5G

5G capabilities

1. 5G aims to enable a truly pervasive video experience
2. 5G will enable a revolution in the smart office
3. 5G will deliver 50Mbps everywhere
4. 5G will allow you to create your own network
5. 5G will support dynamic increase of capacity on the fly
6. 5G will enable a working solution on planes trains and cars
7. 5G will deliver a single scalable solution for sensor networks and IoT
8. 5G will enable a ultra reliable network for mission critical applications
9. 5G will make the realization of the tactile internet possible
10. 5G will deliver meaningful and efficient broadcast service

5G technical objectives

1. 1000X increase in mobile data volume per geographical area reaching a target of 0.75 Tb/s for a stadium
2. 1000X in number of connected devices reaching a density of $\geq$ 1M terminals/km^2
3. 100X in the user data rate reaching a peak terminal data rate $\geq$ 1Gb/s for cloud applications inside offices
4. 1/10X in energy consumption compared to 2010 while traffic is increasing dramatically at the same time
5. 1/5X in the end-to-end latency reaching delays $\geq$ 5 ms *
6. 1/5X in network management Operational Expenditure (OPEX)
7. 1/1000X in service deployment time reaching a complete deployment in $\leq$ 90 minutes *
8. Guaranteed user data rate $\geq$ 50 Mb/s
9. Number of supported IoT terminals $\geq$ 1 trillion
10. Service reliability $\geq$ 99.999% for specific mission critical services *
11. Mobility support at speed $\geq$ 500km/h for ground transportation
12. Accuracy of outdoor terminal location $\leq$ 1 m

* indicated that this is a key change in functionality

Carrier bandwidth is between 100-500MHz

<1 millisecond latency when required

10-50Gbps peak data rates

90% energy reduction per service

The Pipe: Old and New

Old

The old pipe allowed developers to create apps that use the network as a dumb/passive bit pipe

No network customization for apps and services

New

Moving from one size fits all to tailored network services, Verticals. e.g mobile, medical, VANET, retails etc.

Verticals refer to the different niches of the telecoms industry, the different services that 5G aims to provide for.

One size doesn't fit all

Cloud technologies together with software defined networking (SDN) and Network Functions Virtualization (NFV) provide the tools that enable architects to build systems with a greater degree of abstraction - which enhances network flexibility.

Cloud, SDN and NFV technologies allow vertical systems to be broken apart into building blocks, resulting in a horizontal network architecture that can be chained together - both programatically and vertically - to suit the services being offered and scaled

Network slicing

A network architecture so flexible that it can be:

1. shared by multiple different user-types
2. tailored to user-type needs
3. Resources allocated in a granular fashion
4. Billed in a regular fashion

5G-as-a-service

A network slice is a connectivity service defined by a number of customizable software-defined functions that govern geographical coverage area, duration, capacity, speed, latency, robustness, security and availability.

Kind of like specialised network configs on demand

Slicing networks provides a greater insight into network resource utilization, as each slice is customized to match the level of delivery complexity required by service or services using the slice.

Software Defined Networks

Provides ability of abstraction from the physical networks infrastructure. Through network-wide programmability - the capability to change the behaviour of the network as a whole - SDN greatly simplifies the management of networks

Allows for the various desired network slices to be supported on the same physical and logical network infrastructure

Network Function Virtulisation

Hardware is separated from software, so NFV can allow network functions to be implemented programatically instead of physically. This allows for instant scalability, which supports the delivery of services like capacity or coverage on demand.

The most significant benefit is the ability to execute network functions independently of location. By virtualizing a network function it is no longer bound to a specific location or node. The same network function can be executed in different places for different network slices. Can move the network function location around to change latencies.

Back to 5G

5G is a programmable, dynamic network

There will be a physical infrastructure

but on top of this static infrastructure will be any number of dynamic networks and running functions, all defined in software.
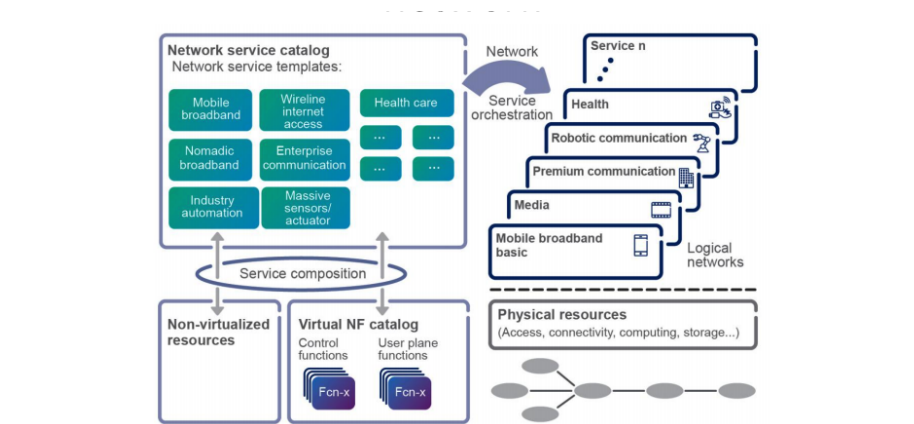
Acronyms

- OTT: Over The Top
- SDN: Software Defined Networks

- NFV: Network Function Virtualization
- XaaS: Anything as a service