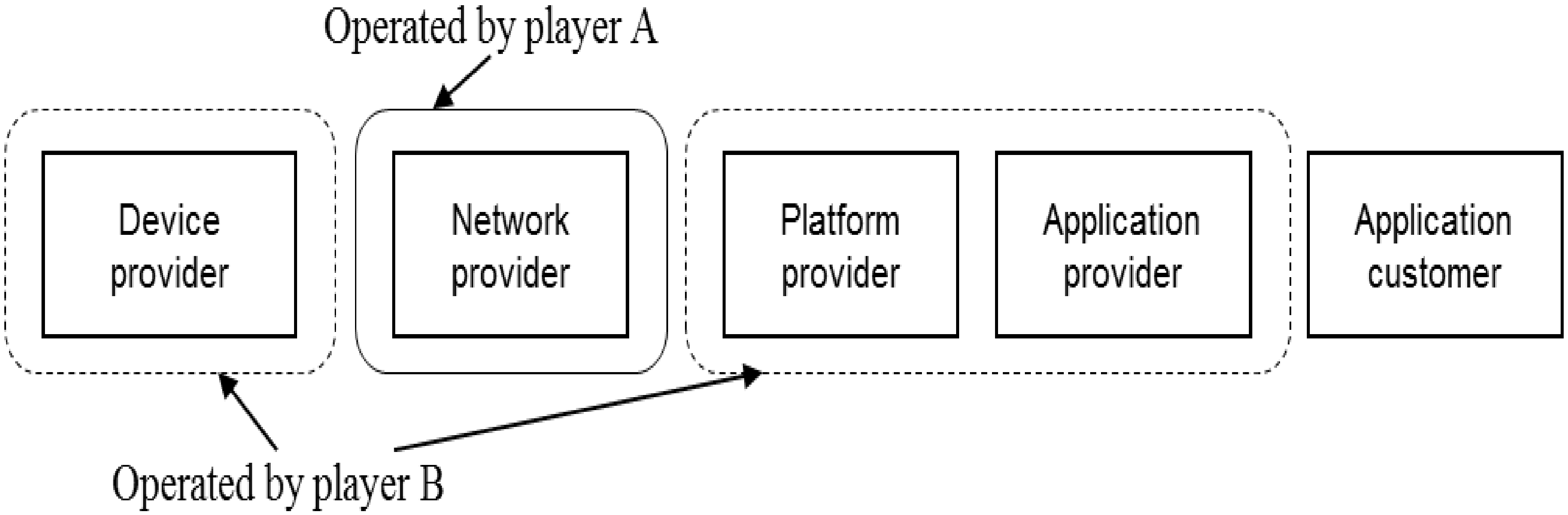
Telecom operators act as player A, other service providers as player B in model 2.

IoT Business Model 3



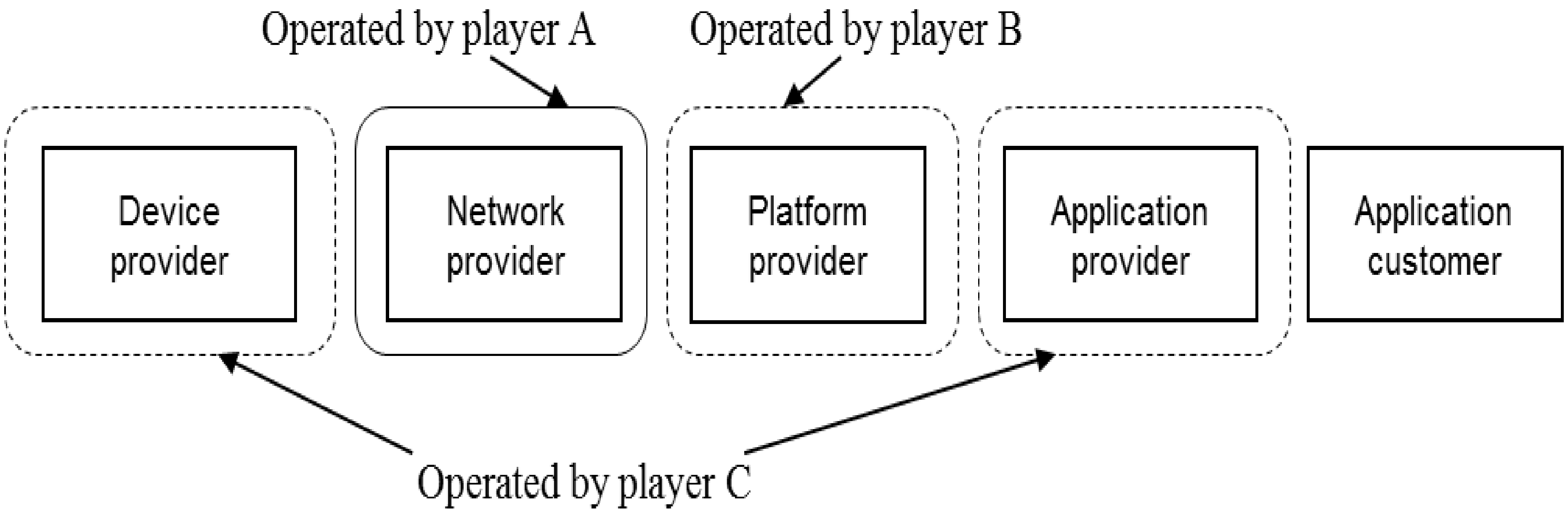
Telecom operators act as player A and other service providers act as player B

IoT Business Model 4



Telecom operators act as player A, other service providers and vertically integrated businesses act as player B in model 4.

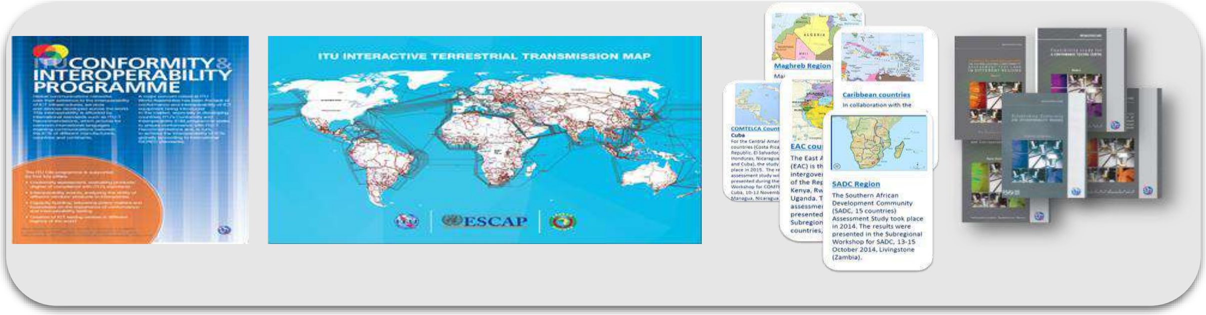
IoT Business Model 5



Telecom operators act as player A, other service providers act as player B, and vertically integrated businesses act as player C in model 5.

Telecommunication Networks

Our work is carried out by various means, including symposia, workshops, conferences, seminars and expert advice as well as information sharing, creation of tools and training material, direct assistance, partnership, publications and events. Our priority areas are as follows:



- **Next-Generation Networks:** assistance on planning, deployment, migration, interoperatbility, digitization and evolution of networks, network elements and applications
- **Broadband Networks (wired and wireless technologies):** assitance with planning, implementation and development of national ICT broadband networks, including promoting IXPs
- **Rural communications:** provision of information on access and backhaul technologies and source of power supply, latest technologies and best practice, implementation of projects on public community broadband access points
- **Conformance and interoperability (C&I):** assistance on the establishment of national, regional or subregional C&I programmes, assessment and feasibility studies, providing information and training to technicians, policy-makers and businesses on C&I, providing guidelines on C&I
- **ITU Broadband, IPv6 and Internet Exchange Implementations:** to provide broadband connectivity free or low cost digital access for schools, hospitals, underserved populations; IXPs to reduce transmission costs, optimize Internet traffic, improve QoS
- **ITU Interactive Transmission Maps:** cutting-edge ICT-data mapping platform to take stock of national backbone connectivity and other key ICT metrics.
- **Bridging the Standardization Gap**: Increasing the knowledge and capacity of developing countries for the effective application/implementation of standards
- **WSIS** ALC2 (Infrastucture)

For more information please visit: http://www.itu.int/en/ITU-D/Technology/Pages/default.aspx

Telecommunication Networks

ITU Broadband, IPv6 and Internet Exchange Implementations

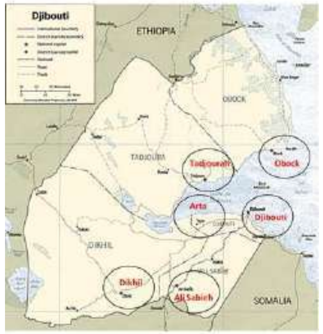
- **Broadband Wireless Networks Implementation**: To provide broadband connectivity free or low cost digital access for schools and hospitals, and for underserved populations in rural and remote areas in selected countries.
- **Internet Exchange Development**:

To bring the value of IXPs in leveraging the benefits of connectivity through potentially reduced transmission costs, optimized Internet traffic, improved Quality of Service.

Widely accepted best practices for the design, installation and operation of IXPs. peering as an effective way for Internet Service Providers (ISPs) to improve the efficiency of operations and interconnection business relationships

Broadband Wireless Projects

Djibouti - Mobile WiMax standard IEEE802.16e

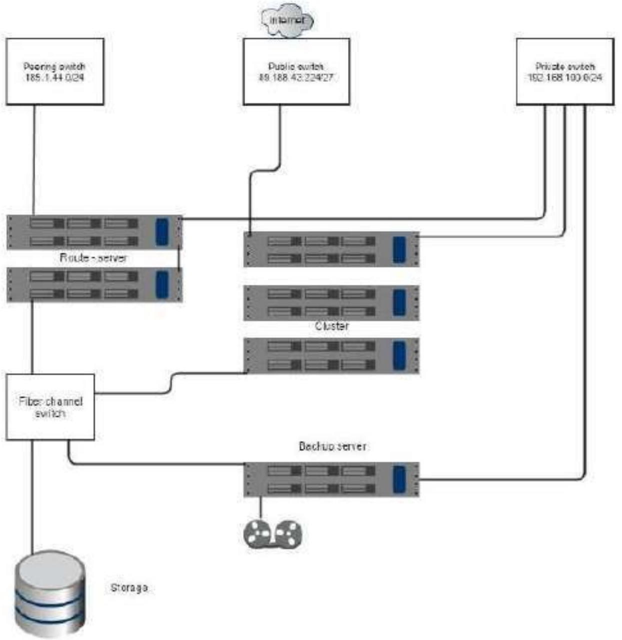


Burundi Training & Network Installation

Swaziland Project Implementation - field Missions

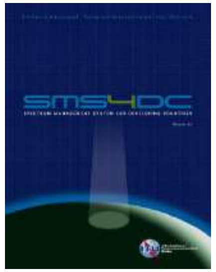
Burundi - Connecting Hospitals for E-Health

IXP In Montenegro



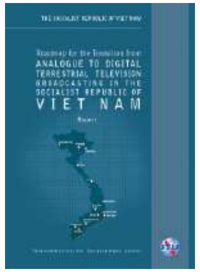
- Implemented and operational since July 2015

Spectrum Management and Broadcasting



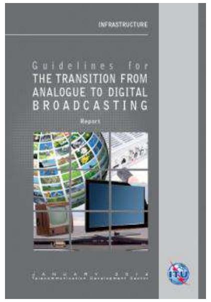
Spectrum Management Tool (SMS4DC)

- A computer program to assist the administrations of developing countries
- On technical and regulatory procedures for managing spectrum
- around 50 subscribers



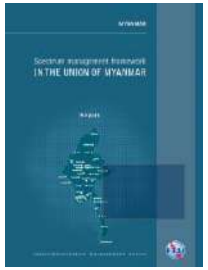
National Roadmaps for Digital Broadcasting Transition

- ITU has helped over 30 countries around the world since 2009 for establishing national goals, strategies, key activities and so forth



The Guidelines for DTTB Transition

- for the smooth transition to Digital Terrestrial Television Broadcasting (DTTB)
- On policy, technologies, network planning, customer awareness and business planning
- Worldwide revision published in 2014



Direct assistance in spectrum management

- Assistance in Cross Border Frequency Coordination (HCM4A in Africa)
- Spectrum management assessment
- Establishment of spectrum master plans
- Spectrum monitoring
- Consulting to specific issues (e.g. spectrum fee, NTFA)

Other Activities

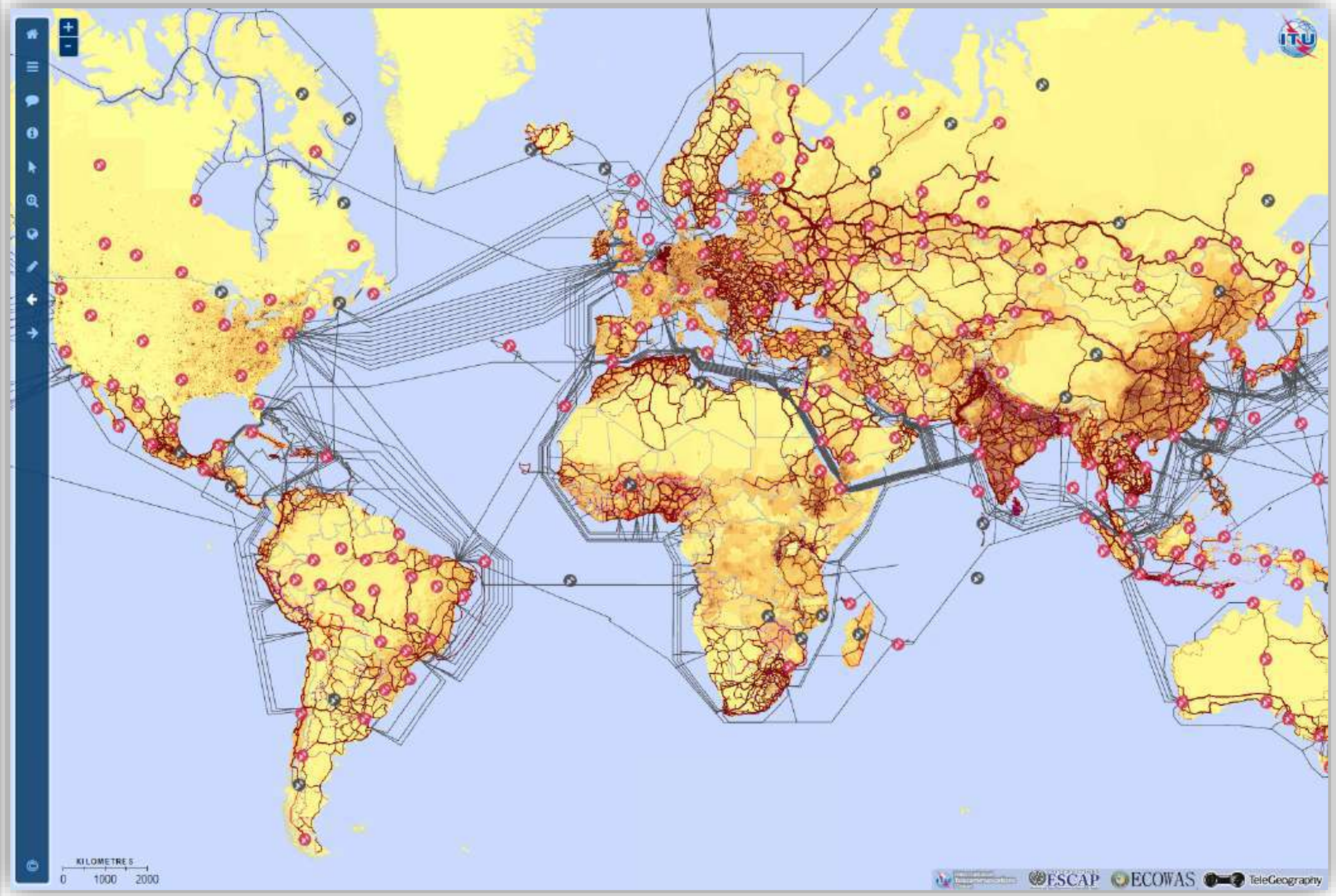
- DSO database on status of the transition to Digital Terrestrial TV Broadcasting
- Spectrum Management Training Program (SMTP)
- ITU-D Study Group Questions (Q8/1, Resolution 9, Q7/2)
- WSIS Action Lines (C3, C7 e-science, C9)

ITU Interactive Transmission Maps

The Interactive Transmission Maps are a cutting-edge ICT-data mapping platform to take stock of national backbone connectivity (Optical Fibres, Microwaves and Satellite Earth Stations) as well as of other key metrics of the ICT sector. Data concerning submarine cables are also included as provided by TeleGeography

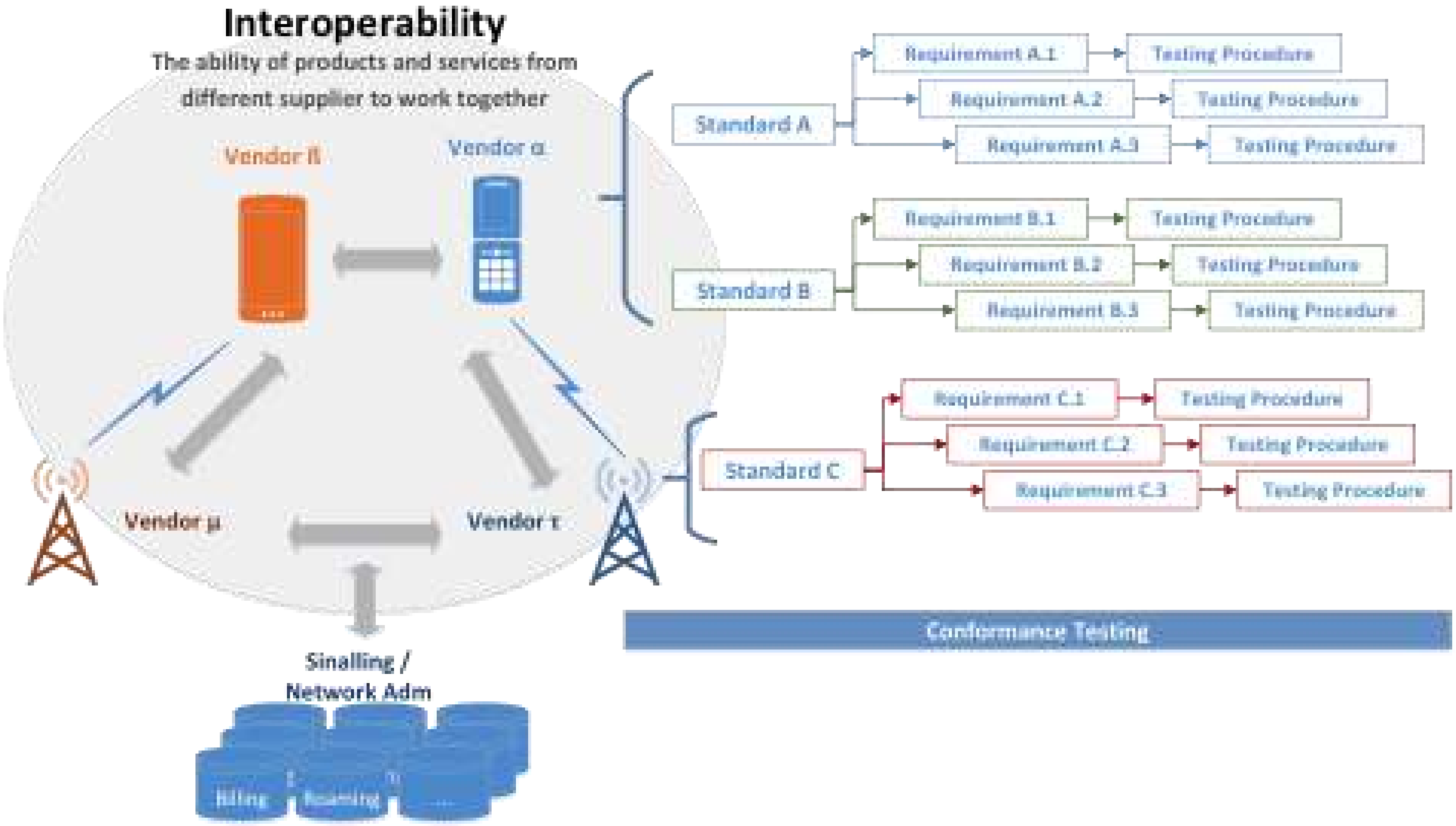
- **The Scope** of this ITU project is to research, process and create maps of core transmission networks worldwide

- **The Objectives** of this ITU project are:
  - to assess the status of national connectivity and to identify gaps enabling the design of targeted strategies and implementation programs for increasing the use of broadband.
  - to assess market opportunities, thus serving as a management tool for making investment decisions, promoting broadband and achieving universal connectivity.
  - to be used as a source of abundant and current data on global ICT connectivity.



http://itu.int/go/Maps

Conformity and Interoperability

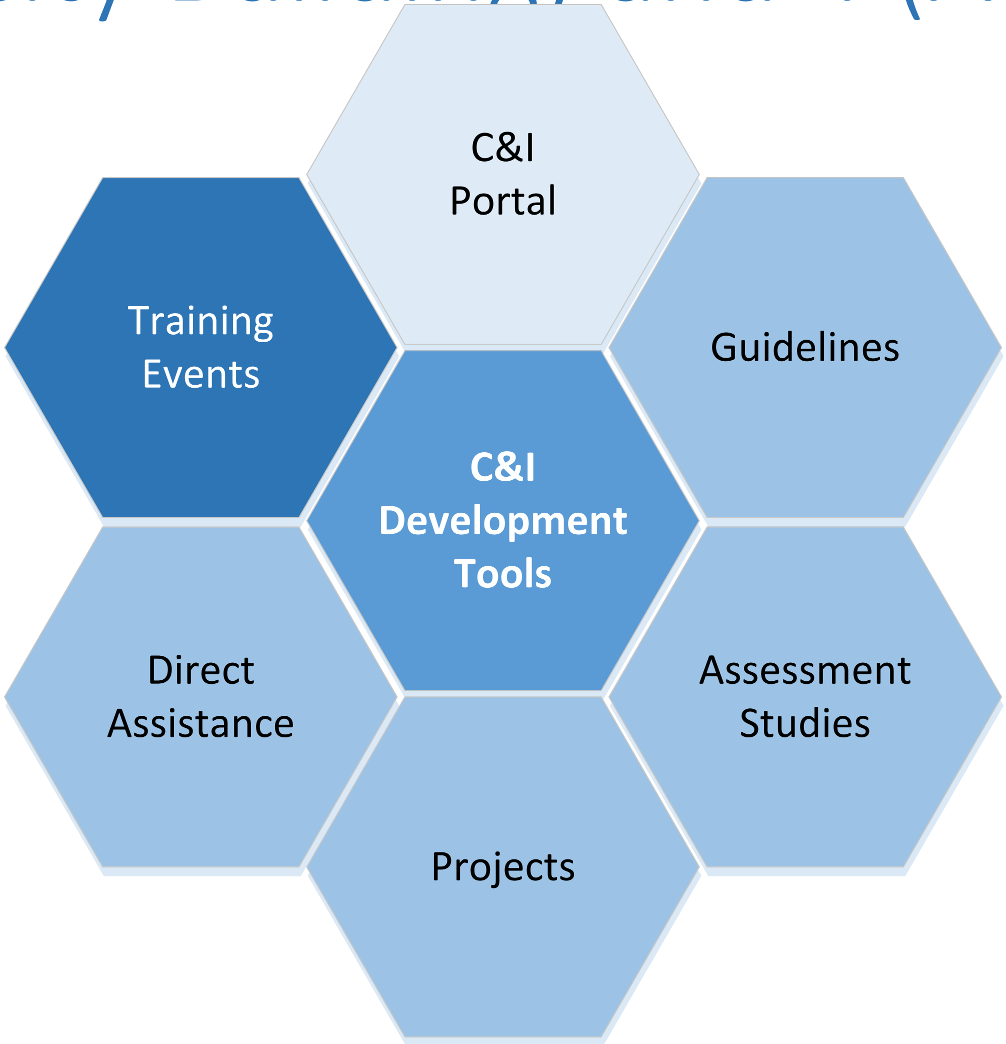


Conformity Assessment

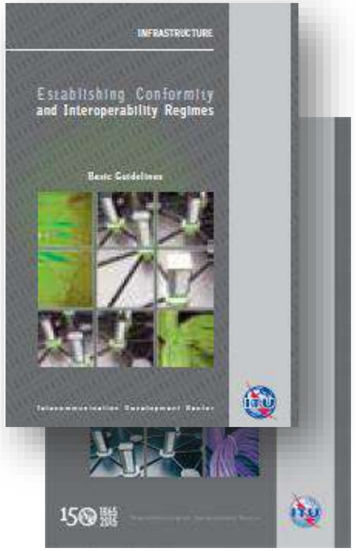
Demonstration that specified requirements relating to a product, process or system are fulfilled

ITU – C&I Programme

Pillars 3 (Capacity Building) and 4 (Assistance)

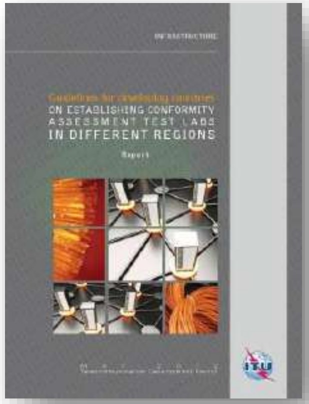


ITU C&I - Guidelines



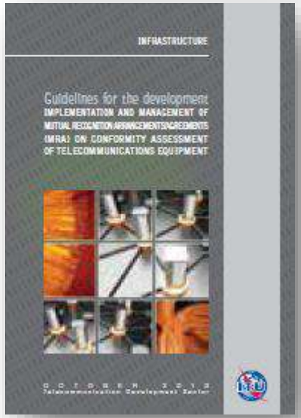
Establishing Conformity and Interoperability Regimes – Basic Guidelines (2014) and Complete Guidelines (2015)

These Guidelines address challenges faced by developing countries as they plan and review their own C&I regimes. Aspects covered by this publication include, inter alia, conformity assessment procedures; legislation to promote an orderly equipment marketplace; surveillance; coordination across regulatory agencies; and relevant international standards.



Guidelines for developing countries on Establishing Conformity assessment Test Labs in Different Regions (2012)

This set of guidelines is the first publication on C&I, its valuable content includes information concerning: The process required for building testing labs; A site analysis (e.g. existing testing labs, know-how);Collaboration mechanisms; Best practices; Reference standards and ITU Recommendations



Guidelines for the Development, Implementation and Management of Mutual Recognition Arrangements/Agreements on Conformity Assessment (2013)

These guidelines promote the understanding and establishment of Mutual Recognition Agreements (MRAs) on conformity assessment that are intended to promote efficiency and resource sharing as well as to streamline the flow of products among participating Parties such as ITU Member States and private sector organizations, such as testing laboratories

Feasibility Study for the establishment of a Conformance Testing Centre (2013)

This feasibility study describes environments, procedures and methodologies to be adopted to establish, manage and maintain a testing center covering different kinds of conformance and interoperability testing areas

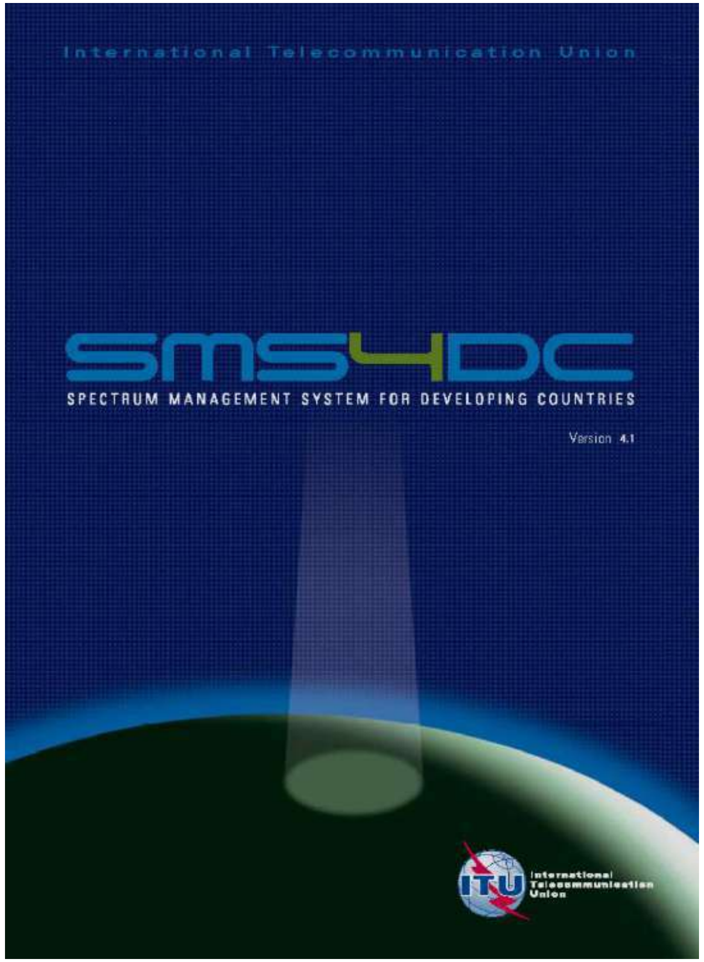
http://itu.int/go/CI_Guidelines

Spectrum Management

Spectrum Management and Broadcasting - summary

- Spectrum management
  - Spectrum Management Tool for Developing Countries (SMS4DC)
  - Assistance in Cross Border Frequency Coordination (HCM4A)
  - Spectrum Management Assessment, SM Master Plans
  - Spectrum Management Training Program (SMTP)
- Broadcasting
  - Guidelines for Transition to Digital Broadcasting (E, F, S)
  - Assistance for the preparation of national roadmap (more than 40 countries since 2009)
  - DSO database
- Others
  - ITU-D Study Group Questions (Q2/1, ex. 8/1, Q7/2)
  - WSIS Action Lines (C2, C3, C7 e-science, C9)

Spectrum Management Tool (SMS4DC)

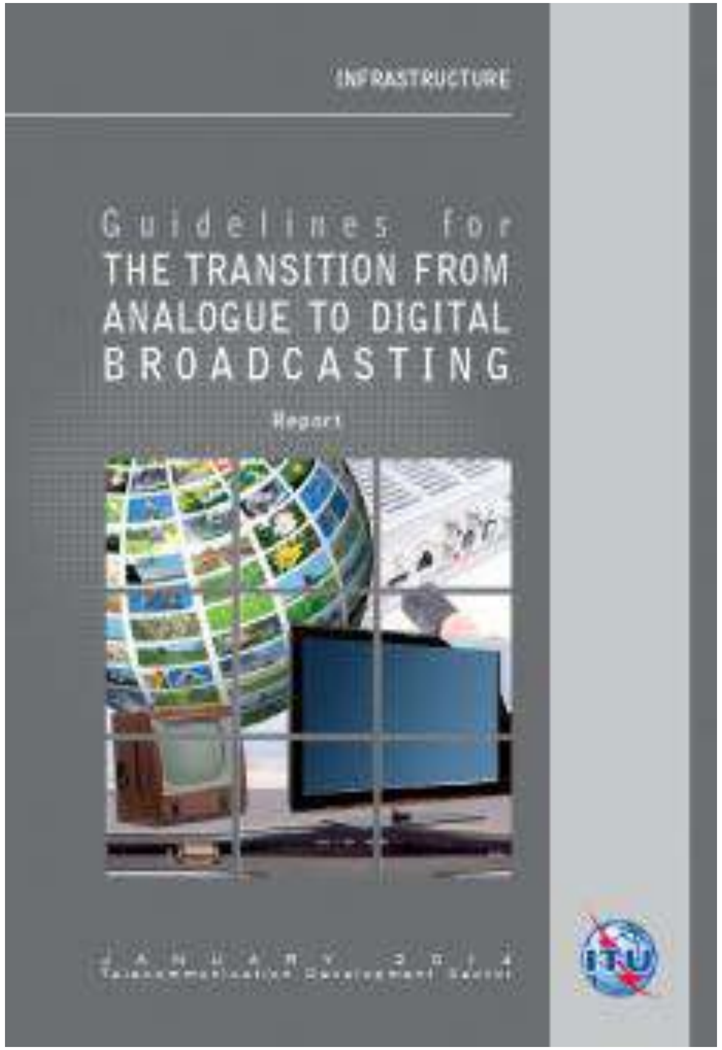


- ❑ A computer program to assist the administrations of developing countries
  - On technical and regulatory procedures for managing spectrum
  - A software package on CD containing a digital terrain map (only 1 km resolution!)
- ❑ Known as Spectrum Management System for Developing Countries (SMS4DC)
  - Made available in 2007, current version is 5.1
  - Subscribers: around 50 countries

Cross Border Frequency Coordination

- Harmonized Coordination Method for Africa (HCM4A)
  - Set a standard on a mutually beneficial approach by consensus
  - Provide a solid basis for bilateral and mutual agreements
  - Oblige each country to take account of other stations
- Implementation of HCM4A in four phases
  1. Assessment of existing administrative and technical procedures
  2. Multilateral agreement proposal by technical working group
  3. Validation workshop to adopt draft agreement
  4. Development of HCM4A software
- HCM4A involves 4 sub regions
  - Central, East, Southern and West Africa

The Guidelines for Transition to Digital Broadcasting



- ❑ Intended to provide information and recommendation
  - On policy, technologies, network planning, customer awareness and business planning
  - for the smooth transition to Digital Terrestrial Television Broadcasting (DTTB) and introduction of Mobile Television Broadcasting
- ❑ Prepared in 2010 for Africa
  - 1st Revision (2012) for ASP adding a section on archives migration
  - 2nd revision (2014) for global including Satellite TV, Cable TV, IPTV

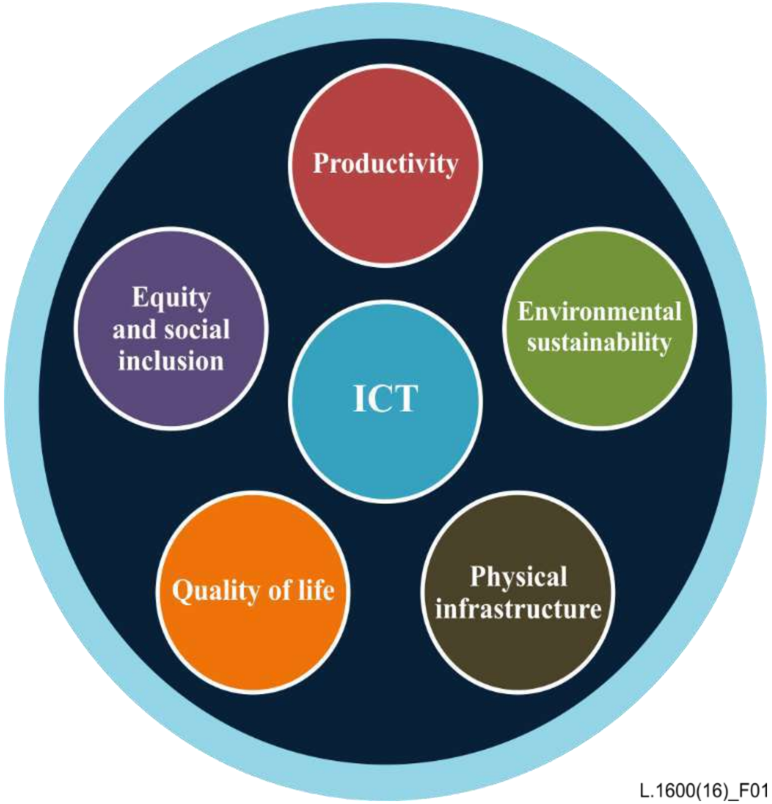
Key Performance Indicators in smart sustainable Environment

KPIs focuses specifically on a set of ICT-related indicators for smart sustainable Environment/Cities

The dimensions of KPIs can be categorized as shown :

- Information and communication technology
- Environmental sustainability
- Productivity
- Quality of life
- Equity and social inclusion
- Physical infrastructure

In the UN-Habitat prosperity index, ICT forms part of the general 'Infrastructure' category. ICT is defined as a separate category to highlight the focus of ITU.



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Thank you

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ITU-R studies in support of the Internet of Things

The Internet of Things

IoT **enables a wide range of devices to be sensed or controlled remotely** and to **exchange data through connection to the Internet network infrastructure**.

IoT has a **very broad range of application** – extending from **smart clothing**, to **smart cities**, to **global monitoring systems**.

To meet these varied requirements, **a range of access technologies, both wired and wireless, are required** to provide access to the network.

Connections of IoT applications **using wired technologies and short-range wireless technologies**, are **now being augmented by the deployment of low power wide area networks and optimized mobile cellular and satellite systems**.

Wireless access

The **spectrum requirements and standards** for **IoT wireless access technologies and techniques** are **being addressed in ITU-R**, including:

- **protection of radio services** from power line telecommunication system emissions
- **harmonization of frequency ranges, technical and operating parameters** used for the operation of **short range devices (SRDs)**
- standards for **wide area sensor and actuator network (WASN) systems**
- spectrum to support the implementation of **narrowband and broadband machine-type communication infrastructures**
- support for **massive machine-type communications** within the framework of the **standards and spectrum for IMT-Advanced (4G) and IMT-2020 (5G)**
- use of **fixed-satellite and mobile-satellite communications** for IoT

Resolution ITU-R 66-1: *Continue studies related to wireless systems & applications for the development of the Internet of Things*

- **Different radiofrequency bands**, many of which provide **communication channels, infrastructure and capacity**, could be used with the aim of **ensuring cost-effective IoT deployment and efficient use of the radiofrequency spectrum**
- IoT is a **concept encompassing various platforms, applications, and technologies** that are, and will continue to be, **implemented under a number of radiocommunication services**
- IoT implementation currently **does not require specific regulatory provisions in the Radio Regulations**

➢ ITU-R continues **studies on technical & operational aspects** of **radio networks &systems for IoT**

➢ Development of ITU-R Recommendations, Reports and/or Handbooks as appropriate, on the basis of the studies

Source: Resolution ITU-R 66 http://www.itu.int/pub/R-RES-R.66

Power Line Telecommunication (PLT)

- Question **ITU-R 221-2/1** calls for **studies of acceptable levels of radiation from telecommunication systems utilizing wired electrical power supply so as not to impair the performance of radiocommunication systems**

- **Reports ITU-R SM.2158 and ITU-R SM.2212 on Impact of PLT systems on radio systems operating below 80 MHz and in the VHF and UHF bands above 80 MHz**
  - ✓ Illustrates the potential for interference to various radiocommunication services in the presence of emissions/radiation from PLT systems and devices
  - ✓ Describes the radio-frequency emission/radiation characteristics of PLT systems as well as the characteristics and protection criteria of radiocommunication systems
  - ✓ Discusses potential methods for mitigating interference from PLT emissions

- On-going studies on the consideration of the interference potential of the **use of MIMO diversity techniques for home networking systems based on PLT**

Sources: Question ITU-R 221-2/1 http://www.itu.int/pub/R-QUE-SG01.221
Report ITU-R SM.2158 http://www.itu.int/pub/R-REP-SM.2158
Report ITU-R SM.2212 http://www.itu.int/pub/R-REP-SM.2212

Studies mainly by ITU-R WP 1A

Power Grid and Smart Grid utility

- Question **ITU-R 236/1** calls for studies including on:
  data rates, bandwidths, frequency bands and spectrum requirements needed in support of power grid management systems and interference considerations to radiocommunications associated with the **implementation of wireless** and wired **technologies and devices** used in support of **power grid management systems**

- **Report ITU-R SM.2351 on Smart grid utility management systems provides**
  - ✓ A general description of the smart grid systems (network technologies, objectives and benefits, reference architecture overview, standards (incl. wireless), etc.)
  - ✓ Interference considerations associated with the implementation of wired and wireless data transmission technologies used in power grid management systems
  - ✓ Impact of widespread deployment of wired and wireless networks used for power grid management systems on spectrum availability

- On-going studies to update this Report regarding the **use of both narrow-band wireless & wide band IMT based technologies** for smart grid management & smart metering

Sources: Question ITU-R 236/1 http://www.itu.int/pub/R-QUE-SG01.236
Report ITU-R SM.2351 http://www.itu.int/pub/R-REP-SM.2351

Short Range Devices (SRDs)

- **Achieve Harmonization for SRDs** for Economies of scale; Technological advances / Tuning ranges; Spectrum sharing; Integration in consumer products crossing borders
  - ✓ Harmonization of technical and operating parameters (use advanced technologies)
  - ✓ Measurement procedures to verify these parameters and ensure protection to radio services
  - ✓ Deployment in specific bands, harmonised globally or regionally (may ease the use of relevant frequency bands/tuning ranges, preferably on a global or regional basis)
  - ✓ Recognized role played by some SRDs in the Internet of Things (IoT)
- Technical & operating parameters and spectrum use for SRDs (Rep. ITU-R SM.2153)
- Frequency ranges for global/regional harmonization of SRDs (Rec. ITU-R SM.1896)
  - Considering new range around 1.6 GHz for Assistive Listening Systems
- Global harmonization of SRD categories (Rec. ITU-R SM.2103)
- Opportunities to contribute to the next WP 1B meeting (24 Nov. – 2 Dec. 2020)

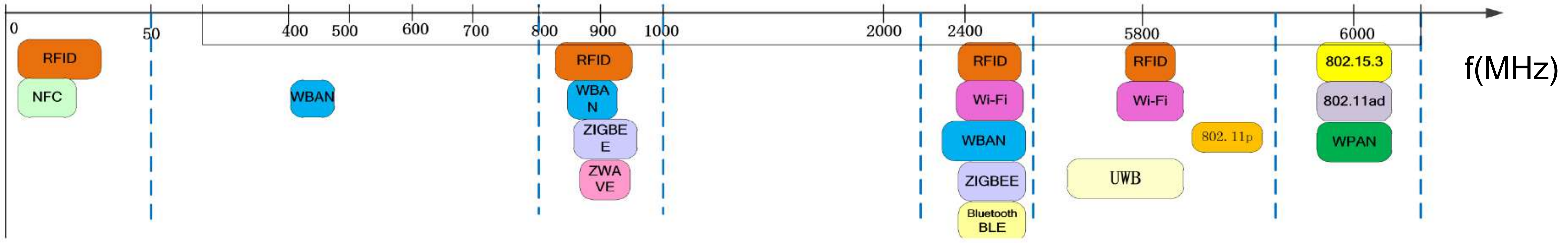
Studies mainly by ITU-R WP 1B

Source: Resolution ITU-R 54-3 http://www.itu.int/pub/R-RES-R.54

Typical applications supported by SRDs

Class	Applications	Technologies
Personal Area Networks (PANs)	Headsets, device links (e.g. medical/sport to iPhone)	Bluetooth®(2.4 GHz)
Home Area Networks (HANs)	Alarms, Home Automation, Smart Lighting (sub GHz)	ZigBee® (2.4 GHz), KNX® (868-870 MHz), Wideband Networking such as IEEE 802.11ah (sub GHz)
RFID (See Report ITU-R SM.2255)	Tag reading, Ticketing, payment cards, car tolls	Sub GHz (4-channel plan) and 2.4 GHz
Metropolitan Area Networks (MANs)	Sensing and control applications	Low Power Wide Area Networks (LPWAN – LoRa™ and SigFox) (sub GHz); Wi-SUN (sub GHz) Low speed metering networks (169 MHz)
Satellite M2M	Truck tracking, remote sensor reading	Under study at 862-863 MHz

Some widely deployed SRD technologies in Sub 6 GHz bands



Source: Presentations at the ITU Workshop on Spectrum Management for IoT Deployment (www.itu.int/go/ITU-R/RSG1SG5-IoT-16)

LPWAN and VLC

- **Low Power Wide Area Networks (LPWAN) for MTC* and IoT in harmonised frequency ranges operating under SRD regulations** - Rep. ITU-R SM.2423:
  - ✓ describes some **LPWAN technologies and operational aspects**
  - ✓ explains that **SRD regulations are suitable for LPWAN** (**general authorisation regime**, or **licence exemption**)
  - ✓ presents some applications using LPWAN for **smart cities**, **manufacturing**, **home automation**, **environment & agriculture**, **transport & logistics**, **energy & utilities** (e.g. with typically numerous devices transmitting a few messages per day)
  - ✓ Indicates some **frequency ranges** used for LPWAN in **Region 1: 865-870 MHz**; **Region 2: 902-928 MHz**; **Region 3: 915-925 MHz**.

Studies mainly by ITU-R WP 1B

- Rep. ITU-R SM.2422 on **Visual Light for broadband Communications (VLC)** using **Image sensor Com'(ISC), Low or High Rate Photodiode receiver Com' (LR-PC / HR-PC)** suitable **for different applications such as IoT** (wavelengths typically between 390 and 750 nm)
- Opportunities to contribute to the next WP 1A meeting (24 Nov. – 2 Dec. 2020)

Studies mainly by ITU-R WP 1A

Sources: Report ITU-R SM.2423 http://www.itu.int/pub/R-REP-SM.2423 on LPWAN
Question ITU-R 238/1 http://www.itu.int/pub/R-QUE-SG01.238 on VLC
Report ITU-R SM.2422 http://www.itu.int/pub/R-REP-SM.2422 on VLC

* Machine-Type Communication

Wide-area Sensor and Actuator Network (WASN) Systems

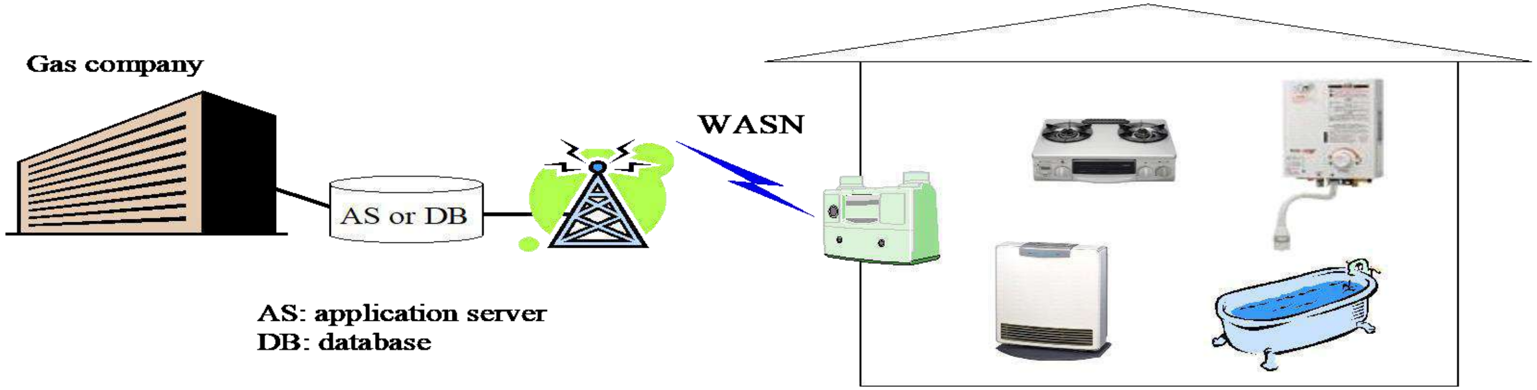
Wide-area sensor and/or actuator network (WASN) systems support machine-to-machine communications to a large number of sensors and/or actuators.

- Recommendation ITU-R M.2002 "*Objectives, characteristics and functional requirements of wide-area sensor and/or actuator network (WASN) systems*". The key objective of WASN systems is to support machine-to-machine service applications irrespective of machine location.
- Report ITU-R M.2224 "*System design guidelines for wide area sensor and/or actuator network (WASN) systems*". The Report provides detailed information for system design policy, the wireless applications and examples of WASN systems for information sharing.

Studies by ITU-R WP 5A

WASN – 2 main network functionalities

- *Automatic sensing and information collection*: automatically collect the information acquired by sensors and send it to application servers (ASs) or databases (DBs) via the core network.



- *Remote actuator control*: control actuators remotely using ASs via the core network.

IMT-based & Non-IMT-based MTC

- **Technical and operational aspects of terrestrial IMT-based radio networks and systems** supporting **MTC applications**, as well as spectrum needed, including possible harmonized use of spectrum to support the implementation of narrowband and broadband MTC infrastructure and devices can be found in Report ITU-R M.2440.
- Other information on **various Wireless Industrial Automation (WIA) applications (**incl. factory automation, process automation, audio visual interaction, remote control, mobile robotics and vehicles, ranging from low latency applications (e.g. robotic arms) to reliable and secure applications (e.g. driverless autonomous transportation systems) can be found in Report ITU-R M.2479. It also includes information of the applications of MTC in Smart Grid, such as millisecond-level precise load control, distribution automation, electricity information acquisition, distributed generation monitoring, electric vehicle charging stations;
as well as examples of frequency bands used for IoT/M2M applications.

Studies by ITU-R WP 5A (non-IMT) and ITU-R WP 5D (IMT)

Sources: Report ITU-R M.2440 http://www.itu.int/pub/R-REP-M.2440 on IMT-based MTC
Report ITU-R M.2479 http://www.itu.int/pub/R-REP-M.2479 on non-IMT-based MTC

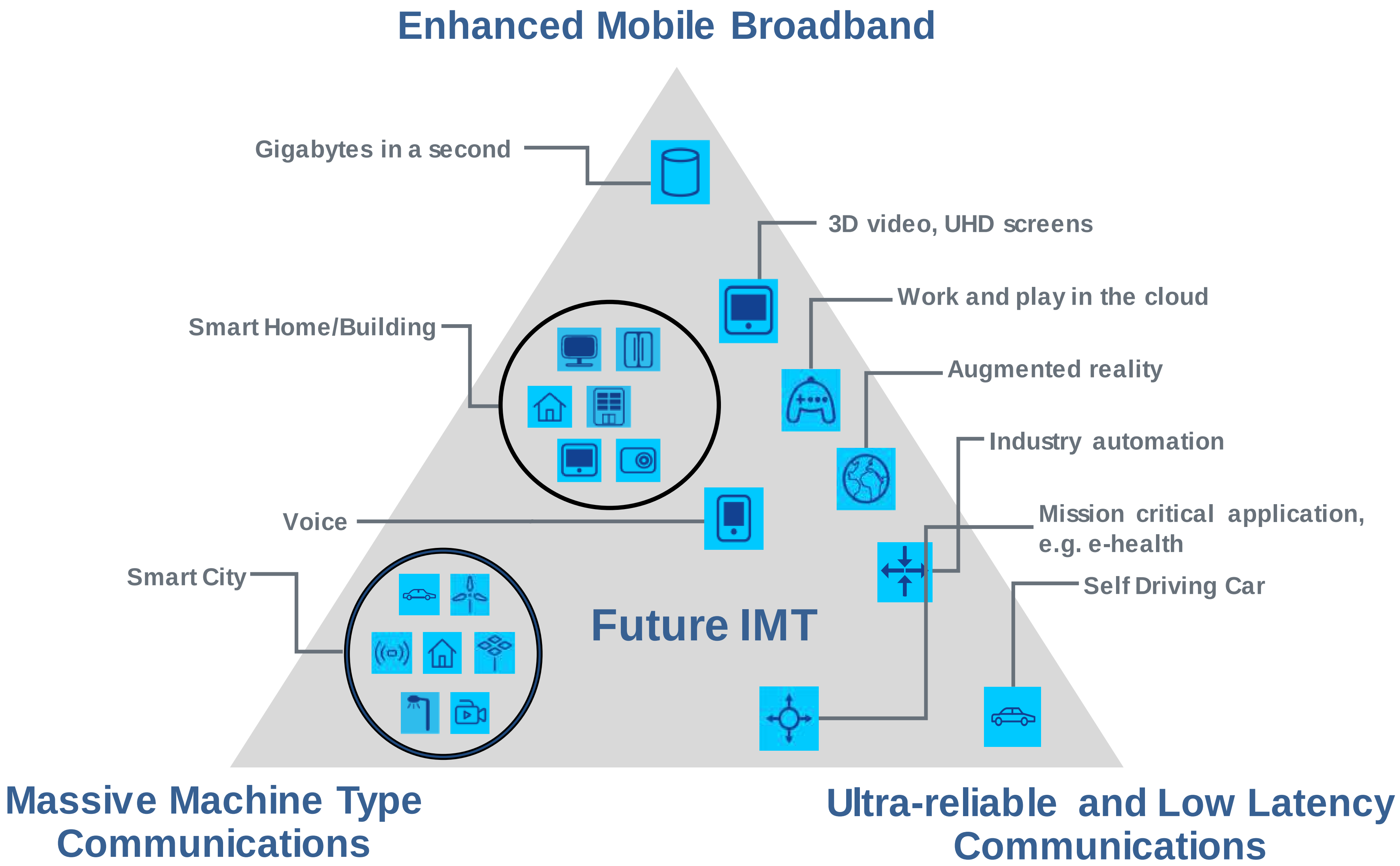
IMT - International Mobile Telecommunications

IMT support for IoT:

- In the short term, the current IMT-Advanced 4G standard (Rec. ITU-R M.2012) is being enhanced to include support for IoT (e.g. NB-IoT systems).
- In the longer term, IoT is seen as an integral element of the IMT-2020 5G standard being developed in ITU – extending the benefits of the IMT massive economies of scale and globally harmonized frequencies and standards to all industry sectors.
- The framework and overall objectives of the future development of IMT for 2020 and beyond is detailed in Recommendation ITU-R M.2083.

Studies by ITU-R WP 5D

5G usage scenarios



Integration of **satellite systems** into Next Generation Access Technologies

Satellites have the capability to cover a wide area and, in many cases, have high throughput capacity which allows the following:

- Scalability: by leveraging multicast capabilities across a wide area with simultaneous local caching in the cloud as close as possible to the end user, significant "statistical multiplexing benefits" can be gained, leading to a more efficient use of overall bandwidth and a more reliable service.

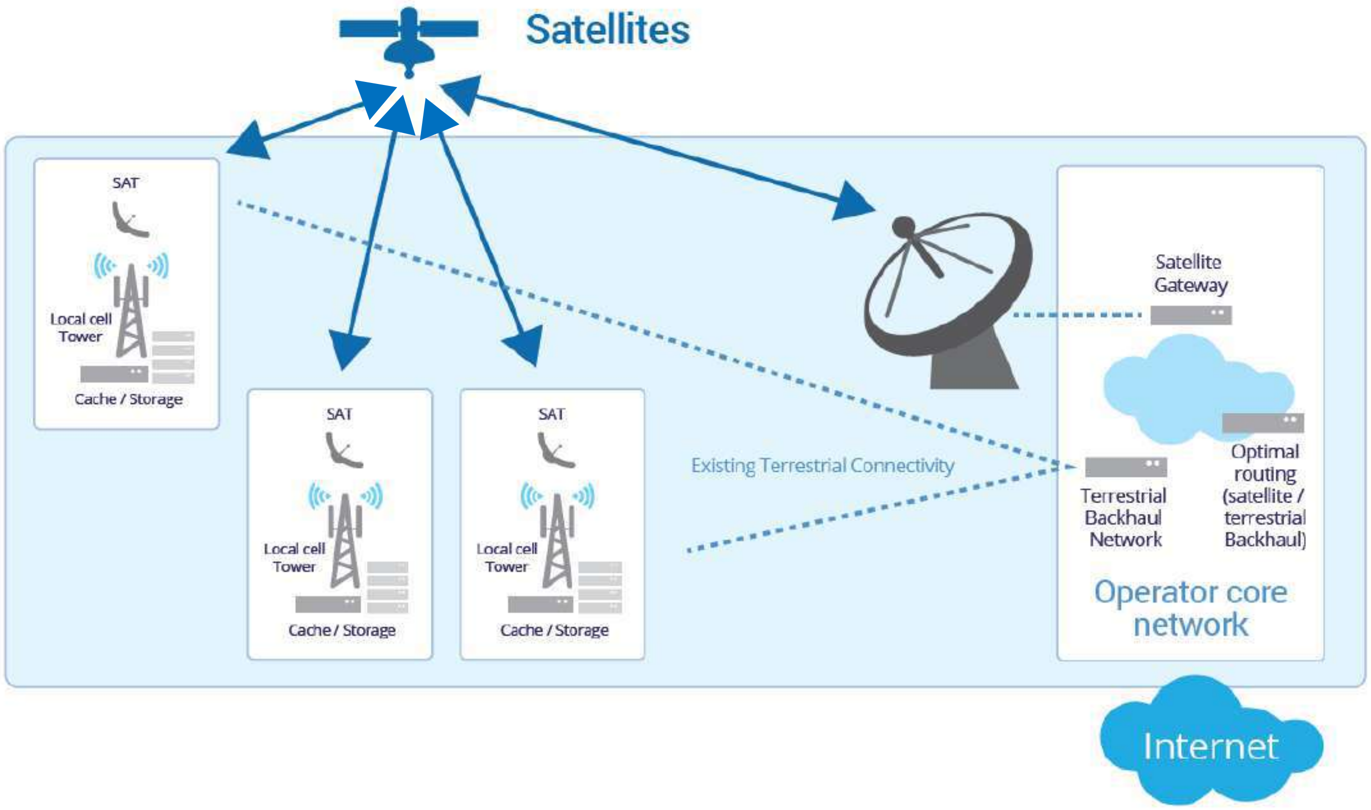
- Rapid deployment of connectivity: satellite ground stations can be rapidly deployed to connect any place within their footprint, allowing connection of cities, villages, businesses and homes with a predictable quality of service. Moreover, satellite networks are resilient to physical attacks and natural disasters – a property that provides a solution for secure communications.

Satellites will thus be able to help facilitate the development of Next Generation Access Technologies. Both geostationary and non-geostationary satellite systems provide unique benefits to Next Generation Access Technologies.

Source: Report ITU-R M.2460 http://www.itu.int/pub/R-REP-M.2460

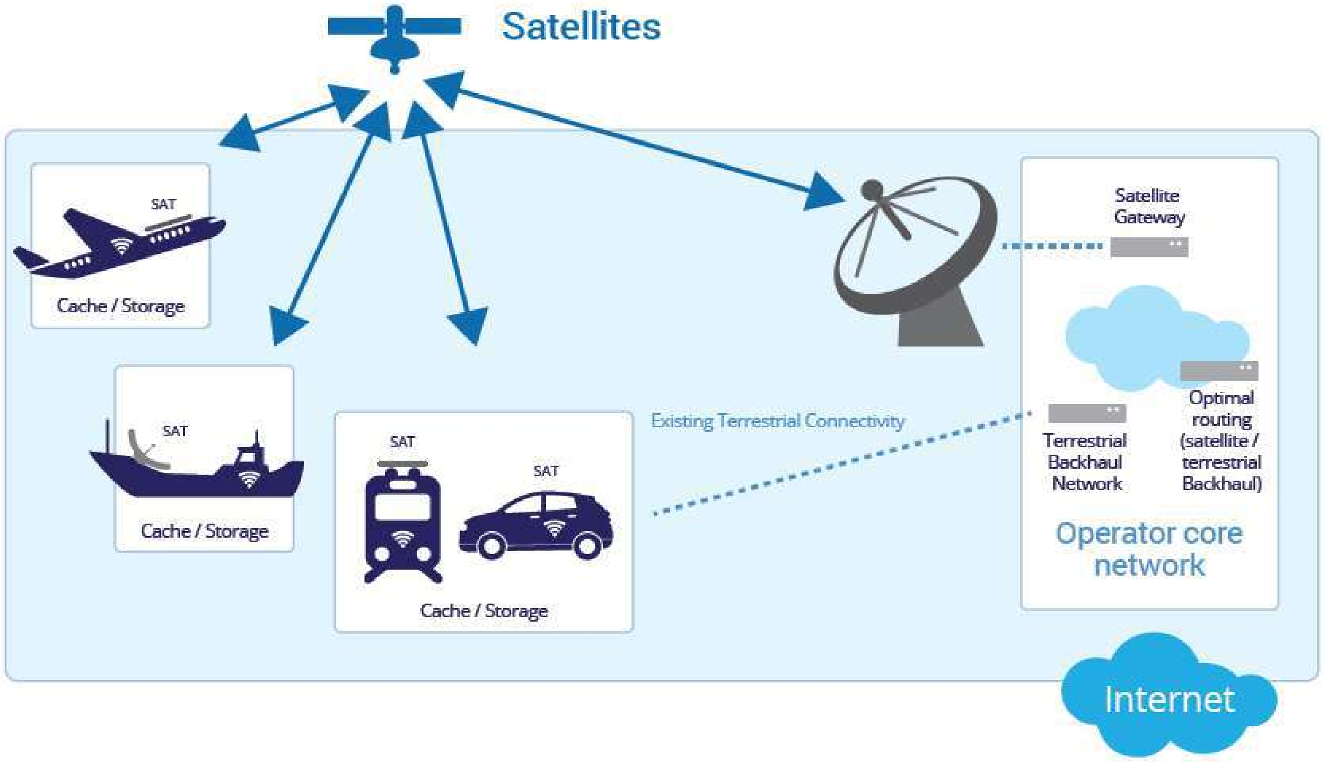
Studies by ITU-R WP 4B

Example use case - Backhauling and Multicasting Tower Feed



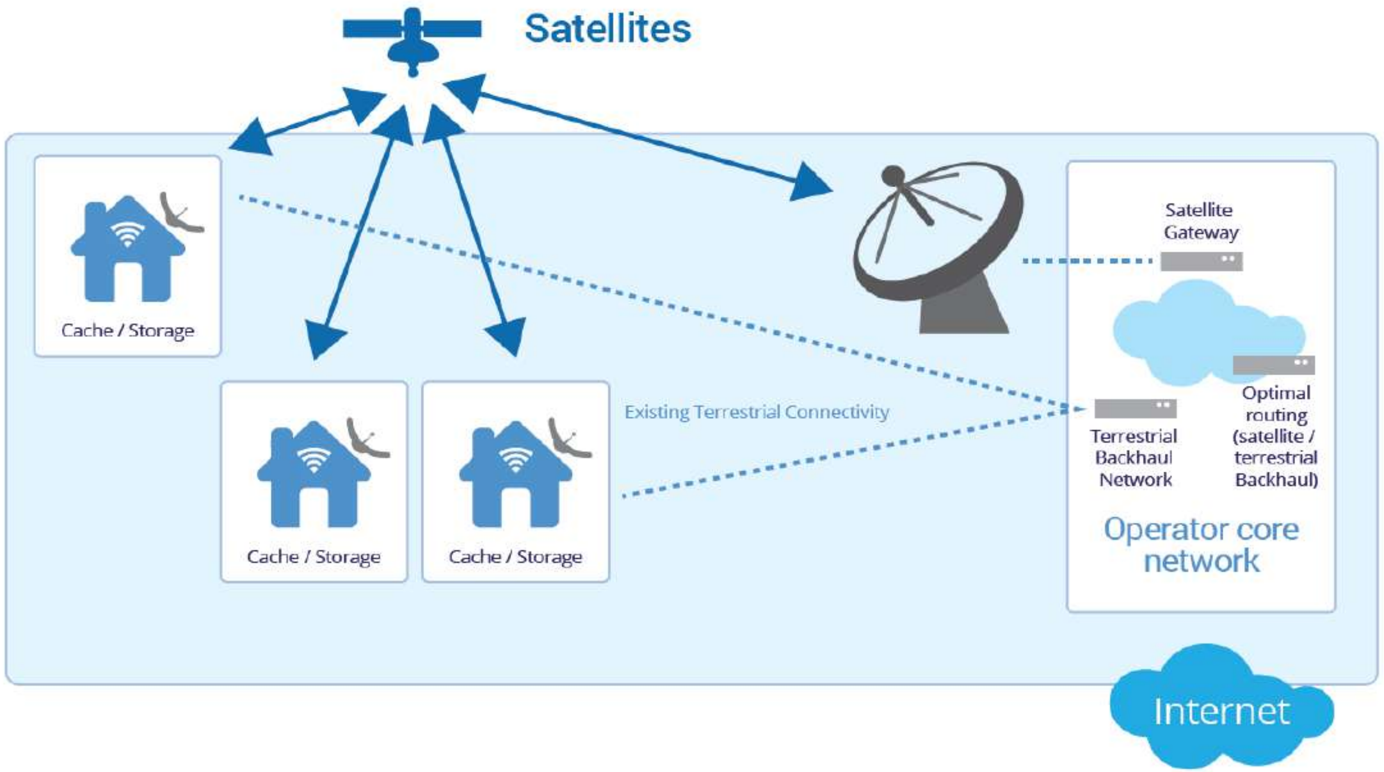
A high throughput, multicast-enabled, satellite link from geostationary and/or non geostationary satellites, direct to the cell towers complements existing terrestrial connectivity to enable backhaul connectivity to individual cells with the ability to multicast the same content (e.g. video, HD/UHD TV, as well as non-video data) across a large coverage area as well as efficient backhauling of aggregated IoT traffic from multiple sites.

Example use case - Communications on the Move



A high throughput, multicast-enabled, satellite link from geostationary and/or non-geostationary satellites, provides connectivity to individual planes, vehicles, trains and vessels (including cruise ships and other passenger vessels), with the ability to stream unicast on demand content (e.g. Over-the-Top IPTV) or multicast the same content (e.g. video, HD/UHD TV, as well as other non-video data such as FOTA/SOTA) across a large coverage (e.g. for local storage and consumption). The same capability also allows for the efficient direct connectivity to end user devices or sensors and aggregated IoT traffic from these moving platforms.

Example use case - Hybrid Multiplay



A high throughput, multicast-enabled, satellite link from geostationary and/or non-geostationary satellites has the capability to complement, or interwork with existing terrestrial connectivity, as well as to provide direct broadband connectivity with the ability to multicast the same content (video, HD/UHD TV, as well as other non-video data) across a large coverage area (e.g. for local storage and consumption) for in-home or in-office distribution via Wi-Fi or femto and nano-cells, and DTH satellite TV, integrated within the home or office IP network. The same capability also allows for an efficient connectivity for aggregated IoT data.

NB MSS on WRC-23 agenda (item 1.18)

- Studies relating to **spectrum needs and potential new allocations** to the **mobile-satellite service (MSS)** for **future development of narrowband (NB) MSS systems**, in accordance with Resolution **248 (WRC-19)**.
- **Frequency bands to be considered** under this agenda item:
  - **1 695-1 710 MHz in Region 2**
  - **2 010-2 025 MHz in Region 1**
  - **3 300-3 315 MHz & 3 385-3 400 MHz in Region 2**
- On-going **ITU-R studies** on **spectrum and operational requirements** as well as **system characteristics of low-data rate systems** for the **collection of data from, and management of, terrestrial devices in the MSS**
- WRC-27 preliminary agenda item 2.13, if confirmed at WRC-23, may consider a **possible global allocation to the MSS** within the range [1.5 to 5] GHz for the same purpose

Sources:
Res. 248 (WRC-19) https://www.itu.int/dms_pub/itu-r/oth/0c/0a/R0C0A00000D0018PDFE.pdf
Res. 811 (WRC-19) - WRC-23 Agenda https://www.itu.int/dms_pub/itu-r/oth/0c/0a/R0C0A00000D0041PDFE.pdf
Res. 812 (WRC-19) - WRC-27 Preliminary Agenda https://www.itu.int/dms_pub/itu-r/oth/0c/0a/R0C0A00000D0040PDFE.pdf

Studies mainly by ITU-R WP 4C

Summary

- A **variety of radio technologies will be used to implement the Internet of things**, extending from **short range devices** to **wide area sensor networks** and **global terrestrial IMT systems** as well as **satellite systems**
- The **ITU-R Study Groups are developing technical and operational standards** to **facilitate the deployment of IoT on a global basis**, including **harmonized frequency spectrum** and **appropriate regulatory regimes**
- Associated aspects related to **spectrum allocations & regulatory framework of involved radiocommunication services will also be addressed at** the forthcoming ITU World Radiocommunication Conference 2023 (**WRC-23**)

➢ **Your participation in these activities is more than welcome**!

Thank you!

ITU-R Study Groups: www.itu.int/ITU-R/go/rsg; Email: brsgd@itu.int

ITU-R Study Group 1 – Spectrum management
www.itu.int/ITU-R/go/rsg1 ; Email: rsg1@itu.int

ITU-R Study Group 4 – Satellite services
www.itu.int/ITU-R/go/rsg4 ; Email: rsg4@itu.int

ITU-R Study Group 5 – Terrestrial services
www.itu.int/ITU-R/go/rsg5 ; Email: rsg5@itu.int

Additional information on some WRC-23 agenda items and issues

AI	WRC Resolution	Responsible Group(s)	Topic of the agenda item (AI) / Issue
1.1	Res.223 (Rev.WRC-19)	**WP 5B** & **WP 5D**	to consider, based on the results of the ITU R studies, possible measures to address, in the **frequency band 4 800-4 990 MHz**, protection of stations of the aeronautical and maritime mobile services located in international airspace and waters from other stations located within national territories, and to review the pfd criteria in No. **5.441B** in accordance with Resolution **223 (Rev.WRC-19);**
1.2	Res.245 (WRC-19)	**WP 5D**	to consider identification of the frequency bands **3 300-3 400 MHz, 3 600-3 800 MHz, 6 425-7 025 MHz, 7 025-7 125 MHz and 10.0-10.5 GHz** for **International Mobile Telecommunications** (IMT), including possible additional allocations to the **mobile service** on a primary basis, in accordance with Resolution **245 (WRC-19)**;
1.3	Res.246 (WRC-19)	**WP 5A**	to consider primary allocation of the band **3 600-3 800 MHz** to **mobile service** within Region 1 and take appropriate regulatory actions, in accordance with Resolution **246 (WRC-19)**;
1.4	Res.247 (WRC-19)	**WP 5D**	to consider, in accordance with Resolution **247 (WRC-19)**, the use of **high-altitude platform stations as IMT base stations (HIBS)** in the **mobile service** in certain frequency bands **below 2.7 GHz** already identified for IMT, on a global or regional level;
1.5	Res.235 (WRC-15)	**TG 6/1**	to review the **spectrum use and spectrum needs** of **existing services** in the frequency band **470-960 MHz** in Region 1 and **consider possible regulatory actions** in the frequency band **470-694 MHz** in Region 1 on the basis of the review in accordance with Resolution **235 (WRC-15)**;
1.10	Res.430 (WRC-19)	**WP 5B**	to conduct studies on spectrum needs, coexistence with radiocommunication services and regulatory measures for possible **new allocations for the aeronautical mobile service** for the use of **non-safety aeronautical mobile applications**, in accordance with Resolution **430 (WRC-19)**;
1.18	Res.248 (WRC-19)	**WP 4C**	to consider studies relating to **spectrum needs and potential new allocations** to the **mobile-satellite service** for future development of **narrowband mobile-satellite systems**, in accordance with Resolution **248 (WRC-19)**;

Source: www.itu.int/go/rcpm-wrc-23-studies

SRDs Terms and Definitions

Short Range (radio or radiocommunication) Devices

- For the purpose of Report ITU-R SM.2153 the term SRD is intended to cover radio transmitters providing either unidirectional or bidirectional communication and which have low capability of causing interference to other radio equipment
- SRDs are permitted to operate on a non-interference and non-protected basis, subject to relevant standards or national regulations
- Simple licensing requirements may be applied, e.g. general licences or general frequency assignments or even licence exemption, however, information about the regulatory requirements for placing SRD equipment on the market and for their use should be obtained by contacting individual national administrations

Ultra-wideband technology (UWB): Technology for SRD, involving the intentional generation and transmission of radio-frequency energy that spreads over a very large frequency range, which may overlap several frequency bands allocated to radiocommunication services (see e.g. Rec. ITU-R SM.1755 & Rec. ITU-R SM.1756)

SRDs use in many countries & regions

- Report ITU-R SM.2153 - Technical and operating parameters and spectrum use for SRDs
  - Provides SRD definitions and short description of different applications using SRDs, e.g.: Telecommand, Telemetry, Voice and video, Detecting avalanche victims, RLANs, Railway applications, Road transport and traffic telematics, Detecting movement and equipment for alert, Alarms, Model control, Inductive applications (e.g. car access), Radio microphones, RFID, ULP-active medical implant, Wireless audio applications (e.g. cordless loudspeakers), RF (radar) level gauges, among many others not listed
  - Indicates typical technical characteristics/limitations: Common frequency ranges; required radiated power or magnetic/electric field-strength values to allow satisfactory operation (for CEPT countries, USA(FCC)/B/CAN, J and KOR, etc.); Antenna requirements
  - Explains administrative requirements: certification and verification; licensing requirements; mutual agreements between countries/regions
  - Provides also useful information on national/regional rules (incl. technical and operational parameters and spectrum use)
- Report updated on regular basis

SRD harmonization activities (1/2)

- Rec. ITU-R SM.1896 – Frequency ranges for global/regional harmonization of SRDs
  - Frequency ranges appropriate for global harmonization:

    9-148.5 kHz; 3 155-3 400 kHz (low power wireless hearing aids, RR No. **5.116**);

    and following ISM bands listed in RR Nos. **5.138** and **5.150**:

    6 765-6 795 kHz; 13 553-13 567 kHz; 26 957-27 283 kHz; 40.66-40.7 MHz;

    2 400-2 500 MHz (up to 2 483.5 MHz in some countries); 5 725-5 875 MHz;

    24.00-24.25 GHz; 61.0-61.5 GHz; 122-123 GHz; 244-246 GHz

    [proposal under consideration for the addition of 3.7-4.8 GHz & 7.25-9 GHz (see note 1)]
  - Frequency ranges appropriate for regional* harmonization:

    (* bands entirely or just partly available in a Region or only in some countries)

    7 400-8 800 kHz (in Reg. 1 & 2 and some Reg. 3 countries);

    312-315 MHz (in Reg. 2 and some countries of Reg. 1 & 3);

    433.050-434.790 MHz (in Reg. 1 and some countries of Reg. 2 & 3);

    862-875 MHz (not in Reg. 2; in Reg. 1 and some Reg. 3 countries);

    875-960 MHz (in Reg. 2 as a tuning range but not available for SRDs in a number of countries due to the use by commercial mobile systems; in some countries of Reg. 1 & 3)

    [proposal under consideration for addition of 3.1-4.8 GHz & 6-9 GHz in some countries of Reg. 1 & 3 (see note 1)]

Note 1: Refer to UWB application for communication, location tracking, radio determination, see Annex 13 to Doc. 1B/237

SRD harmonization activities (2/2)

- Rec. ITU-R SM.2103 – Global harmonization of SRD categories
  - to facilitate the global harmonization process (e.g. global identification of freq. ranges)
  - benefits for end users, manufacturers and regulators (e.g. economies of scale)
  - **Non-specific SRD applications** (any, can avoid fragmentation of spectrum use and foster innovation)
  - SRD for **transport and traffic telematics** purposes (e.g. car-to-car, car-to-infrastructure)
  - SRD for **radio determination** purposes (e.g. equipment for detecting movement and alert)
  - SRD for **wireless alarms** (SRD applications incl. alarms for security and safety)
  - SRD for **model control** (equipment solely for purpose of controlling movement of the model, in the air, on land or over or under the water surface, e.g. flying models normally limited in weight & height above ground by national regulations)
  - Radio **microphone & audio applications,** including aids for the hearing impaired under licence-exempt regulation
  - **Radio Frequency Identification applications (RFID)** (e.g. automatic article identification, asset tracking, waste management, personal identification, access control, proximity sensors, anti-theft systems, etc., often also described as the "internet of things" or "machine-to-machine communications")
  - **Ultra low power active medical implant** (**ULP-AMI** typically used to support and improve quality of people's lives, e.g. regulating heart rates, administering pharmaceuticals, treating neurological tremors, etc.)
- Rec. ITU-R SM.2104 – Guidelines for narrow-band wireless home networking transceivers Specification of spectrum related components

WASN applications

- automation and efficiency enhancement of business works such as remote meter-reading of utilities, i.e. water, gas, and electricity;
- meteorological observation such as air temperature and humidity measurement;
- environment observation, forecasting, and protection such as environmental pollution observation, including air, water, and soil;
- crime prevention and security, such as intrusion detection, child tracking;
- healthcare, medical applications, and welfare support such as monitoring of vital parameters (e.g. body temperature, weight, and heart rate);
- remote control and monitoring of plant facilities and goods distribution;
- disaster prevention and measures, such as disaster notification;
- smart homes and control commercial building, such as home and office appliance networking;
- intelligent transportation and traffic management systems;
- monitoring of avian species that may carry the avian influenza virus.

IoT data management (data access, cross-border data flow and data localization)

Kamal Tamawa, GSMA

08 August 2020

Cross-Border Data Flows

Development of the digital economy and continued productivity growth in traditional industries depend on organisations' ability to transfer data, including consumers' personal data, within and between countries for efficient analysis, processing and storage.

Some jurisdictions apply restrictions to the flow of personal data "cross border" and may require it to be located in a specific country or region

Why restrict CBDF?

Reasons for introducing restrictions differ from country to country, but typically include one or more of the following justifications:

1. Data privacy and security
2. Foreign surveillance
3. National security
4. National digital economy

Approaches to imposing control on CBDF

Conditional Data Flow

OR

Localisation + Subsequent Flow

OR

Localisation

IMPLICATIONS

Administrative ease of doing business

Cost of production of goods and services

Overall running cost of business

Development and delivery of IoT products and services

Understanding the benefits of freely flowing data

The freedom to move personal data withoutvrestriction between countries generates positive outcomes not only for organisations, but for citizens and countries as well

Benefits to citizens

- access to the wide range of goods and services available online.
- particularly benefits small and medium-size enterprises that do not have an international footprint

Benefits to organisations

- marketing and delivery ideas, goods and services wherever data is allowed to flow.
- allow efficient operation of multinational organisations
- permits businesses to improve service quality and reduce costs and lower customer prices

Benefits to countries and society

- Introducing more national businesses and consumers into the digital fold
- allowing small, specialised organisations to establish an internet presence that is simultaneously national and international
- Benefits to Public-sector bodies and government departments

Policy approaches to Data Localisation and CBDF

1 –Commit to facilitating cross-border data flows and removing restrictive localisation measures.

2 – Ensure privacy frameworks are fit for the digital age.

3 – Review legacy sector-specific privacy rules.

4 – Encourage regional data privacy initiatives.

5 – Avoid localisation by addressing foreign surveillance concerns pragmatically.

6 – Avoid localisation by addressing law enforcement and national security pragmatically.

Procedural Measures for safe CBDF

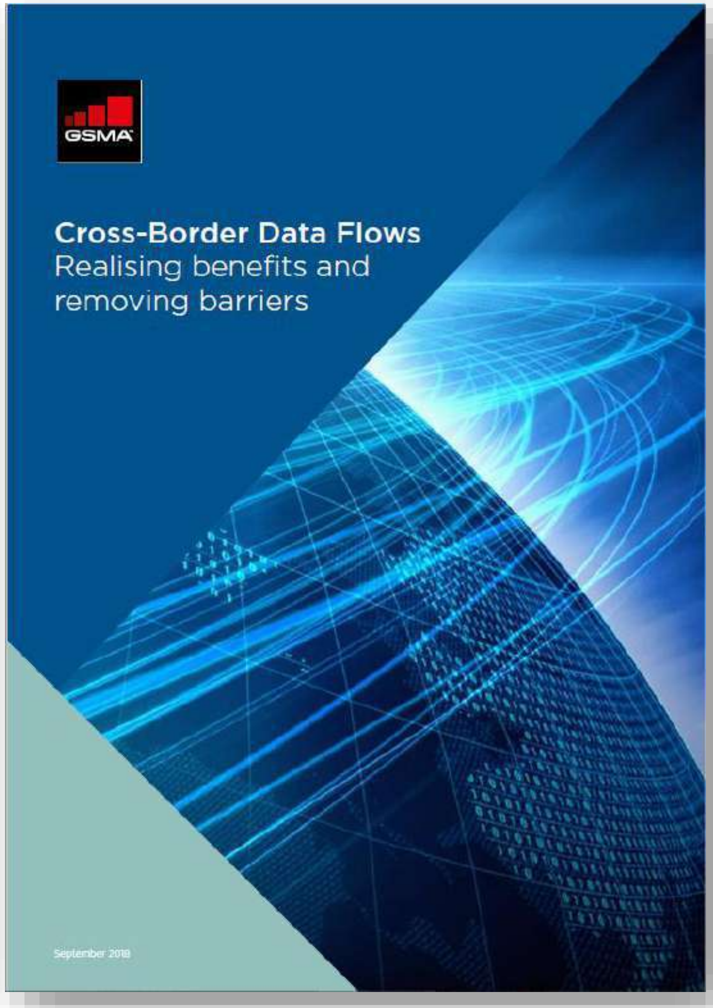
Data transfers outside of the country or region can reasonably still take place if contractual and/ or technical measures are put in place.

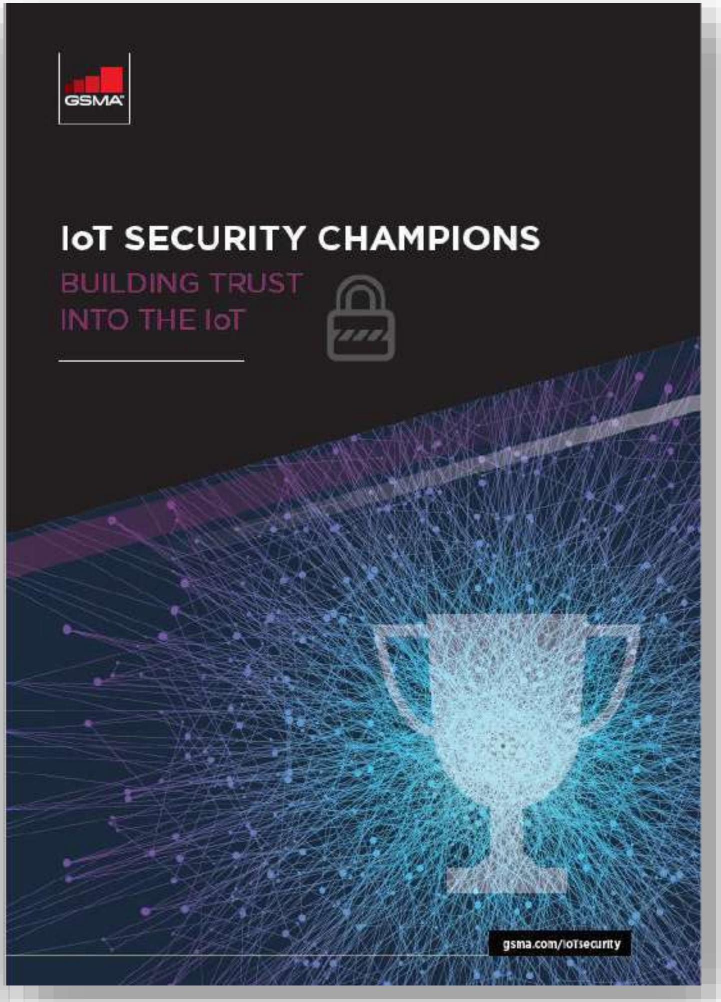
For IoT services, with a global customer base or devices which are not confined to remaining in a single country or region, restrictions may be addressed with a number of technical solutions.

- Use of anonymisation and pseudonymisation techniques to make data less personally identifiable;
- Aggregating data so that it is now about a group of users or devices rather than an identifiable individual;
- Using strong encryption when transferring data between countries/ regions and when storing data (at rest);
- Gaining user's informed consent for data storage & processing;
- Using techniques such as 'k-anonymisation' and 'differential privacy' to minimise privacy risks.

Read More


GSMA
PROTECTING PRIVACY AND DATA
IN THE INTERNET OF THINGS
Considerations and techniques for big data, machine learning and analytics
FEBRUARY 2019


GSMA
Cross-Border Data Flows
Realising benefits and removing barriers
September 2018


GSMA
IoT SECURITY CHAMPIONS
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gsma.com/iotsecurity

SPECTRUM & IoT TECHNOLOGIES

Seyni Fati/Kamal Tamawa, GSMA

August 2020

Key characteristics of IoT networks

Satellite	Traditional cellular (e.g. 2G, 3G, 4G)	LPWA (e.g. Sigfox, LoRa, NB-IoT)	Local Area IoT Network (e.g. Wi-Fi , ZigBee)	General Local Area Network (e.g. Bluetooth, Wi-Fi 802.11ac)

Technology group dimensions

Satellite

Traditional cellular (e.g. 2G, 3G, 4G)

LPWA (e.g. Sigfox, LoRa, NB-IoT)

Local Area IoT Network (e.g. Wi-Fi , ZigBee)

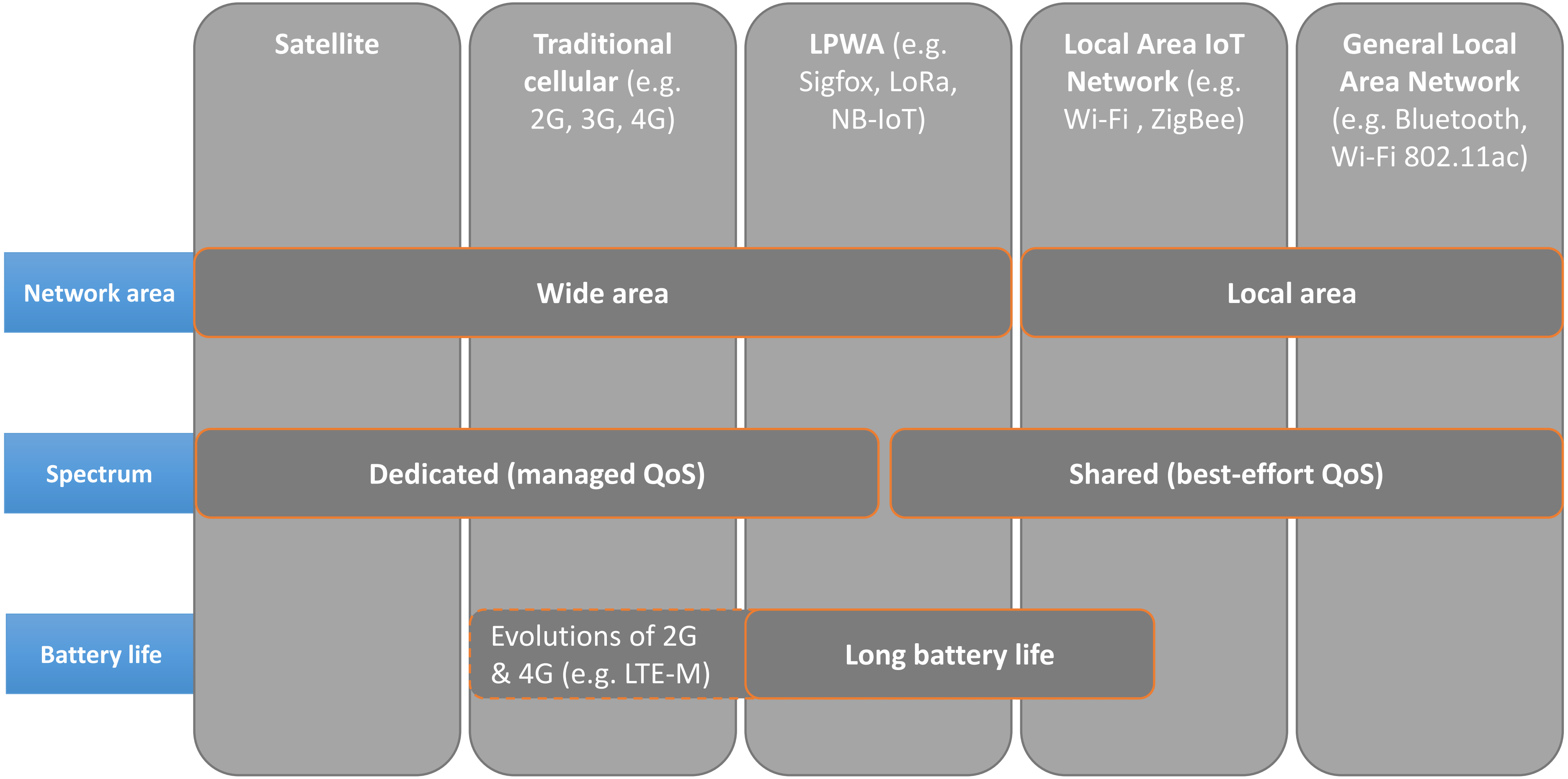
General Local Area Network (e.g. Bluetooth, Wi-Fi 802.11ac)

Network area (wide area or local area)

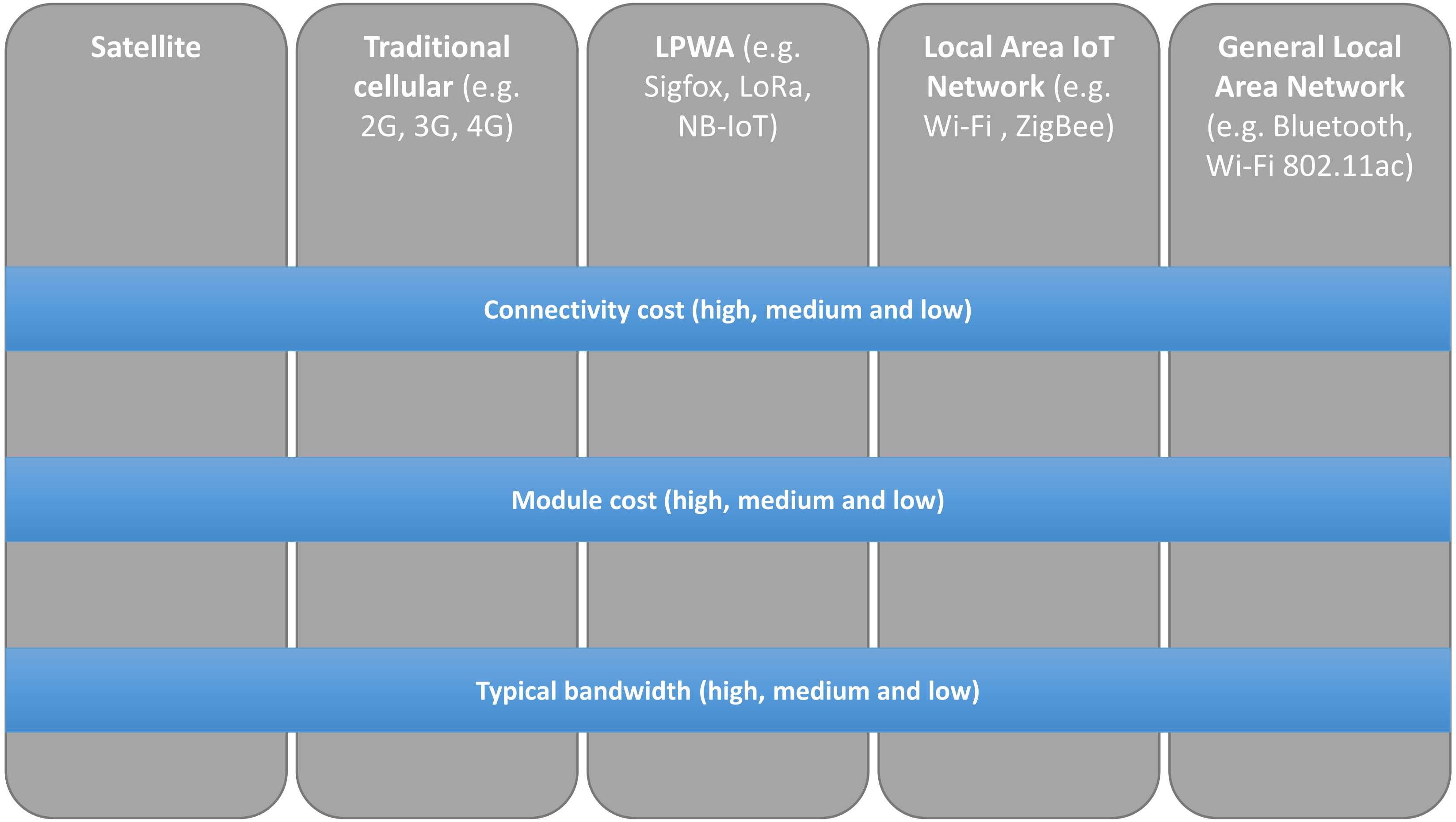
Spectrum (dedicated or shared)

Battery life (long or short)

Technology group dimensions



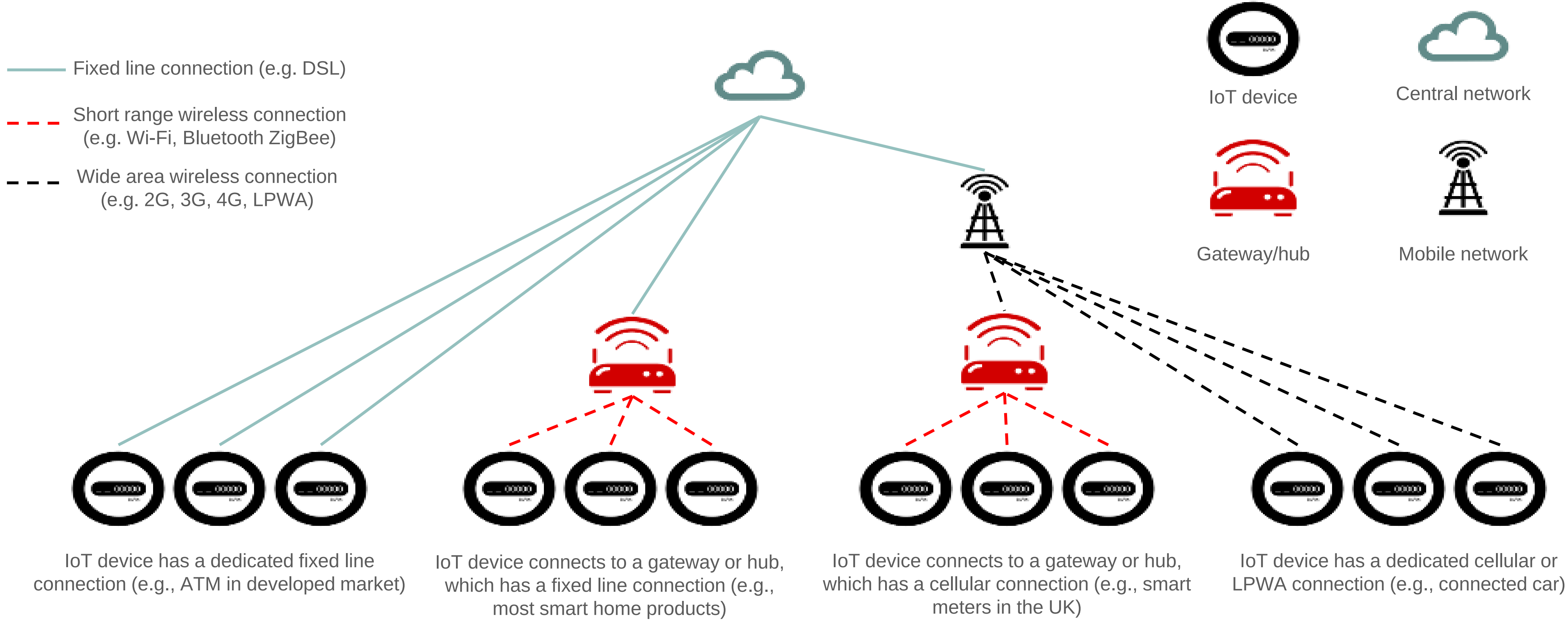
Technology-specific dimensions



Technology-specific dimensions

	Satellite	**Traditional cellular** (e.g. 2G, 3G, 4G)	**LPWA** (e.g. Sigfox, LoRa, NB-IoT)	**Local Area IoT Network** (e.g. Wi-Fi , ZigBee)	**General Local Area Network** (e.g. Bluetooth, Wi-Fi 802.11ac)
Connectivity cost	High	*2G*: Medium *3G*: Medium *4G*: Medium	Low	Low	Low
Module cost	High	*2G*: Low *3G*: Medium *4G*: High	Low	Low	Low
Typical bandwidth	Low to high	*2G*: Low *3G*: Medium *4G*: High	Low	*ZigBee*: Low *Wi-Fi*: High	*Bluetooth*:Low *Wi-Fi 802.11ac* : High

There are many configurations for IoT solutions



Spectrum used for IoT solutions can be dedicated (licensed) or shared (unlicensed)

Each option has benefits and disadvantages

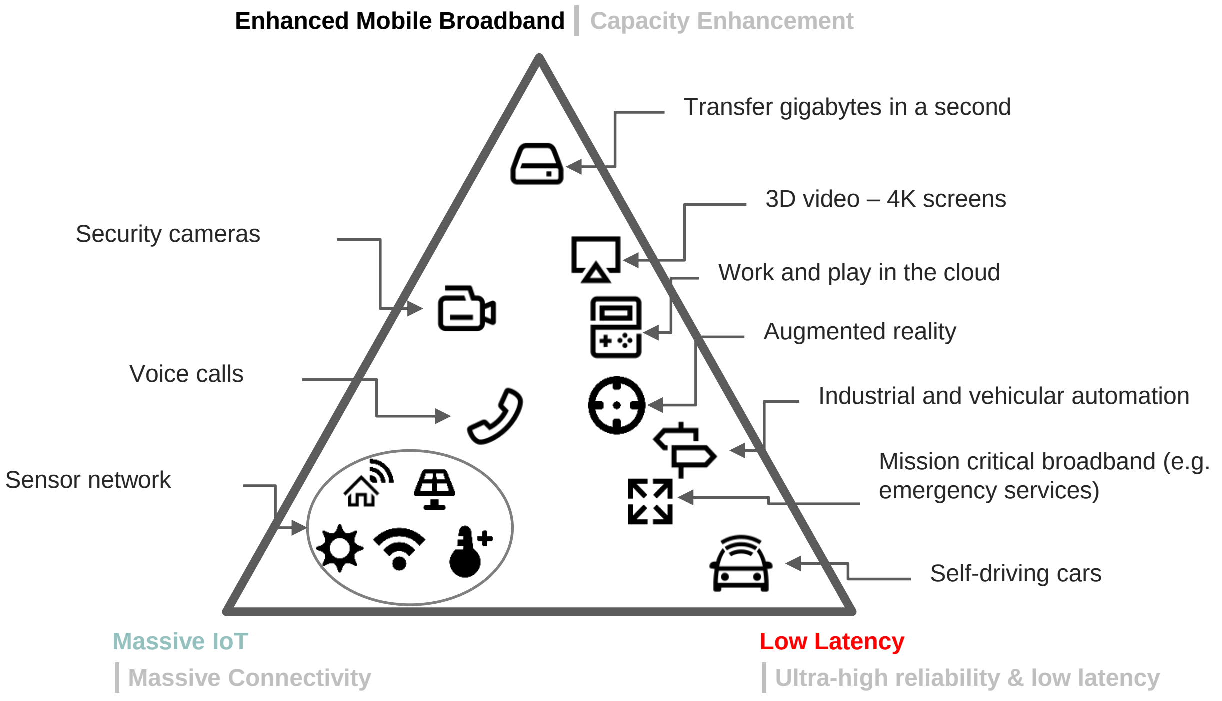
Spectrum for IoT		
Characteristic	**Dedicated**	**Shared**
QoS	Supported	Not supported
Cost	Higher	Lower
Time to market	Slower	Faster

IoT Technologies: Licensed vs. Unlicensed

Name	LoRa	Sigfox	LTE-M	LTE NB-IoT
Description	Uses spread-spectrum technology and is optimised for long battery life.	Uses Ultra Narrow Band technology to deliver long battery life and low data-transfer speeds	Offers the broadest range of cellular IoT capabilities	Scalable, ultra low-end cellular IoT with deep indoor coverage
Spectrum	Unlicensed	Unlicensed	Licensed	Licensed
Deployment	ISM bands	ISM bands	In-band LTE	In-band & Guard-band LTE, standalone
Bands	868/ 902-928Mhz	868/915 MHz	LTE bands 1, 2, 3, 5, 7, 8, 11,12, 13, 17, 18, 19, 20, 21, 26, 27, 28, 31(HD/FD – FDD) 39, 41 (TDD)	LTE bands 1, 2, 3, 5, 8, 12, 13, 17, 18, 19, 20, 26, 28, 66
Standard Org.	LoRa Alliance	ETSI*	3GPP	3GPP
Coverage	153-161 dB	149-161 dB	155.7 dB (23 dBm power class) **	164 dB for standalone (23 dBm power class) *
Max. Data Rate	50 kbps	100 bps	1 Mbps	~240kbps

5G and its applications

Three service categories enabled by three capabilities



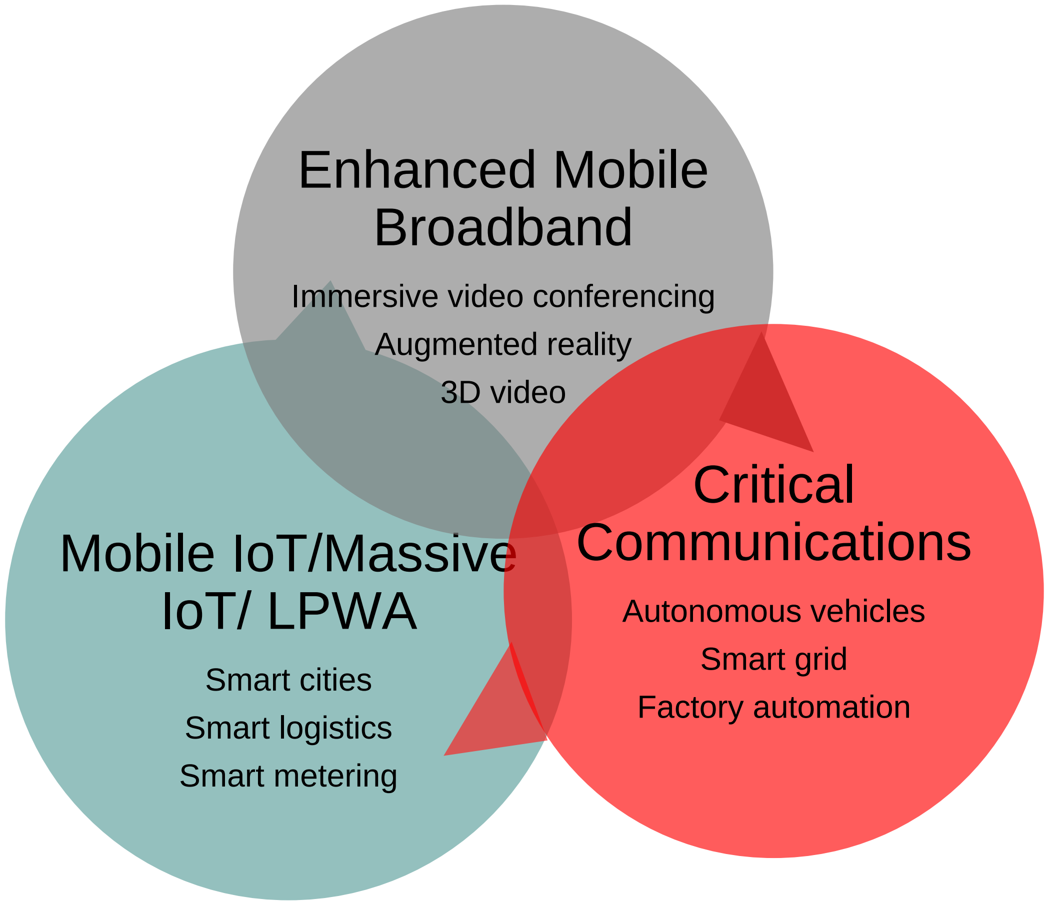
Source: ITU-R WP5D/TEMP/548-E: IMT Vision - "Framework and overall objectives of the future development of IMT for 2020 and beyond", February 2015

The fundamentals of 5G

- A ‘system of systems’ fulfilling a wide variety of use cases
- A new radio (e.g., mmWave-based)
- A new core network integrating diverse access technology (HetNets)
- A flexible network that adapts to the service (virtualisation)

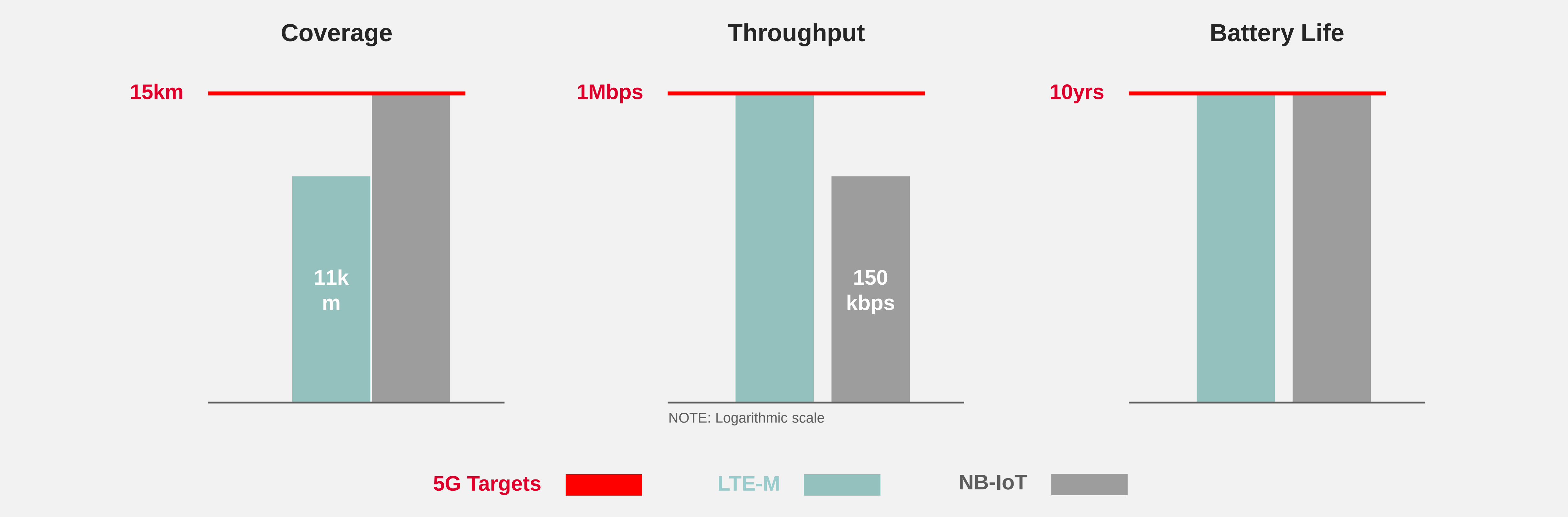
Mobile IoT in the 5G future

- Mobile IoT delivers massive IoT for 5G
- Mobile IoT is set to coexist with other 5G technologies
- 3GPP will continue to address LPWA use cases by Mobile IoT in 5G specifications
- To enable smooth operator migration to 5G bands, 3GPP is investigating how the 5G core network will support Mobile IoT radio access networking



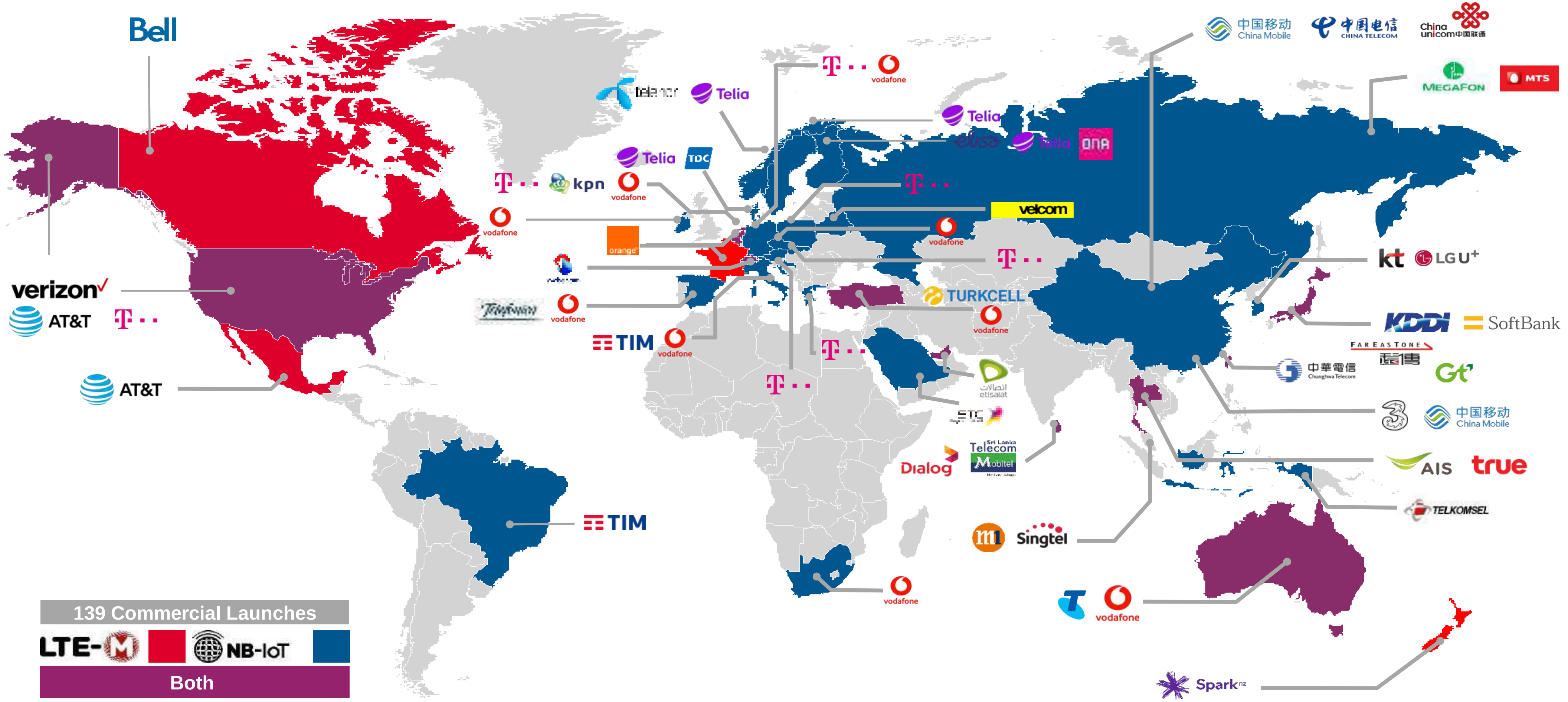
IoT and 5G

NB-IoT and LTE-M already meet 5G requirements



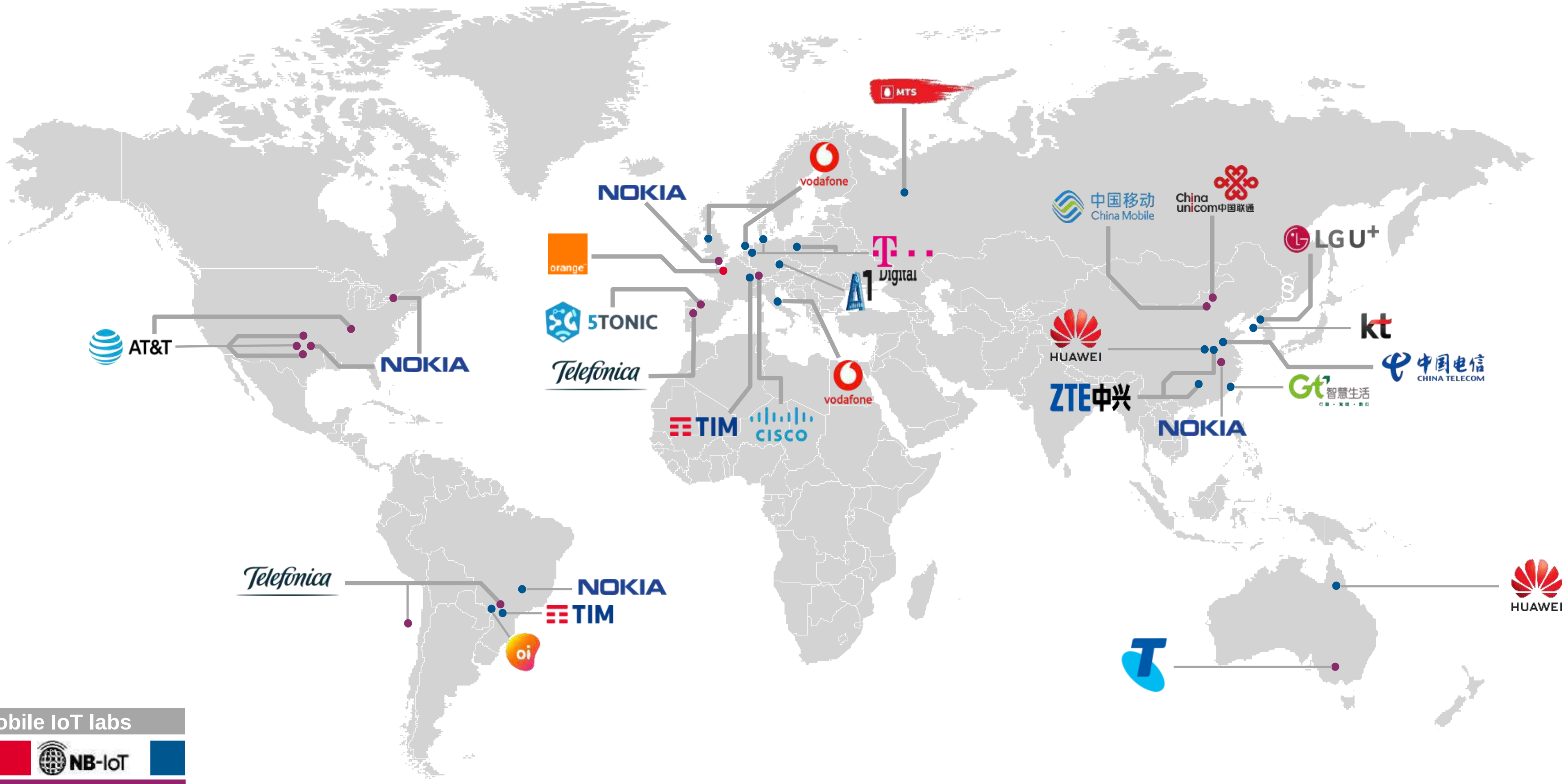
3GPP has no plans to standardise 5G-specific IoT technology, but may do so for high-end IoT applications in the future

Mobile IoT Coverage



*As at August 2020

Mobile IoT in the 5G future



37 Mobile IoT labs

LTE-M | NB-IoT | Both

IoT Applications and Technologies

Case Study Template

Application requirement	Application Feature
Network Area	▪ Wide ▪ Local
Spectrum	▪ Dedicated ▪ Shared
Battery life	▪ Long ▪ Short ▪ N/A
Connectivity cost	▪ High ▪ Medium ▪ Low
Module cost	▪ High ▪ Medium ▪ Low
Bandwidth	▪ High ▪ Medium ▪ Low
Connectivity technology?	

Oil Industry Remote Resource Management

Feature	Requirement
Network Area	▪ Wide
Spectrum	▪ Dedicated
Battery life	▪ N/A
Connectivity cost	▪ High
Module cost	▪ High
Bandwidth	▪ Low to high

Connectivity Technology: **Satellite**

Other technologies: 2G, 3G, 4G, LPWA

Smart washer

Feature	Requirement
Network Area	▪ Local
Spectrum	▪ Shared
Battery life	▪ N/A
Connectivity cost	▪ Low
Module cost	▪ Low
Bandwidth	▪ Medium

Connectivity Technology: **Wi-Fi**

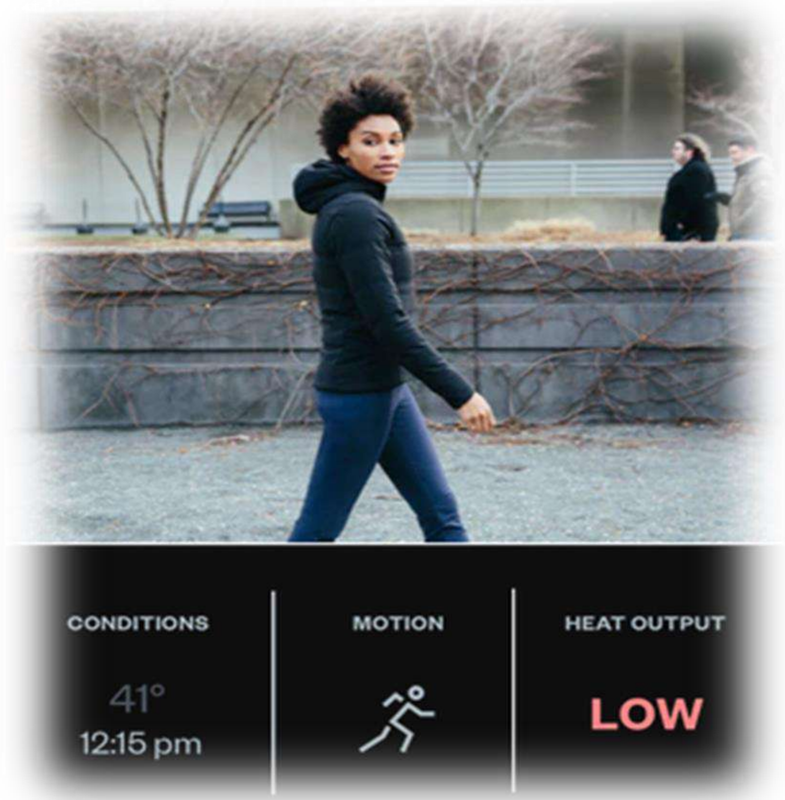
Other technologies: 2G, 3G

Smart heated jacket

Feature	Requirement
Network Area	▪ Local
Spectrum	▪ Shared
Battery life	▪ Long
Connectivity cost	▪ Low (None)
Module cost	▪ Low
Bandwidth	▪ Low

Connectivity Technology: **Bluetooth**

Other technologies: LPWA



Smart eHealth Monitoring

Feature	Requirement
Network Area	▪ Wide
Spectrum	▪ Dedicated
Battery life	▪ N/A
Connectivity cost	▪ Medium
Module cost	▪ Medium
Bandwidth	▪ Medium

Connectivity Technology: 3G

Other technologies: 4G

HD surveillance camera

Feature	Requirement
Network Area	▪ Wide
Spectrum	▪ Dedicated
Battery life	▪ N/A
Connectivity cost	▪ Medium
Module cost	▪ High
Bandwidth	▪ High

Connectivity Technology: **4G**

Other technologies: 3G, Wi-Fi

Smart water pump

Feature	Requirement
Network Area	▪ Wide
Spectrum	▪ Shared
Battery life	▪ N/A
Connectivity cost	▪ Low
Module cost	▪ Low
Bandwidth	▪ Low

Connectivity Technology: 2G

Other technologies: LPWA

Smart Parking Sensors

Feature	Requirement
Network Area	▪ Wide
Spectrum	▪ Shared
Battery life	▪ Long
Connectivity cost	▪ Low
Module cost	▪ Low
Bandwidth	▪ Low

Connectivity Technology: **LPWA**

Other technologies: 2G, Wi-Fi

Spectrum Policy Levers to support IoT

1. Technology Neutrality

Technology specific licenses risk preventing service providers from deploying the latest cellular IoT technologies.

2. Licensed Spectrum

Unlicensed spectrum has its place in the IoT ecosystem.

But Licensed spectrum is uniquely able to provide quality of service guarantees.

3. Spectrum Set-asides

Setting aside spectrum for IoT risks wasting valuable spectrum.

4. Spectrum Harmonisation

Widely harmonised spectrum bands help drive economies of scale to drive down the cost IoT devices.

5. Planning is key!

IoT will play an important role in 5G so must be included in ongoing spectrum planning.

THANK YOU