Spectrum aspects of Internet of Things
Short Range Devices Technologies & Applications

Capacity Building Workshop

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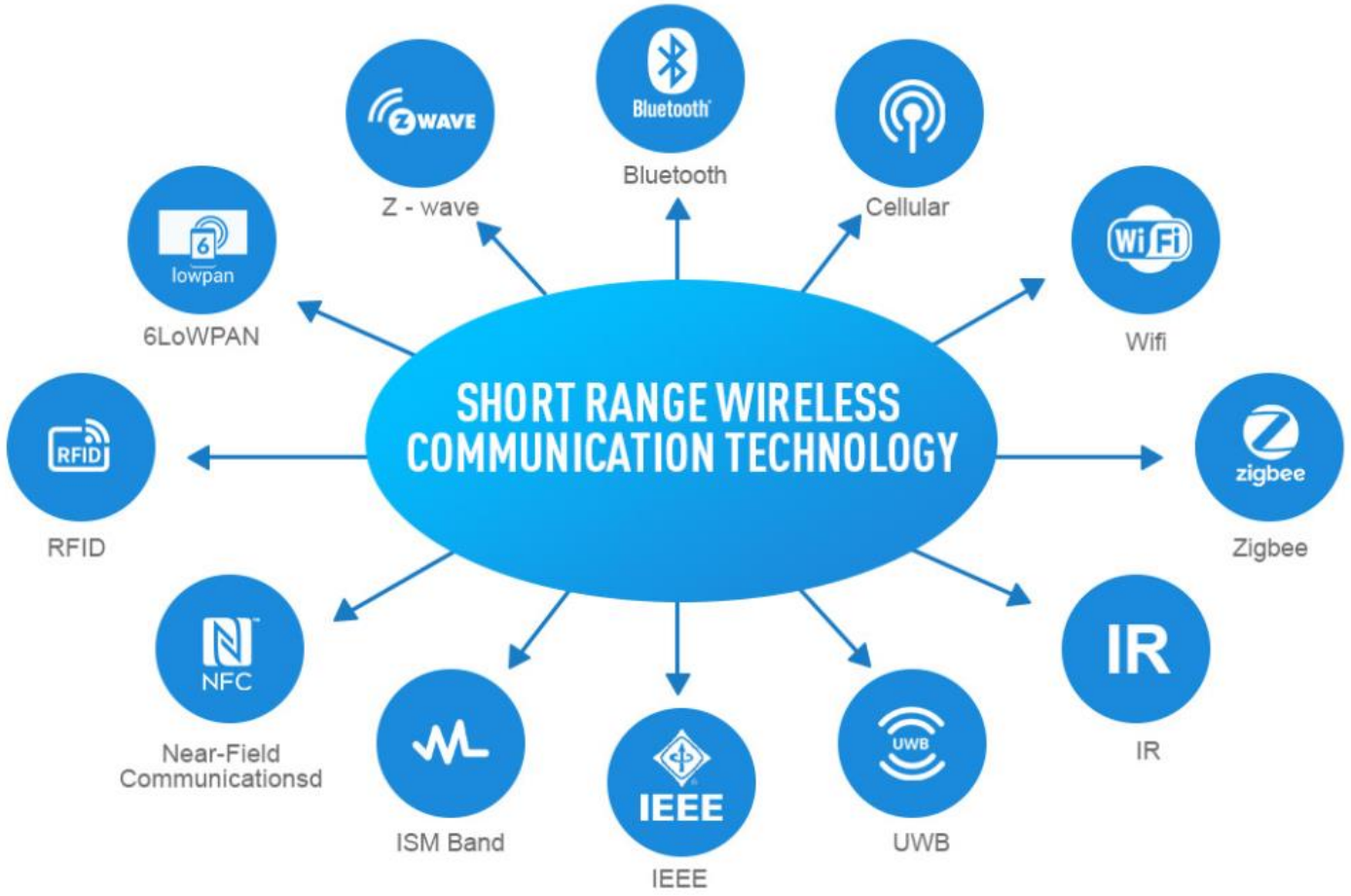
Day 3
Short Range Devices

01 **Short Range Regulations & Legislations**

02 **Short Range Devices Technologies**

03 **Short Range Devices Applications**

Wireless Short Range Wireless Communication Technologies



Short Range Radiocommunications Devices Terms Conditions

ITU-R SM.2153-9 (07/2022) the term short-range radio device is intended to cover radio transmitters which provide 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,
- Simple licensing requirements may be applied, e.g. general licenses or general frequency assignments or even license 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)

Wireless Short Range Devices
ITU-R Studies

RESOLUTION ITU-R 54-3 Studies to achieve harmonization for 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, harmonized 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)
- Other on-going studies on global harmonization of SRD Categories & for IoT Deployment

Source: Resolution ITU-R 54-3 R-RES-R.54-3-2019-MSW-E

Wireless Short Range Devices harmonization activities-1

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

Wireless Short Range Devices harmonization activities-2

Rec. ITU-R SM.2103-0– 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.)

Short Range Devices Applications
Wide-area Sensor and Actuator Network (WASN) Systems

Studies on Wide-area Sensor and Actuator Network (WASN) Systems

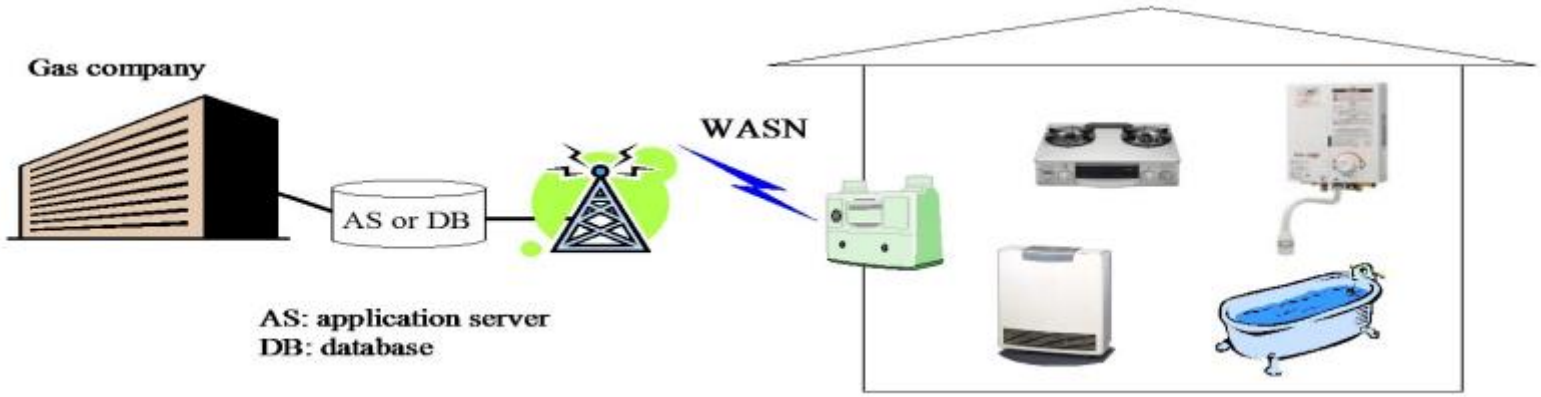
Wide-area sensor and/or actuator network (WASN) systems support machine-to-machine communications to a large number of sensors and/or actuators

- 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

SRD Applications

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.

SRD Applications

WASN – Applications

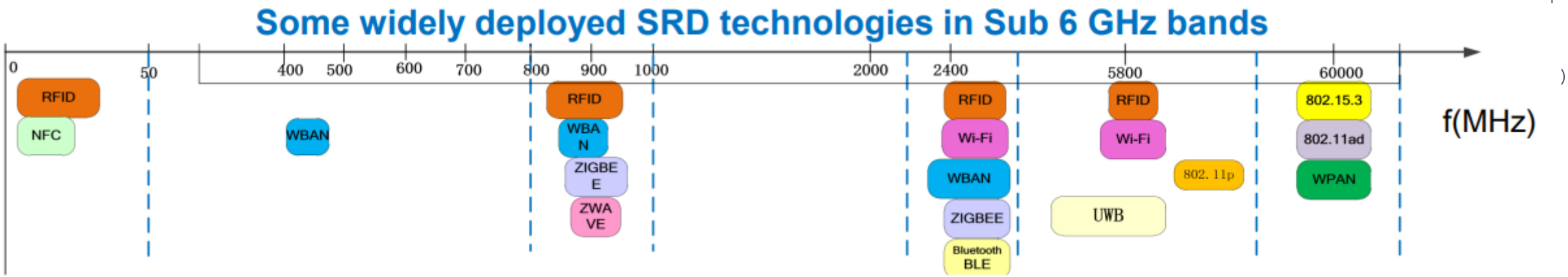
- Automation and efficiency enhancement of business works such as remote meter-reading of utilities, i.e. water, gas, and electricity;
- meteorological observation such as air temperature and humidity measurement; environment observation, forecasting, and protection such as environmental pollution observation, 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.

Short Range Devices Technologies &Applications

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

Short Range Devices Technologies Deployment in Sub 6GHz band



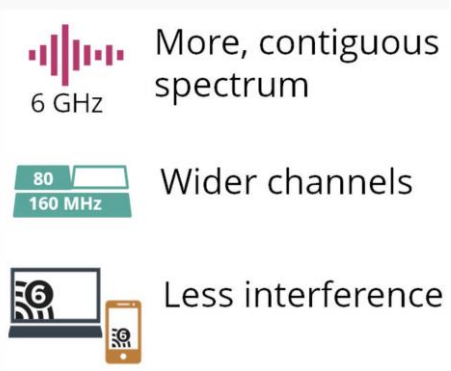
Short Range Devices Technologies
Comparison between UWB, WIFI, Zigbee & Bluetooth

Items	Working frequency band	Standard of globalization	Communication range	Communication speed	Encryption mode	Application field
UWB	3.1GHz~10.6GHz	null	>100m	>100Mb/s	THSS	Home network
Wi-Fi	2.4GHz	IEEE 802.11b	100m	11Mb/s	WPA/PSK	Connected to the network
ZigBee	2.4GHz	IEEE 802.15.4	10~20m	20K~250Kb/s	AES-128	The sensor network
Bluetooth	2.4GHz	IEEE 802.15.1	1~10m	10Mb/s	PIN code	Mobile devices

SRDs Applications
WiFi Standards in Brief

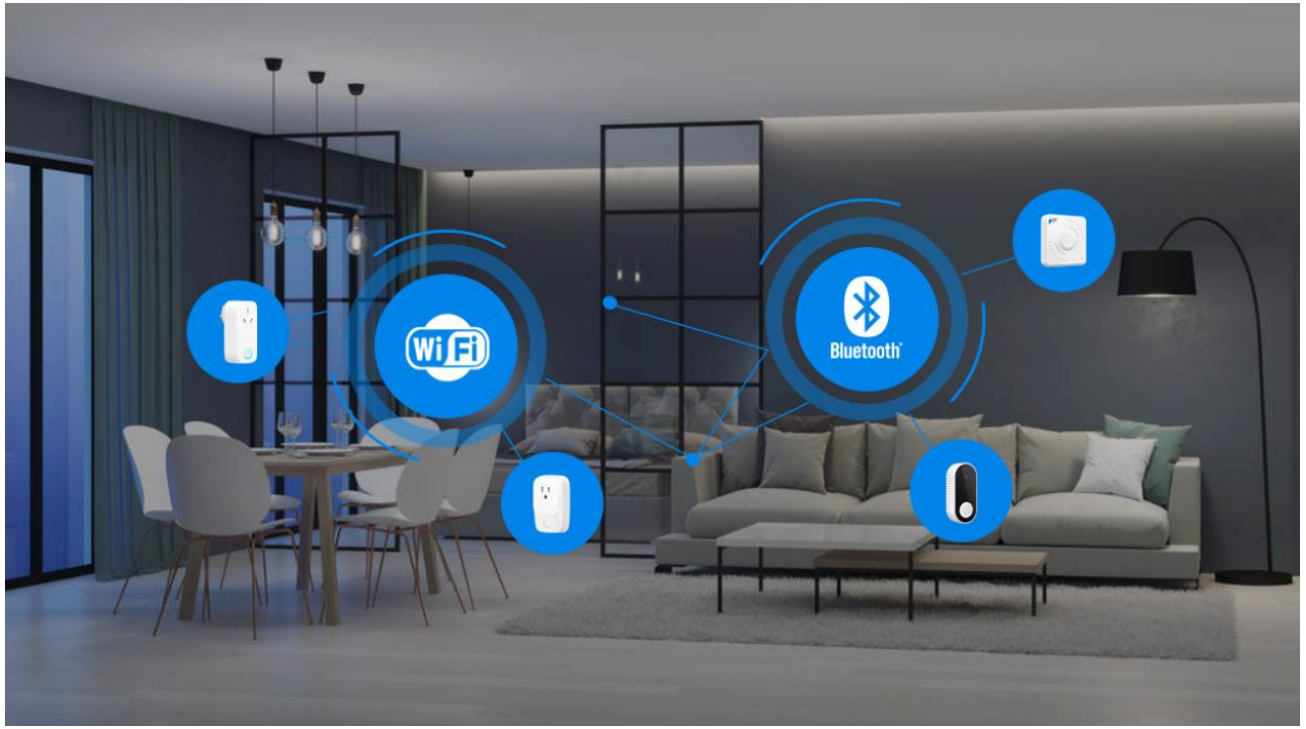
Standard (name)	Availability	Top Speed per Stream (theoretical)	Bandwidth	Security	Frequency and Bands	Status
802.11b	1999	11Mbps	20MHz	Open WEP	2.4GHz	Obsolete
802.11a	2000	54Mbps	20MHz	Open WEP	5GHz	Obsolete
802.11g	2003	54Mbps	20 MHz	Open WEP	2.4GHz	Obsolete
802.11n (Wi-Fi 4)	2009	150Mbps (40MHz)	20MHz 40MHz	Open WEP WPA	2.4GHz, 5GHz, Dual-band	Legacy
802.11ac (Wi-Fi 5)	2012	433Mbps (80MHz)	20MHz 40MHz 80MHz	Open WPA WPA2	5GHz, Dual-band, Tri-band	Mainstream
802.11ad (WiGig)	2015	Multi-Gig	2.16GHz	Open WPA WPA2	60 GHz	Limited Use Obsolete
802.11ax (Wi-Fi 6)	2019	1200Mbps (160MHz)	20MHz 40MHz 80MHz 160MHz	Open WPA WPA2 WPA3	2.4GHz 5GHz Dual-band, Tri-band	Mainstream
802.11axe (Wi-Fi 6E)	2021	1200Mbps (160MHz)	20MHz 40MHz 80MHz 160MHz	OWE WPA3	6GHz, Dual-band, Tri-band, Quad-band	Mainstream
802.11be (Wi-Fi 7)	2023	2.9Gbps (320MHz)	20MHz 40MHz 80MHz 160MHz 320MHz	OWE WPA3	6GHz, 5GHz, 2.4GHz, Dual-band, Tri-band, Quad-band	Latest
802.11ah (Wi-Fi HaLow)	2024 (esitmate)	83.7Mbps (16MHz)	1MHz 2MHz 4MHz 8MHz 16MHz	OWE WPA3	900MHz	Upcoming

Wi-Fi 6E deals with this spectrum shortage and problem by using an entirely new frequency band
The 6GHz with 1200MHz wireless spectrum
That opens hardware up to large *Wi-Fi-exclusive* airspace,
including seven 160MHz or fourteen 80MHz channels
Drawback: Use the new 6GHz band, you'll need a broadcaster, like a router, and a client that supports it, such as a phone, laptop, or desktop adapter card.
No existing Wi-Fi equipment



Typical applications of short range wireless communication Applications

Households



Home consumer electronics are loaded with wireless
Almost all entertainment products have IR remote controls

- Energy metering and accessory monitors,
- remote thermometers, wireless thermostats, and other weather monitors,
- security systems, garage door openers, smart parking sensors are also connected to the wireless networK

Almost every family has Wi-Fi connection.

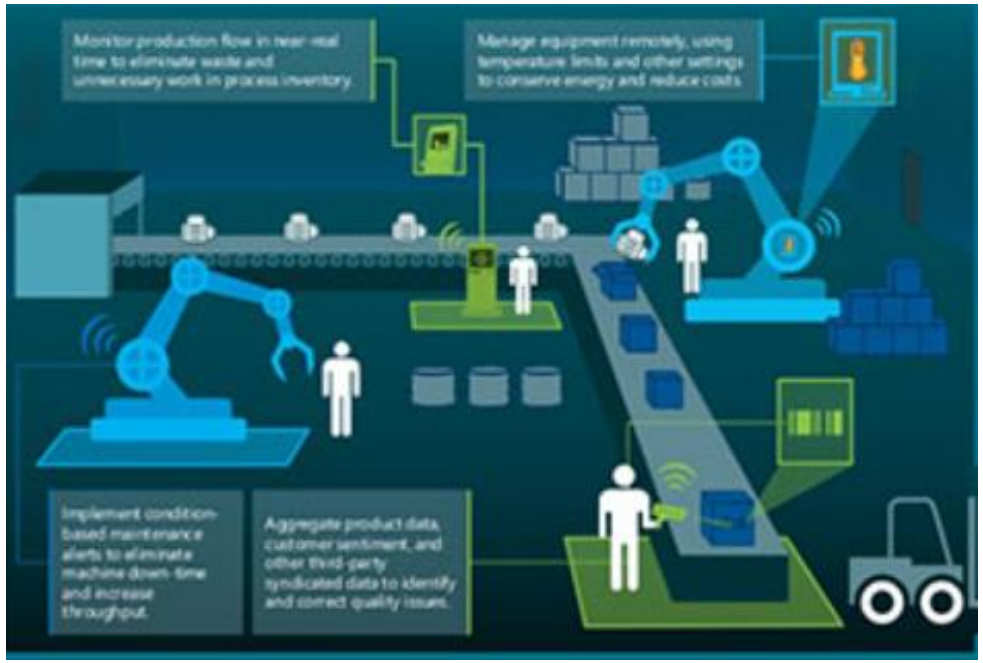
Typical applications of short range wireless communication Applications

Commercial

Wireless temperature and humidity monitoring, lighting control and wireless thermostats are commonly used in commercial applications
Some video surveillance cameras use wireless instead of coaxial cables
Wireless payment systems for mobile phones promise to revolutionize commerce

Typical applications of short range wireless communication Applications

Industrial



Wired connections are gradually replaced by wireless in the industry

Remote monitoring of flow, humidity, temperature, and pressure are common applications

Wireless control of robots, industrial processes and machine tools promotes convenience and boosts the economy in industrial Settings

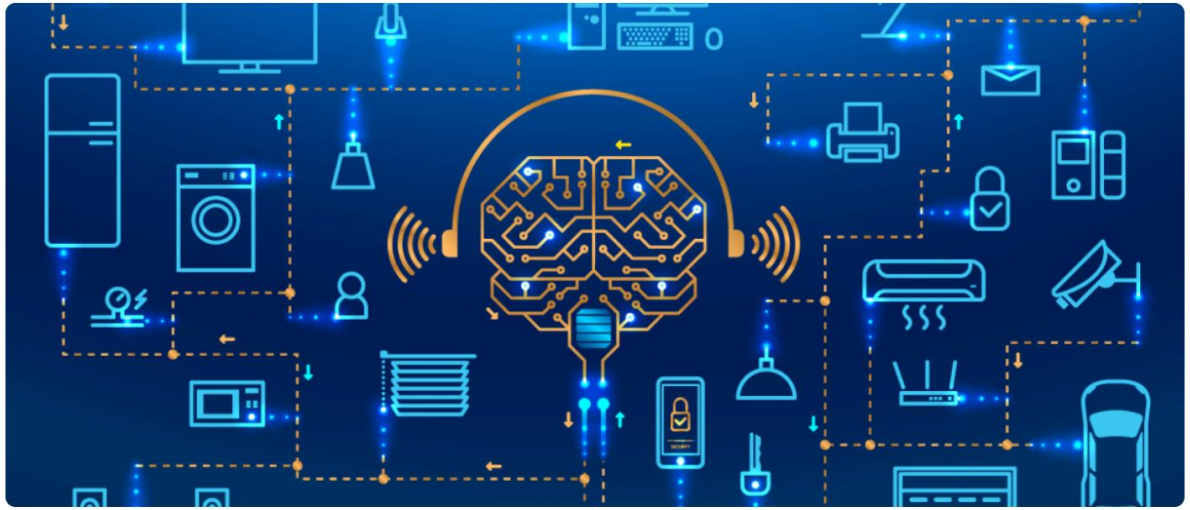
M2M technology opens the door to many applications like automobile positioning (GPS) and monitoring vending machines

The IoT is mostly wireless

- Radio frequency identification technology makes it possible to track and locate almost anything more easily.

Ultra wideband Technology Applications

Technology for short-range radio communication, 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 radio communication services, It broadcasts digital pulses that are timed very precisely on a carrier signal across a very wide spectrum (number of frequency channels) at the same time



- Ultra-wideband was formerly known as pulse radio, but the FCC and the International Telecommunication Union Radio communication Sector (ITU-R) currently define UWB as an antenna transmission for which emitted signal bandwidth exceeds the lesser of 500 MHz or 20% of the central frequency.
- UWB radio not only can carry a huge amount of data over a distance up to 230 feet (70m) at very low power (less than 0.5 milliwatts), but has the ability to carry signals through doors and other obstacles that tend to reflect signals at more limited bandwidths and a higher power
- UWB can be compared with another short-distance wireless technology, Bluetooth, which is a standard for connecting handheld wireless devices with other similar devices and with desktop computers.

Short range devices EU Legislations

RLAN (WiFi), Internet of Things, ultra-wide band (UWB) equipment and Intelligent Transport Systems (ITS)

implementing decisions mostly concern **harmonization**, while others deal with **specific frequency bands for specific purposes**, in addition to limits on signal strength and harmful interference where applicable

- Implementing Decision (EU) 2019/785 on the harmonisation of radio spectrum for equipment using ultra-wideband technology
- Implementing Decision (EU) 2018/1538 on the harmonisation of radio spectrum for use by short-range devices within the 874-876 and 915-921 MHz frequency bands
- Implementing Decision (EU) 2017/1483 amending Decision 2006/771/EC on harmonisation of the radio spectrum for use by short-range devices
- Implementing Decision (EU) 2016/339 on the harmonisation of the 2 010-2 025 MHz frequency band for portable or mobile wireless video links and cordless cameras used for programme making and special events
- Implementing Decision 2014/641/EU on harmonised technical conditions of radio spectrum use by wireless audio programme making and special events equipment
- Implementing Decision 2013/752/EU amending Decision 2006/771/EC on harmonisation of the radio spectrum for use by short-range devices
- Implementing Decision 2011/829/EU amending Decision 2006/771/EC on harmonisation of the radio spectrum for use by short-range devices
- Decision 2010/368/EU amending Decision 2006/771/EC on harmonisation of the radio spectrum for use by short-range devices
- Decision 2007/90/EC amending Decision 2005/513/EC on the harmonised use of radio spectrum in the 5 GHz frequency band for the implementation of Wireless Access Systems including Radio Local Area Networks (WAS/RLANs)