Internet of Things

Industrie 4.0 is the upcoming industrial revolution

Notice how its spelled Industrie -> that's because it originates fom Germany

MTC

Massive variance of the requirements of MTC from massive MTC to critical MTC

Massive IoT/MTC

Examples: monitoring and automation of buildings and infrastructure, smart agriculture, logistics, tracking and fleet management

Refers to services that typically span a very large number of devices

Typically a very small amount of data generated by the devices and and low latency is not a critical requirement.

Requirements of massive MTC:

1. architecturally simple devices that use a low-complexity transmission mode
2. devices that can run on battery power for many years
3. long transmission ranges for devices in remote locations
4. scalable networks that can connect either a large or a small number of M2M devices

Sometimes, a mobile network may be used to bridge connectivity to the device by means of capillary networks. Here, local connectivity is provided by means of a short-range radio access technology, for example Wi-Fi or Bluetooth. Wireless connectivity beyond the local area is then provided by the mobile network via a gateway node

Critical IoT/MTC

Examples: traffic safety/control, control of critical infrastructure and wireless connectivity for industrial processes

Industries to benefit: Automotive, Energy utilities, Industrie 4.0

High reliability and low latency

Low cost not as important.

5G in IoT/MTC

Looks to satisfy both massive and critical.

Will have 99.999% uptime and ultra low latency $<$ 5ms RTT

Will have to be highly customizable. Network slicing. Move data storage much closer to where control is required for latency -> Edge/Fog computing

Having the same network cover such a wide range of applications is good. Reduces the need for any new application/service to require an entirely different network and avoids spectrum fragmentation.

Reduced signaling is a big thing as it is a dominant part of the overall traffic in the network.

4g and 5g not ready for this yet

LPWAN

The aim of this type of technology is to support a vast number of cheap devices that transmit bursty, small, infrequent messages.

have a similar topology to mobile networks with the added benefits of better range and penetration through the use of lower frequencies and more robust signals.

Typically, LPWANs aim to exceed the radio link budget performance of 2G's GPRS by 20dB

Estimates range from 50,000 to 100,000 devices per square kilometre/cell in Non Line Of Sight (NLOS) urban areas

In LOS situations the aim is to achieve >~15km range. Typically they operate in sub-1GHz so that the system can access Things placed deep indoors, i.e. in basements

BOM must be very low so that cheap devices running on batteries last for up to 10 years.

handshaking Should be reduced as this eats into the battery life

The immaturity of the application means that the traffic patterns are not well known and so it is difficult to design MAC/network schemes that support emerging applications

LoRa

Operates in the 868MHz band (favourable propagation characteristics)

Operates in Unlicensed Spectrum

Similar Innovation potential of WiFi

QoS issues as the rules are lax and primarily designed for short range communication.

LoRa has a high link budget by using spread spectrum-based PHY

Allows for different spreading factors which can be selected in an automatic adaptive fashion.

Uses simple ALOHA MAC for computation and power reasons. This can be detrimental for QoS.

BiDirectional communication is initiated by the thing and not the base station.

250bps to 50kbps

up to 154 dB link budget

Acronyms

- IOT: internet of things
- IIoT: Industrial Internet of Things
- M2M: Machine-to-Machine
- MTC: Machine-Type Communications
- SCADA: Supervisory Control And Data Acquisition
- RTT: Round Trip Time
- LPWAN: Low Powered Wide Area Networks
- BOM: Bill Of Materials
- LoRa: Long Range