Internet of Things and Big Data

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About me: Jad NASSAR

- Telecommunications and networking engineer
- Masters in computer science. Specialty: mobile and distributed computing - UBFC, Belfort, France. 2015
- PhD student at HEI Lille between 2015 and 2018. Specialty: wireless sensor networks
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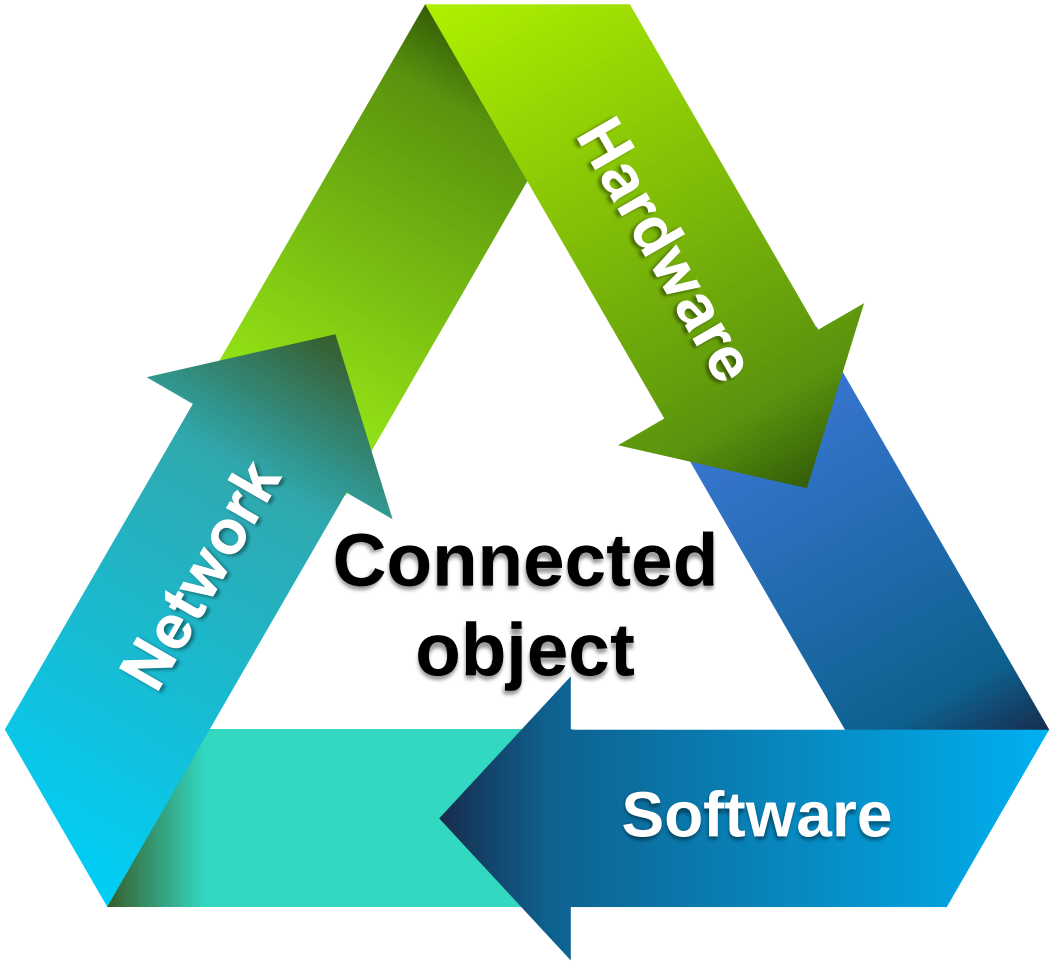
❑Chapter 0

Content, Terms and Conditions and Evaluation

About the course

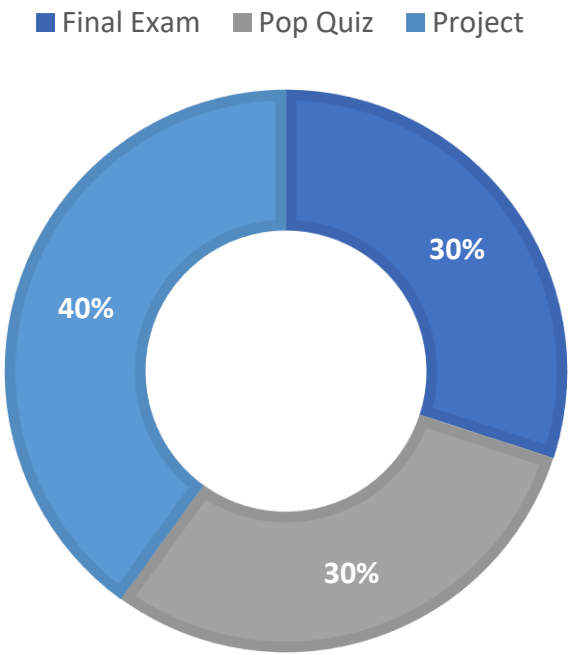


About the course

Course – Exercises – Labs

Project – Prototyping

- Work in groups of 4-6.
- Developing a connected device.



❑ Chapter 1: Introduction

- IoT Definition
- Applications
- Challenges

IoT: By definition

Internet of Things

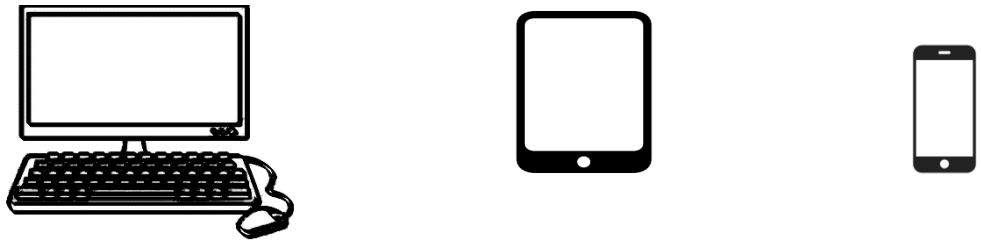
It is the fact of connecting **Things** to the **Internet**, where the human being becomes a minority. By extension, we speak about M2M network or Machine to Machine.

The term "Objects" is carefully chosen because it can literally include everything: obvious things such as computers and smartphones already connected to the Internet, home appliances, laptops, vehicles, machines, tagged animals and consumables .

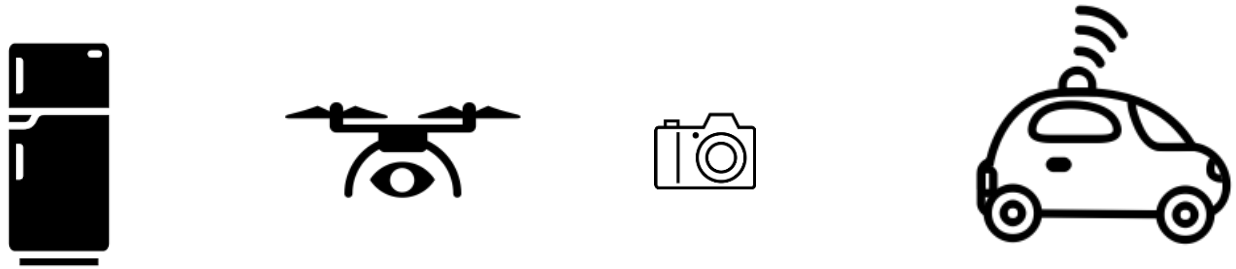
We call them: **Connected devices.**

Some connected devices

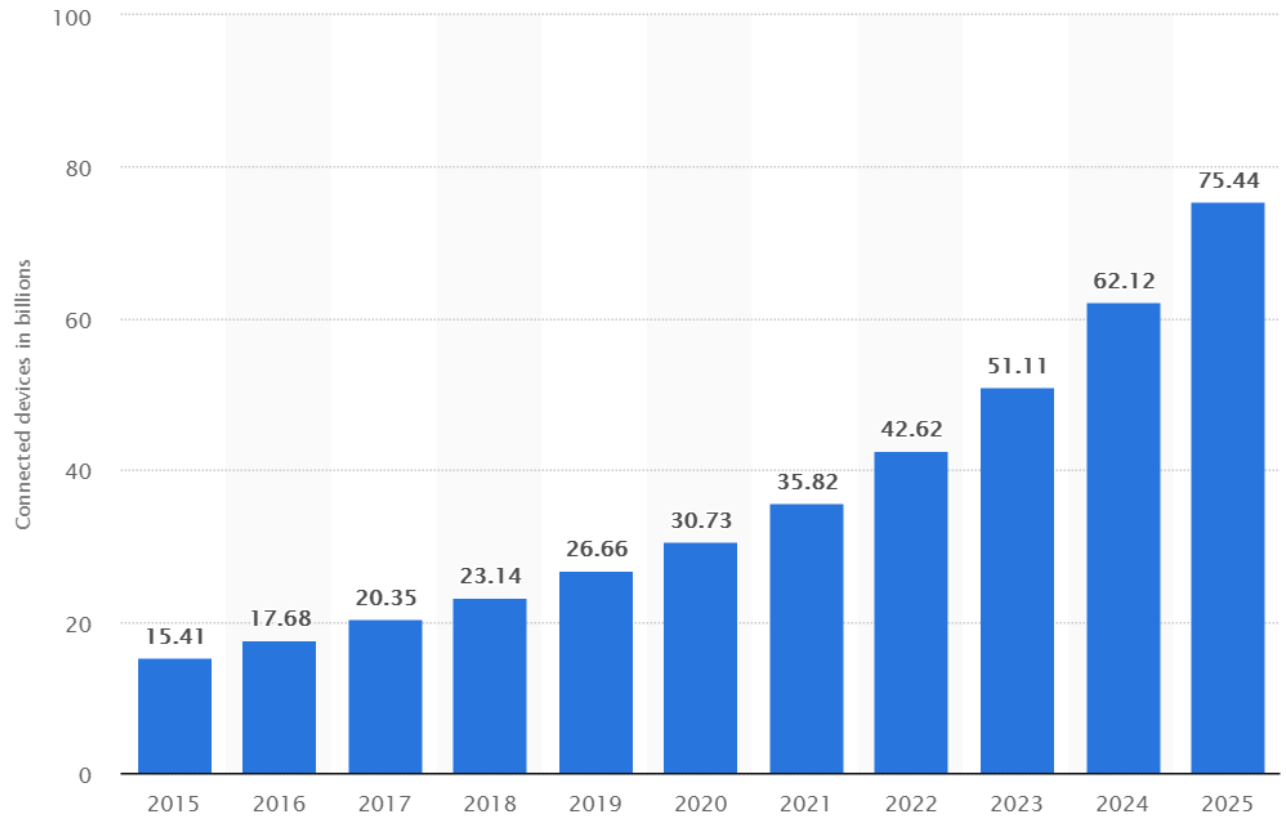
Traditional devices: Laptops, tablets, smartphones, etc.



New connected devices: household appliances, robots, locks, drones, toys, vehicles, etc.



IoT: Some numbers…



https://www.statista.com/statistics/471264/iot-number-of-connected-devices-worldwide/

‘According to CISCO, 97% of the objects around us will be connected to the Internet.
In 2013, only 0.06% of the objects were concerned’’

Why IoT

- Natural evolution of technologies: the inevitable link between the digital and physical world,
- Assistance with our professional and personal activities.
- Ensure a safe and comfortable life for the human being
- Allows a considerable reduction in expenses in today's economy (industry, health, safety, etc.).

The IoT is here and it's evolving fast! There is no time to waste.

Applications

- **Industry** with predictive maintenance, automated alert management, process optimization, yield and supply improvement...
- **Cities** with parking management, traffic flow optimization, street lighting management, energy consumption management...
- **Transport** with the optimization of passenger flows, the optimization of product delivery....
- **Retail** with fraud reduction, inventory optimization, automated stock management...

Intelligent agriculture, Home automation, E-Health, Security and Emergencies, etc.

Examples

Household appliances

E.g.: Bosch connected fridge

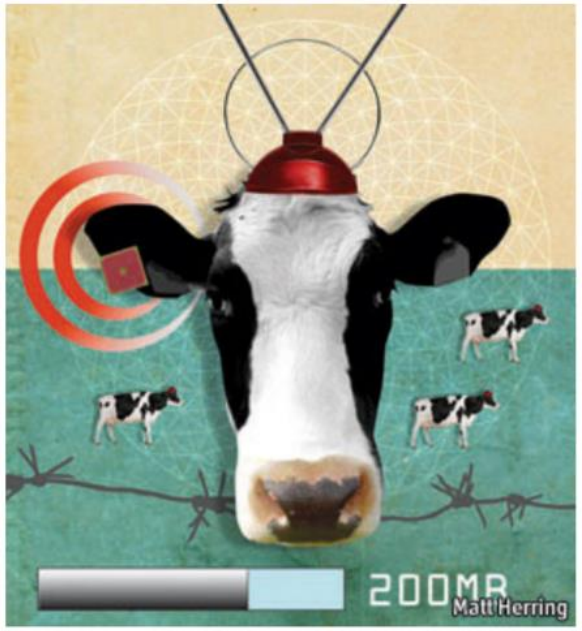
Home Connect

The Home Connect application has useful features like the ability to remotely view the inside of the refrigerator via 2 built-in cameras and your home Wi-Fi network

Examples

Agriculture

E.g.: Connected cow



Source : *The Economist*. 2010.

- ❑ Monitor the health status of the cows
- ❑ Track their movements
- ❑ On average, each cow generates about 200 megabytes of information per year.

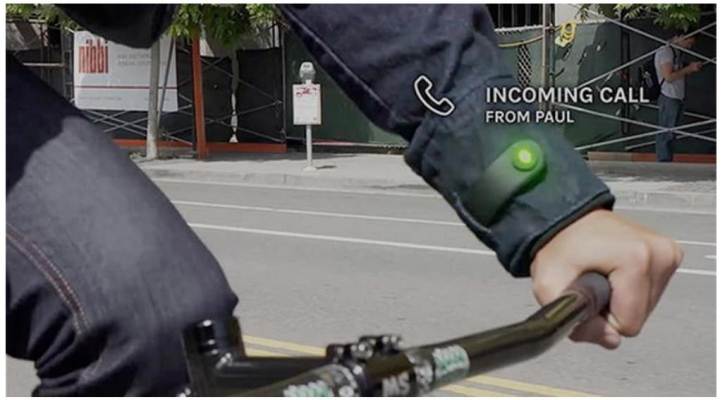
Source: The Economist « Augmented Business »

200 megabytes : Average 1 hour of Skype call
or 50 songs streaming on Spotify
or upload 50 photos on Facebook.

Examples

Clothing

E.g.: Connected jacket from Levi's and Google



https://www.objetconnecte.net/veste-connectee-1407/

- For example, you can **tap on your sleeve to find out how to get navigate** through a connection with Google Maps.
- You can also **accept** or **refuse** a phone call and **start** your music player...

Examples

Logistics

E.g. Transportation of goods

Internet of Things in logistics. James Macaulay, Lauren Buckalew, Gina Chung

One solution from DHL is the SmartSensor38 , which allows a complete monitoring of the status of a device.

This intelligent sensor can monitor temperature and humidity, while indicating shock and light events, to ensure total protection during transport.

M2M interaction

- The acronym M2M (Machine to Machine, machine to machine communication, inter-machine communication...) is used to refer to all information and communication technologies tools, deployed to **enable machines to communicate with each other without human intervention**.

- The IoT is an extended version of the M2M, open to the Internet.

- **The IoT is quite close to the M2M**, and for good reason; it is, in a way, a subset of it. The Internet of Things can be considered as a more extended version of the Machine to Machine and especially more open.

M2M interaction

- Within this system, connected devices are generally identified by an IP address, in the same way as a computer connected to the web.

- In order to ensure this interaction, it is necessary to implement methods of communication between these “devices", which is known as **communication technologies.**

Communication technologies

- Communications technology refers to all the equipment and programs used to process and communicate information.

- Communication technology professionals specialize in the development, installation and maintenance of these hardware and software systems.

Communication technologies: Wired vs Wireless

Wired technologies

G3-PLC Alliance

Pros & Cons of wired technologies:

- ☺ Reliable
- ☺ Secure
- ☺ High capacity
- ☹ High cost
- ☹ Limited/complex extensibility

Wireless technologies

sigfox LoRa

WiFi 3G 4G Bluetooth

Pros & Cons of wireless technologies:

- ☺ Scalable
- ☺ Infrastructure less
- ☺ Low cost
- ☹ Transmission interference
- ☹ Electromagnetic interference
- ☹ Limited autonomy

None of the wired or wireless technologies is suitable for all types of applications, and there is always a technology that may be better suited for a specific application.

Wireless communication technologies: LPWAN

- Low-power WAN (LPWAN) is a wireless wide area network technology that interconnects low-bandwidth, battery-powered devices with low bit rates over long ranges.

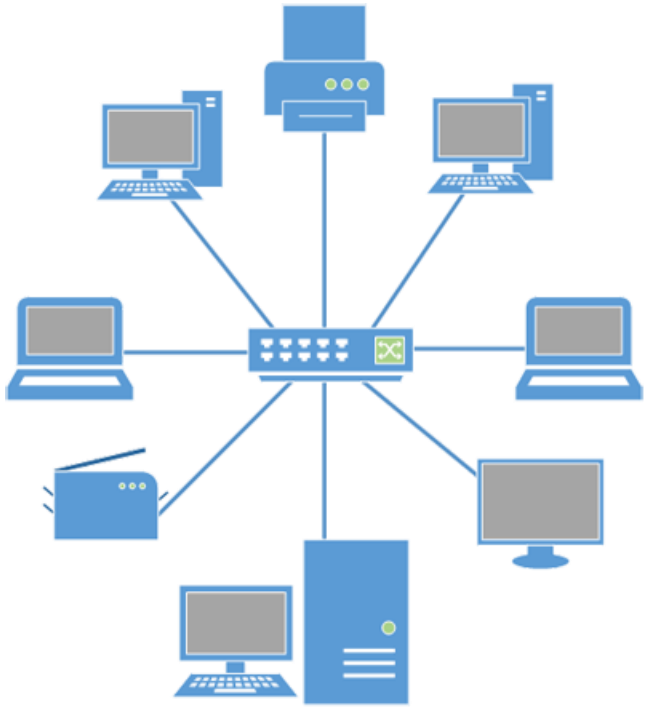
- Created for machine-to-machine (M2M) and internet of things (IoT) networks, LPWANs operate at a lower cost with greater power efficiency than traditional mobile networks.

- They are also able to support a greater number of connected devices over a larger area.

https://internetofthingsagenda.techtarget.com/definition/LPWAN-low-power-wide-area-network

Wireless communication technologies: LPWAN

- Most LPWANs have a ***star topology*** where, similar to Wi-Fi, each endpoint connects directly to common central access points.



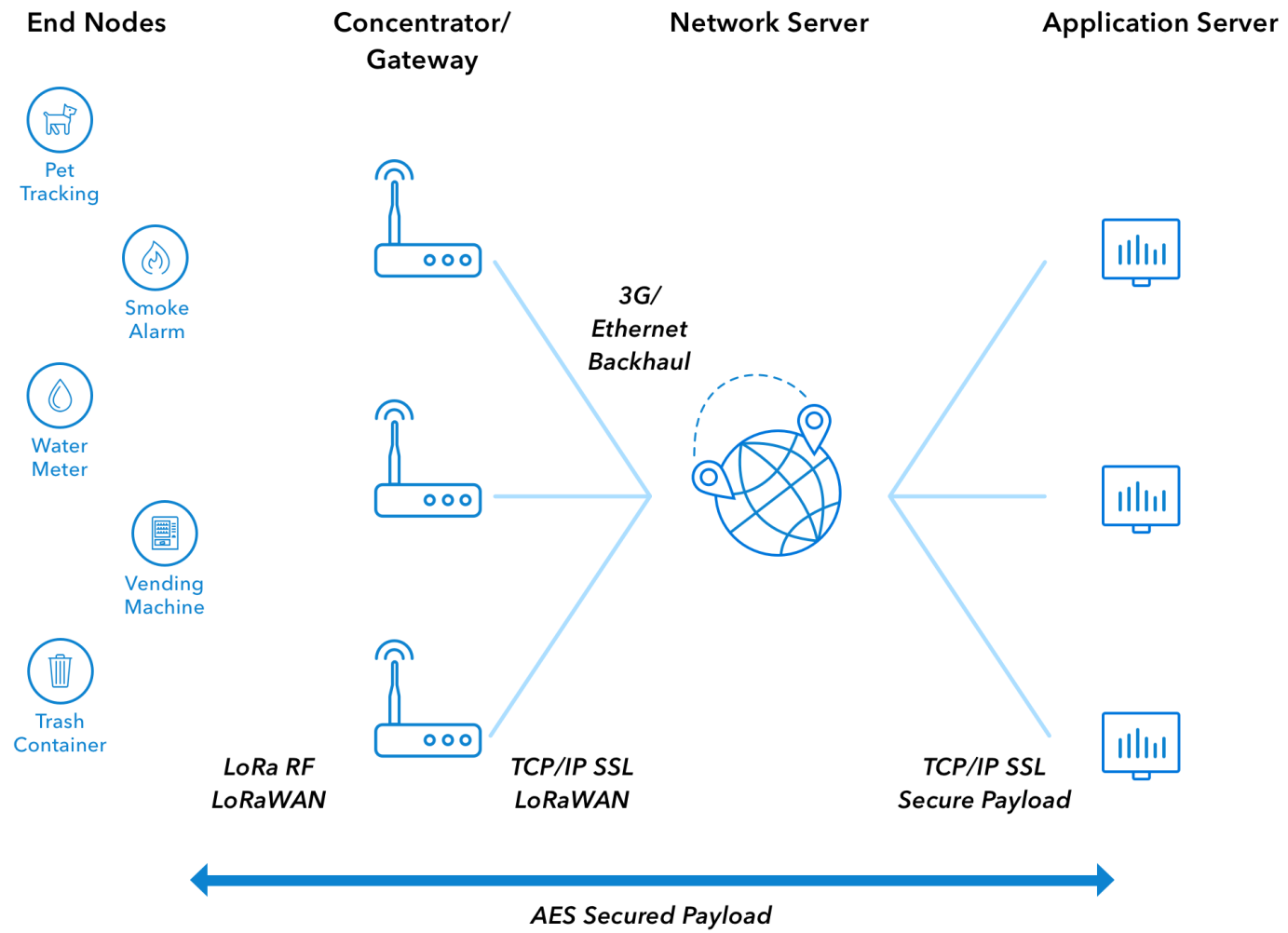
A star topology is a topology in which all nodes are individually connected to a central connection point, like a hub or a switch.

Wireless communication technologies: LPWAN

LoRa vs Sigfox

LoRa and Sigfox, two wireless communication technologies of French origin. They are competing for the dominance of the Internet of Things.

Wireless communication Technologies: LoRaWAN Architecture



- **End Device, Node, Mote**: an object with an embedded low-power communication device.
- **Gateway:** antennas that receive broadcasts from End Devices and send data back to End Devices.
- **Network Server**: servers that route messages from End Devices to the right Application, and back.
- **Application:** a piece of software, running on a server.
- **Uplink Message:** a message from a Device to an Application.
- **Downlink Message**: a message from an Application to a Device.
- **Payload:** in a data packet, the payload is the data itself that needs to be transferred (usually the user's data).

https://www.thethingsnetwork.org/docs/lorawan/

LoRa or LoRaWAN ??

- Definition 1: LoRa defines the physical layer (material, signal…), the reason behind the long-range communication. LoRaWAN defines the communication protocol and system architecture for the network.

- Definition 2: LoRa refers to a wireless modulation allowing a low power high radio budget communication. LoRaWAN is a protocol for a high capacity long range and low power network that the LoRa Alliance is standardizing for Low Power Wide Area Networks (LPWAN).

- Definition 3: LoRaWAN refers to a network protocol using LoRa chips for the communication.

From now on we will use LoRaWAN to indicate LoRa chips using LoRaWAN protocol.

Wireless communication technologies: LoRaWAN

- LPWAN technology (Low Power Wide Area Network)
- **One hop** communication
- Characteristics:
  - **Low cost**: cheap sensors, thousands of sensors managed by the same base station
  - **Low energy consumption**: long battery life
  - **Low bandwidth**
  - **Bidirectional**
  - **Long range**: several Kms of coverage from a single gateway
- License free. Operate on free frequency bands (868 Mhz in France)

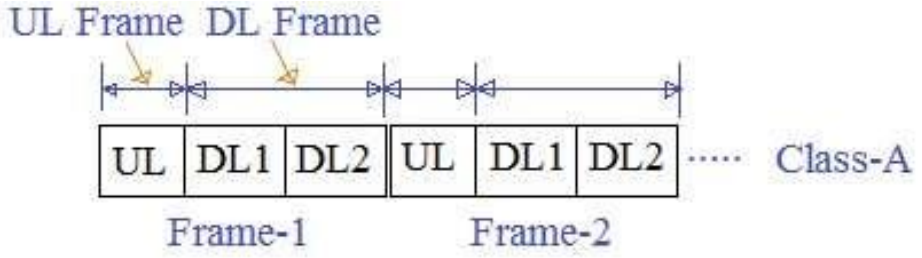
A LoRa network distinguishes Class A, Class B, Class C devices types. All LoRaWAN devices must implement Class A, whereas Class B and Class C are extensions to the specification of Class A devices.

Wireless communication technologies: LoRaWAN

- **Battery Powered – Class A**

  Pros : Lowest power consumption = longest battery life

  Cons: Long latency



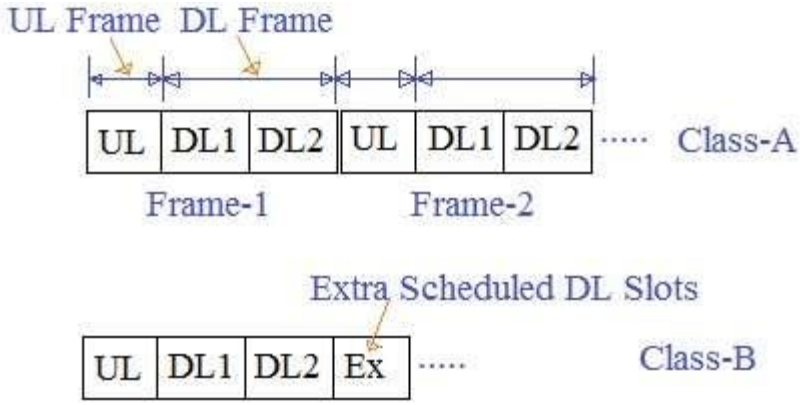
- Support bi-directional communication between a device and a gateway.
- Uplink messages (from the device to the server) can be sent at any time (randomly).
- The device then opens two receive windows at specified times (1s and 2s) after an uplink transmission.
- If the server does not respond in either of these receive windows, the next opportunity will be after the next uplink transmission from the device.
- The server can respond either in the first receive window, or in the second receive window, but should not use both windows.

Wireless communication technologies: LoRaWAN

❑ **Low Latency – Class B**

Pros: Deterministic latency

Cons: Higher power consumption



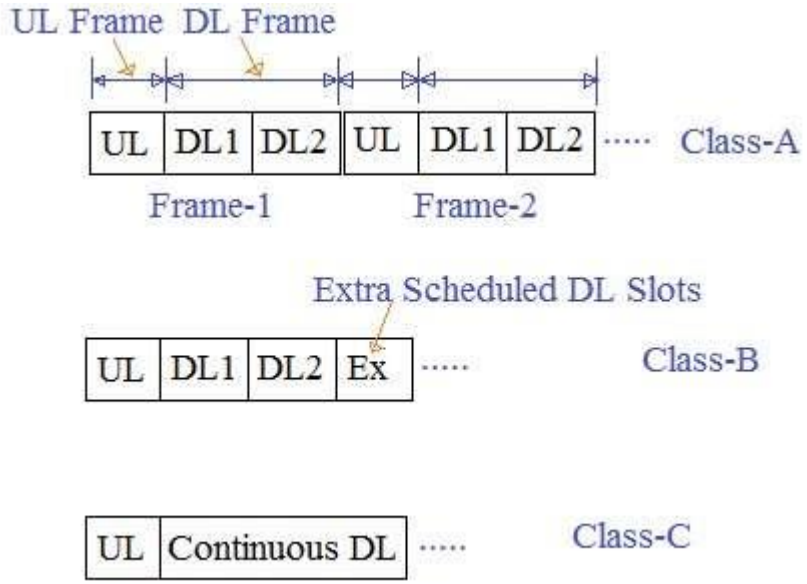
- Class B devices extend Class A by adding scheduled receive windows for downlink messages from the server. Using time-synchronized beacons transmitted by the gateway, the devices periodically open receive windows.

Wireless communication technologies: LoRaWAN

❑ **No Latency – Class C**

Pros: Lowest receive latency
End-device has continuous receive window
Cons: Highest power consumption (expect end-device to be main powered)

- Class C devices extend Class A by keeping the receive windows open unless they are transmitting, as shown in the figure below. This allows for low-latency communication but is many times more energy consuming than Class A devices.



LPWAN technologies: Sigfox vs LoRa vs NB-IoT

	Sigfox	LoRaWAN	NB-IoT
Frequency	Unlicensed ISM bands (868 MHz in Europe, 915 MHz in North America, and 433 MHz in Asia)	Unlicensed ISM bands (868 MHz in Europe, 915 MHz in North America, and 433 MHz in Asia)	Licensed LTE frequency bands
Bidirectional	Limited / Half-duplex	Yes / Half-duplex	Yes / Half-duplex
Max. msgs/day	140 (UL), 4 (DL)	Unlimited	Unlimited
Max. payload length	12 bytes (UL), 8 bytes (DL)	243 bytes	1600 bytes
Authentication & encryption	Not supported	Yes	Yes
Range	10 km (urban), 40 km (rural)	5 km (urban), 20 km (rural)	1 km (urban), 10 km (rural)
Localization	Yes (RSSI)	Yes (TDOA)	No

Mekki, Kais, et al. "A comparative study of LPWAN technologies for large-scale IoT deployment." *ICT Express*(2018).

Wireless communication technologies: WSN with Zigbee

- A Wireless Sensor Network (WSN) is a wireless network composed of autonomous devices distributed in an area that use sensors to monitor physical and/or environmental conditions.

- Most WSNs have a mesh topology which is a type of network where all nodes cooperate to distribute data between them.

- Sending data from the source to the destination is done via a **multi-hop communication**

Wireless communication technologies: WSN with Zigbee

- Multi-hop communication or routing (or multiple-hop routing) is a type of communication in networks in which the network coverage area is larger than the radio range of individual nodes.

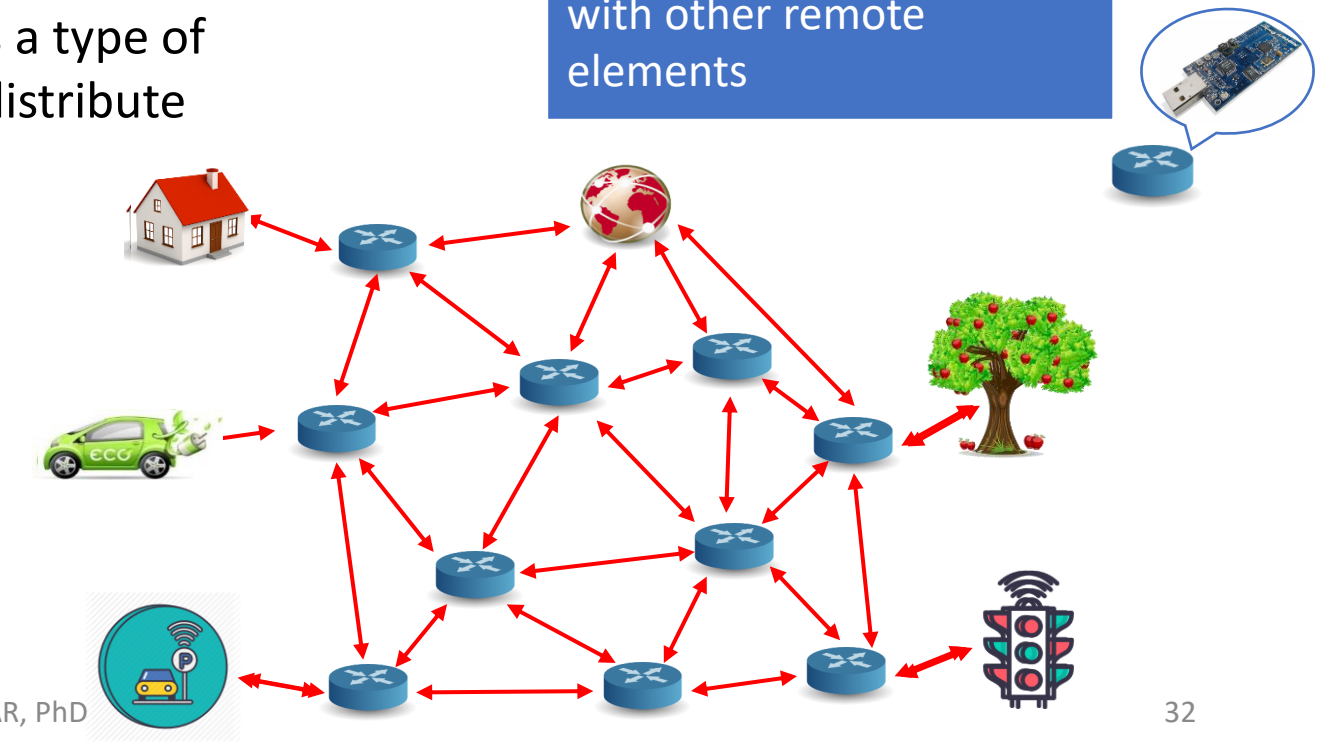
- Therefore, to reach a destination, a node can use other nodes as relays.

Wireless communication technologies: WSN with Zigbee

- A wireless sensor network (WSN) is a wireless network consisting of spatially distributed autonomous devices using sensors to monitor physical or environmental conditions.

- Most WSNs have a ***mesh topology*** which is a type of networking where all nodes cooperate to distribute data amongst each other.

Wireless sensor: a small computer consisting of an autonomous system capable of communicating with other remote elements



Wireless communication technologies: WSN with Zigbee

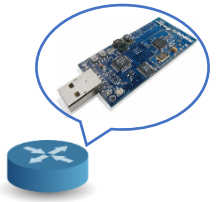
- This network will connect together thousands of millions of sensors. It will be necessary to develop algorithms dedicated to routing of data across the network in an efficient way.

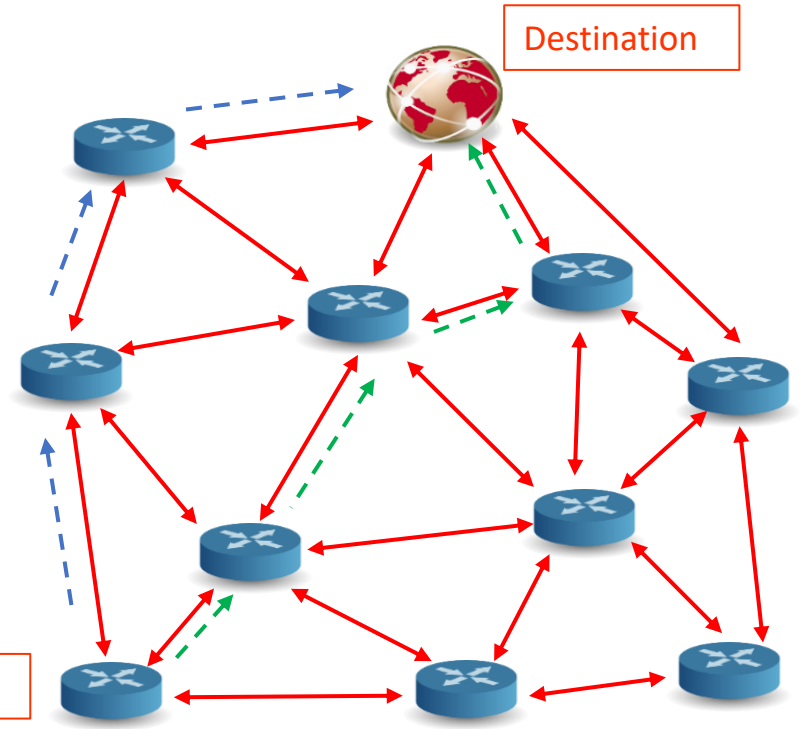
- **WHAT** we call them? ***Routing protocols***

- **HOW** routes are constructed? Using a ***metric*** which is a measurable value that is assigned by the routing protocol to different routes based on the usefulness of that route. E.g.: hop count, link quality…

- **WHERE** the routes are stored? A ***routing table*** is generally used to determine where data packets will be directed

Wireless sensor: a small computer consisting of an autonomous system capable of communicating with other remote elements





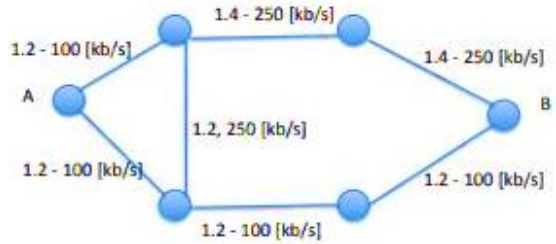
Exercise

- The nodes in the Figure below exchange packets of L=128[byte] which are acknowledged with ACKs of the same size.
  The figure reports for each wireless link the corresponding link capacity C and Expected Transmission Count (ETX).

- Find the Expected Transmission Time (ETT) metric for all the wireless links (assume negligible propagation delay), where *ETT= ETX x RTT*

  The Round Trip Time (RTT) corresponds to the time it takes for a signal to be sent plus the length of time it takes for an acknowledgement of that signal to be received.
  The Round Trip Time (RTT) for each link can be calculated as $RTT= 2 \times \frac{L}{C}$

- Find the shortest path from node A to node B using the ETT as routing metric.



Routing protocol example: RPL

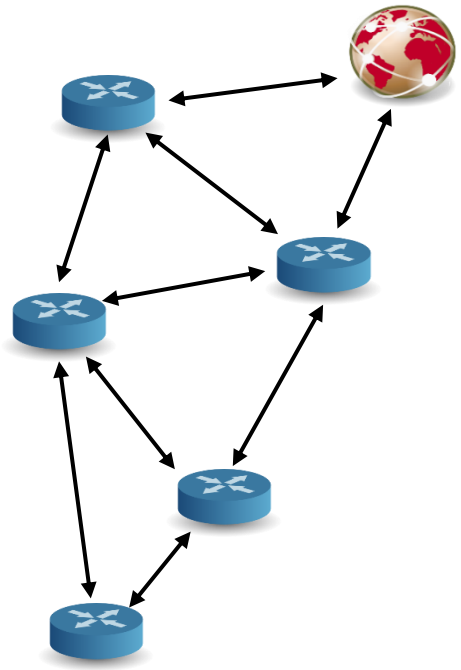
- RPL: Routing Protocol for Low power and Lossy Networks
- Standard for IoT applications
- Designed to work in large scale networks (up to thousands of wireless sensors)

RPL: How It Works?

RPL creates in the network one or more graphs called DODAG (Destination Oriented Directed Acyclic Graphs)

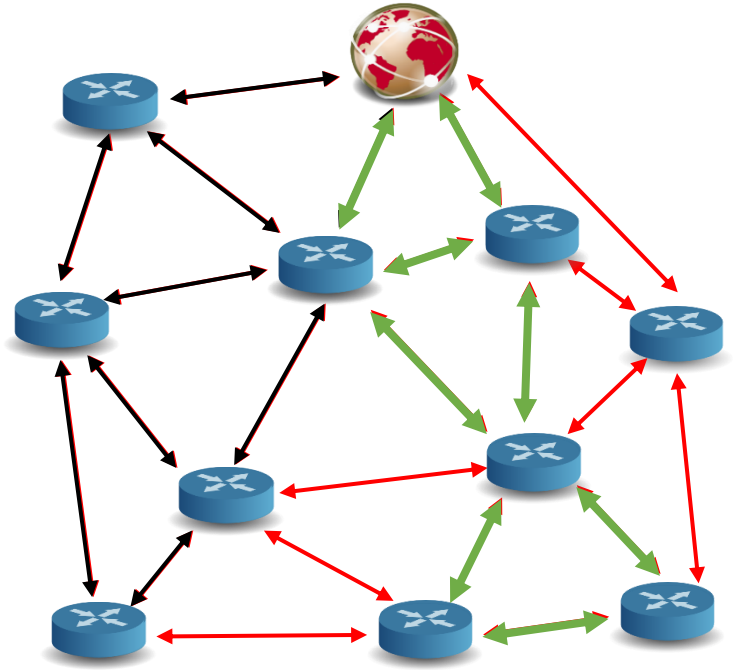
DODAG construction: based on an **Objective Function**

INSTANCE 1: F1

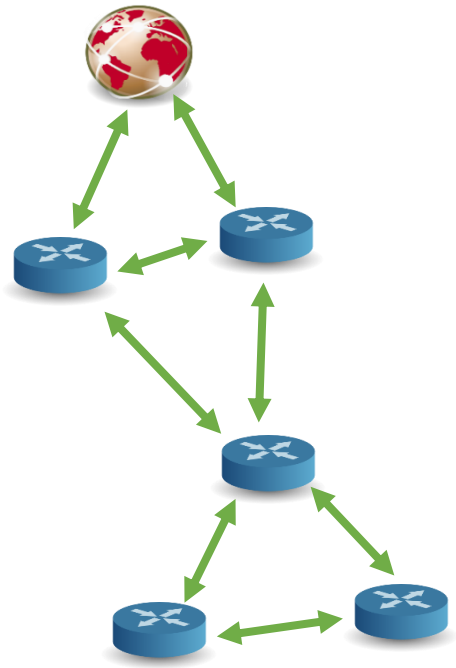


Metrics
E.g: Link Quality

Constraints
E.g : Battery/Main powered nodes



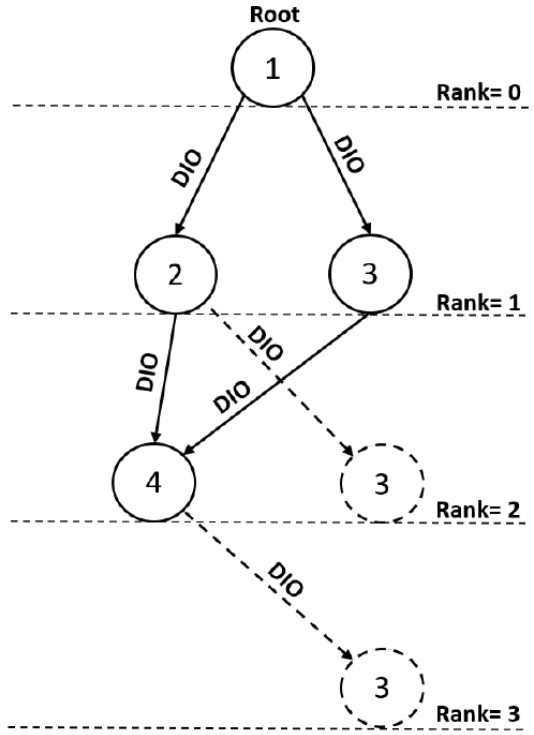
INSTANCE 2: F2



RPL: How It Works?

DODAG construction

- DODAG construction starts from the root by sending DIO messages to the neighbors
- Nodes will receive and process DIO messages potentially from multiple nodes and make a decision to join the DODAG/graph or not according to the objective function
- Each node in a DODAG has a rank that defines its relative position with respect to a root node of the DODAG

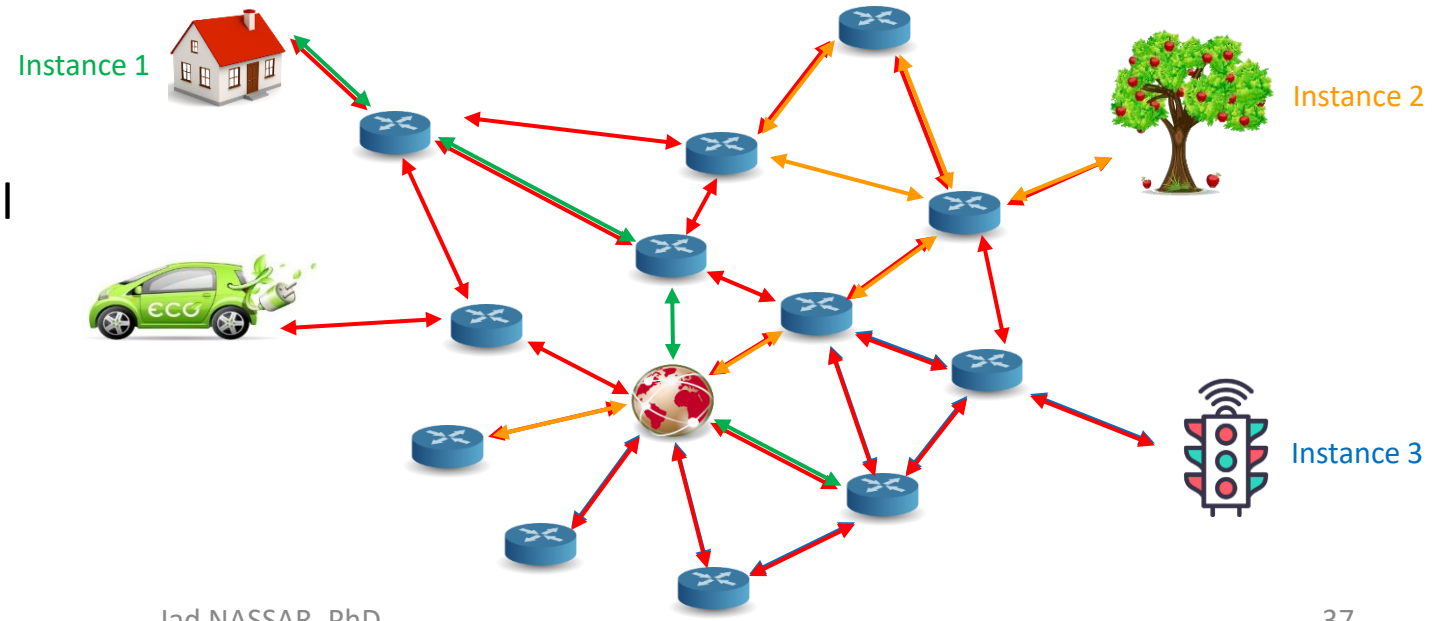


Rank concept in RPL

RPL: How It Works?

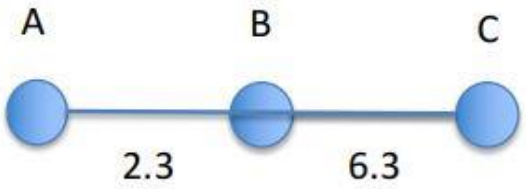
Benefits of using multiple instances:

- Several applications on the same network and at the same time
- Prioritize the flow of data in the network according to criticality
- E.g.
  Application 1: traffic lights control
  Application 2: humidity measurements for plants



Exercise

- Write the expression of the average energy consumed by all the sensor nodes for sending one packet from A to C through the two-hop path. The numbers below each link express the ETX for the link



The energy required to operate the TX/RX circuitry is. called E_c
The energy required to support sufficient transmission output power E_{tx}

Wireless communication technologies: Bluetooth

- Bluetooth is a wireless personal area network technology (WPAN), i.e. a wireless network technology with a short range (a few dozen of meters).
- It makes it possible to connect several devices between them without wire link, by using the radio waves like support of transmission. The radio link operates in a frequency band located around 2.45 GHz.
- This frequency band is free in most countries, which means that Bluetooth equipment can be used anywhere in the world.

Wireless communication technologies: Bluetooth

- Bluetooth was designed for greater connectivity range between devices. Originally designed to replace data communication cables used to connect desktop computers to printers, scanners and other peripherals.

- Bluetooth has evolved over more than a quarter century to become a pillar of short-range wireless connectivity in consumer and business applications.

- The first commercial Bluetooth device was a wireless earphone for cell phones, and today the technology is used to connect not only earphones and speakers, but computer keyboards and mouse, toothbrushes, etc...

Wireless communication technologies: Bluetooth

The main characteristics of Bluetooth technology are the following:

- Low cost
- Low emission power, leading to a short emission distance (a few dozen of meters)
- Low power consumption (therefore suitable for portable products)
- Modest data rates (between 2 and 3 Mbit/s)
- Dynamically configurable support for voice and data transfers
- Intended for personal use (PAN: Personal Area Network)
- Bluetooth certification to ensure compatibility between products.

Wireless communication technologies: RFID

- Radio identification, also known as RFID (Radio Frequency Identification), is a technology for writing or retrieving information stored on remote media called radio tags or TAG or transponder (transmitter and responder).

- These radio tags are made up of an antenna and an electronic circuit, which allow them to dialogue with the transmitter-receiver circuit. These radio labels or transponders contain data allowing to identify it.

- RFID tags, which can be attached to or incorporated into products, react to radio waves and transmit information remotely.

Wireless communication technologies: RFID

- RFID technologies are designed to enable the low-cost sharing of small amounts of data. As the name implies, this technology is generally used to identify objects.

Common applications include:

- Building access cards
- Public transportation systems
- Security tags on merchandise
- Contactless payment card systems.

Next-Generation Wireless in Logistics Philipp Meller, Jonathan Ward, Ben Gesing

Wireless communication technologies: RFID

The RFID tag, active or passive?

Wireless communication technologies: RFID

The main features and benefits of RFID technology are the following:

- Simultaneous reading of several RFID tags without direct visibility
- The possibility of reading at great distance (in UHF)
- The high level of reading security
- Protection of the data encoded in the chip
- The low energy consumption
- A range that can reach up to ten meters depending on the frequency used
- A bidirectional communication; a tag can send information to a reader as well as receive information from it.

Wireless communication technologies: NFC

- Near Field Communication (NFC) is a more recent technology derived from RFID.
- A single NFC device can function as an RFID tag or as a reader. Two NFC devices can use the technology for two-way communication.
- NFC technology is embedded in many modern smartphones and other consumer devices. It powers touch-to-pay services such as Apple Pay and Google Pay.

Next-Generation Wireless in Logistics Philipp Meller, Jonathan Ward, Ben Gesing

Wireless communication technologies: NFC

The main characteristics and advantages of NFC technology are the following:

- NFC transmits data over small distances, usually between 4 and 10 centimeters
- Low power consumption
- Low data rate - 430 Kbit/s maximum
- Bi-directional communication

Wireless communication technologies: Wi-Fi

- Wi-Fi is a universal wireless network technology that uses radio frequencies to transfer data. Wi-Fi allows high-speed Internet connections without the use of cables.

- The term Wi-Fi is a contraction of "wireless fidelity" and is commonly used to refer to wireless network technology.

- From a technical perspective, the IEEE 802.11 standard defines the protocols that enable communications with today's Wi-Fi enabled wireless devices, including routers and wireless access points.

Wireless communication technologies: Wi-Fi

- In the past, Wi-Fi versions were identified by a letter or pair of letters referring to a wireless standard. All these complex code names are being changed. So instead of being called 802.11ac, the current Wi-Fi will be called Wi-Fi 5 (because it's the fifth version)

- Wi-Fi version 6 (Wi-Fi 6) was released in 2019. One of the main advantages of Wi-Fi 6 over its predecessors is **speed**. It is estimated that **the gain enabled by this new technology in this regard is about 40%.** The maximum theoretical throughput allowed by Wi-Fi 6 is **10 Gbps**.

- The frequencies of Wi-Fi are the 2.45 GHz and 5 GHz bands.

- Wi-Fi is much more energy consuming than Bluetooth, NFC or RFID for example

Wireless communication technologies: Barcode

- It is the most widely used identification method in the world.
- This system uses a language that creates unique codes and identifies goods through a series of numbers and bars.
- GS1 is the organization that regulates the coding of products based on the GTIN (Global Trade Item Number).
- This number may be accompanied by additional numbers that provide more information about the goods. Examples: the lot, the SIN (Shipment Identification Number), the SSCC (Serial Shipment Container Code), etc.

Wireless communication technologies: Barcode

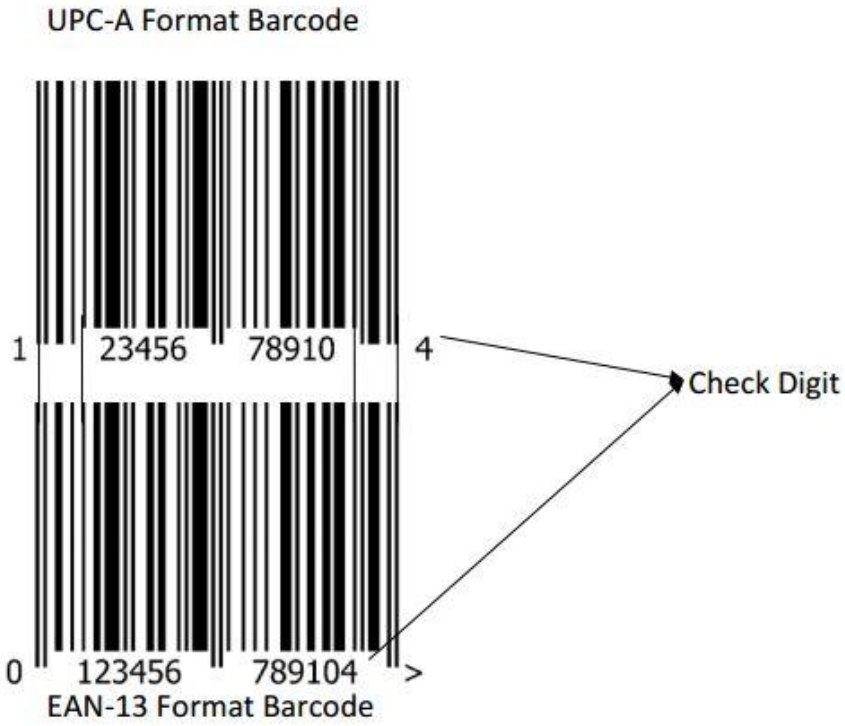
- There are two standards for barcodes:
  - EAN (European Article Numbering; also known as International Article Number or IAN)
  - UPC-A code (Universal Product Code)

What is the difference between EAN and UPC-A?

The UPC-A barcodes formed of 12 digits, are a subset of EAN barcodes, formed of 13 digits. If the first digit of the EAN is a "0", it can then be used in UPC-A by removing this same "0".

Wireless communication technologies: Barcode

- To simplify, a UPC-A code is an EAN code without the "0" at the beginning of it.
- UPC-A barcodes have traditionally been used in the United States, while the EAN format has been used in the rest of the world. Today, most stores around the world accept barcodes in both formats.



https://codesabarres.fr/difference-entre-ean-13-et-upc-a

Wireless communication technologies: QR code

- A QR code (short for "quick response" code) is a type of barcode that contains a matrix of dots. It can be scanned using a QR scanner or a smartphone with a built-in camera.

- Once the code is scanned, the device's software converts the dots in the code into numbers or a string of characters. For example, scanning a QR code with your phone can open a URL in your phone's web browser.

Wireless communication technologies: QR code

- All QR codes are square in shape and include three square outlines in the lower left, upper left and upper right corners. These square outlines define the orientation of the code.

- The dots in the QR code contain information about the format and version, as well as the content itself.

Wikipedia QR code

Wireless communication technologies: QR code

- QR codes have two important advantages over traditional UPCs - the barcodes commonly used in retail packaging.

- **First,** because QR codes are two-dimensional, they can contain much more data than a one-dimensional UPC. While a UPC can contain up to 25 different characters, a 33x33 (version 4) QR code can hold 640 bits or 114 alphanumeric characters. A 177x177 (version 40) QR code can store up to 23,648 bits or 4,296 characters.

Wireless communication technologies: QR code

- **Another advantage** of QR codes is that they can be scanned from a screen.
- Standard UPC scanners use a laser to scan barcodes, which means they generally cannot scan a UPC from a screen (like a smartphone).
- QR scanners are designed to capture 2D images printed on paper or displayed on a screen. This allows you to use a QR code on your smartphone as a boarding pass at the airport or as a ticket to an event.

Communication technologies: To keep in mind

In the communication infrastructure, the elements to be taken into account include:

- The type of communication (short or long range)
- Network coverage
- The energy consumption of the device
- The volume of transmitted data
- The frequency of capture
- The frequency of transmission
- The price of the sensors/transmitters.

Communication technologies: To keep in mind

Short range communication:

It corresponds to links that are made over very small distances (less than 10 cm).

The data exchange can then be done by contact between the sender and the receiver.

Examples:

Wireless: Reading a QR code, NFC, Bluetooth
Physical connection: Reading via Ethernet or USB port

The exchange of information takes place between two devices where one of them (the reader) acts as a local processing server. The reader can also process the information a posteriori and transmit it to other systems

Communication technologies: To keep in mind

Long range communication:

For long-distance communication where objects interact with processing servers, it is necessary to rely on a cellular network that allows a connection in areas that are covered by antennas.

Examples:

- Cellular networks covered by telephone operators (2G,3G, 4G, LTE)
- Low energy networks LPWAN

Wireless sensor networks provide medium distance communication that can be extended to long distance communication with a denser network.

Communication technologies: To keep in mind

Network coverage:

The coverage and scope of the network is very important. It has an impact on the management and deployment of devices.
When the scope of the networks is greater, coverage and deployment are facilitated.

Examples:

- Wifi networks have a coverage often reserved for a room/house…
- 3G/4G networks make it possible to cover a country like France with a very large number of antennas.
- LPWAN networks (SigFox, Lora...) require fewer antennas and cover larger areas, even in hard-to-reach areas.

Communication technologies: To keep in mind

Energy consumption:

Autonomy is one of the main interests of connected devices.

Many industrial devices can be autonomous (especially sensors) and inaccessible once installed (sensors in forests, rural areas...)

Most of the time, the energy is used for data collection and transmission. It is therefore necessary to be able to transmit with as little consumption as possible.

Communication technologies: To keep in mind

Energy consumption:

We can distinguish between:

- Energy consuming equipment, which send a large volume of data via Wifi or GSM
- Less energy consuming equipment/sensors, most of the time in standby mode, with a small volume of information to transmit: Sigfox, LoRa, etc.

Communication technologies: To keep in mind

The volume of transmitted data and the frequency of transmission

The connected devices receive data that is then transmitted through the network. **The volume of data** and **the frequency of transmission** are therefore important to take into account when choosing the device but also the network.

In order to save power consumption of the connected device, it can for example record data at regular intervals (e. g. every minute) but only transmit it once a day.

Communication technologies: To keep in mind

The volume of transmitted data and the frequency of transmission

The data collection/transmission strategy must therefore also be designed according to the services/applications that we want to build from these "data".

The choice of the network is also important in the case of symmetrical bidirectional communication per example.

Communication technologies: To keep in mind

The volume of transmitted data and the frequency of transmission

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Communication technologies: To keep in mind

The frequency of capture

The data capture frequency will determine the types of services that can be created from the captured data. It is therefore also an important element to be taken into account.

The higher the frequency of information capture, the higher the power consumption of the connected device.

It is therefore more common for connected devices that need to capture information in "real time" to have a quasi-permanent power source at their disposal.

Communication technologies: To keep in mind

The price

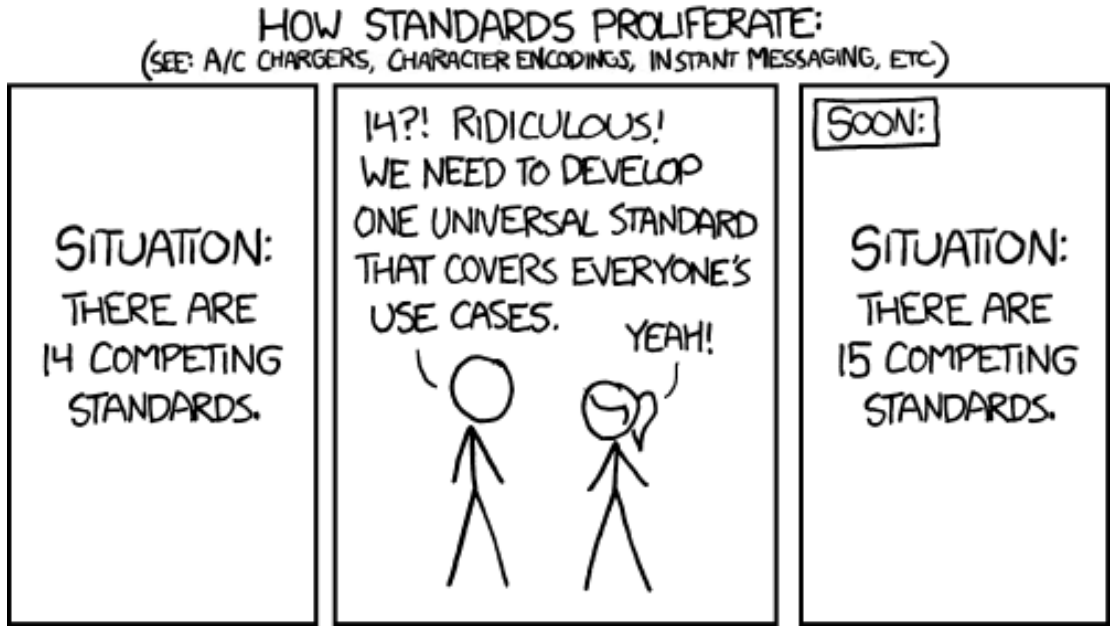
The prices of both sensors and networks are now very low for LPWANs, around a few euros (for example, Sigfox offers the chip or connection module for a few euros, traffic costs between 0.7 euros to 8 euros per object and per year).

For fast networks such as WiFi or 3G/4G, it is much more expensive but the cost can be associated with other applications or services.

IoT standards and protocols: Challenges and risks

❑ **Complexity et interoperability:**

The number of different systems connected via IoT continues to create interoperability issues. It will take time to sort.



https://xkcd.com/927/

IoT standards and protocols: Challenges and risks

❑ Data usage:

The IoT devices generate a huge amount of data. Consistency must be ensured at all levels of implementation. The global architecture must have a robust data management and distributed analytics framework to explore and analyze data where it matters.

Cisco estimates that by the end of 2025, the IoT will generate more than 500 zeta-bytes* of data per year and that in the coming years this number is expected to grow exponentially and non-linearly.

1 000 000 000 000 000 000 000 bytes

*unit equal to one trillion gigabytes

IoT standards and protocols: Challenges and risks

- **Security:** Hackers and loss of sensitive data created significant risk and disrupted operations. It is therefore imperative to have a solution that identifies each actor at each level using **authentication** and **authorization**, while allowing the **encryption** and **anonymization** of the data sent.

150000 security cameras broadcasted their video streaming to OVH.

1 Terabit/s= 1024 Gbit/s = 1099511627776 bits

DoS, DDoS: Késako?

A **Denial of Service attack (DoS attack)** is a computer attack that intends to make a service unavailable, to prevent users of a service from using it.

The vast majority of these attacks are from multiple sources, referred to as DDoS attacks (DDoS attack for Distributed Denial of Service attack).

It may include:

- flooding a network to prevent its operation.
  Example: Sending billions of bytes to an Internet box.

- Disruption of connections between two machines, preventing access to a particular service.

- Obstructing access to a service for a particular person.

Current status of IoT in France

The IoT market value in France is estimated at €10 billion, with a growth rate of about 15% per year.

PAC is forecasting a doubling of the current value by 2025!

Three regional hubs specialized in IoT:

- Cité de l'objet connecté à Angers
- IoT Valley à Toulouse
- Usine IO à Paris

And SMEs:

Sigfox, Actility, Withings (health), Enko (sport), etc...