# The 5G pocket guide

By Networks CoE

**In collaboration with**
Vodafone University | Technology
R&D
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Group Internal Communications

# What is 5G

**5G will be more integrated and more integral to the world we live in and the way the world works.**

Wondering what 5G is? Even though it represents a less distinct technological shift forward from previous generations, Vodafone believes 5G will enable a major shift in our customers' experience.

## With 5G

- Peak speeds will reach and exceed 1Gbps.

- The network will manage traffic more efficiently than with 4G. This means the capacity of our network will increase, so our customers will enjoy higher and more consistent average speeds - even in crowded scenarios or in areas with less-than-ideal coverage.

- There will be less latency, which will also continue to decrease over time as 5G devices evolve. As the time between performing an action (such as moving a character in an online game) and getting a response will be reduced, devices will also become more responsive.

- More devices will be able to connect to a 5G cell site, supporting the expected explosion in the number of devices as part of the Internet of Things.

### Enhanced Mobile Broadband

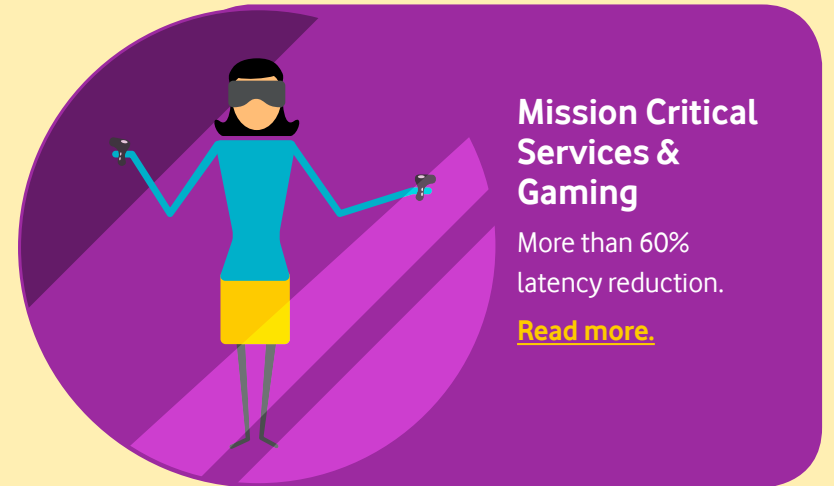100 Mbps whenever needed.

>1Gbps peak data rate.

**Read more.**

### Mission Critical Services & Gaming

More than 60% latency reduction.

**Read more.**

# What will 5G bring?

4G Evo and 5G will create new opportunities. We can foresee some of them, but there will be others we cannot even imagine today.

### Massive IoT communication

10 years on battery.

1M Devices per $Km^2$.

**Read more.**

*Did you know?*

Latency is the round trip time it takes for a packet to go to and from the application server, measured in milliseconds.

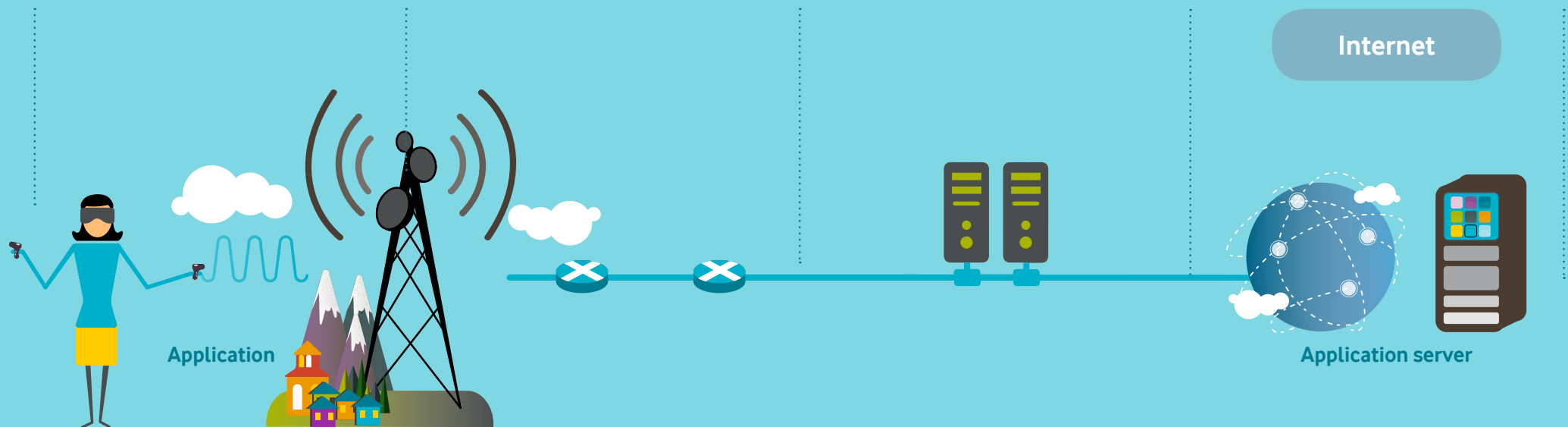5G decreases the cost of delivering data in our network.

# Let's start with
# the basics

Here we explain the fundamentals of our mobile networks: Radio, Transport and Core.

**Click on each of the red buttons for more information.**

**Internet**

**Application**

**Application server**

# 4G Evo

# 5G New Radio (NR)

# What's 5G?

4G Evo is going to act as the bridge to 5G, making this the first time in history that one mobile network has needed the previous one to be born.

5G encompasses 4G Evo, a 5G New Radio (NR) and a new 5G Core (5GCN), supported by a transport and core architectural evolution to deliver great network benefits. For the first time two generations of technologies are going to be closely integrated together. Both 4G Evo and 5G will offer the possibility of higher speed and capacity, lower latency and importantly new possibilities in IoT.

## Did you know?

We will launch 5G NR using our current 4G network. It allows us to speed up the 5G launch.

4G Evo is the evolution of the 4G network, with data rate and latency improvements. It includes IoT and other capabilities brought forward from 5G, such as Massive MIMO.

# 4G Core Architecture evolution

# 5G New Core

# Radio

Our current 2G, 3G and 4G networks use different radio interfaces. 5G NR is a new radio standard interface offering data rates higher than 1Gbps. It's more efficient, meaning it can transmit more data in the same amount of spectrum, as well as utilise more spectrum at once – so it has a double impact. It was defined in the 3GPP standard in Dec'17.
**Read more.**

Transport – **Read more.**

*Did you know?*

The world's first 5G NR standard call was made by Vodafone in February 2018.
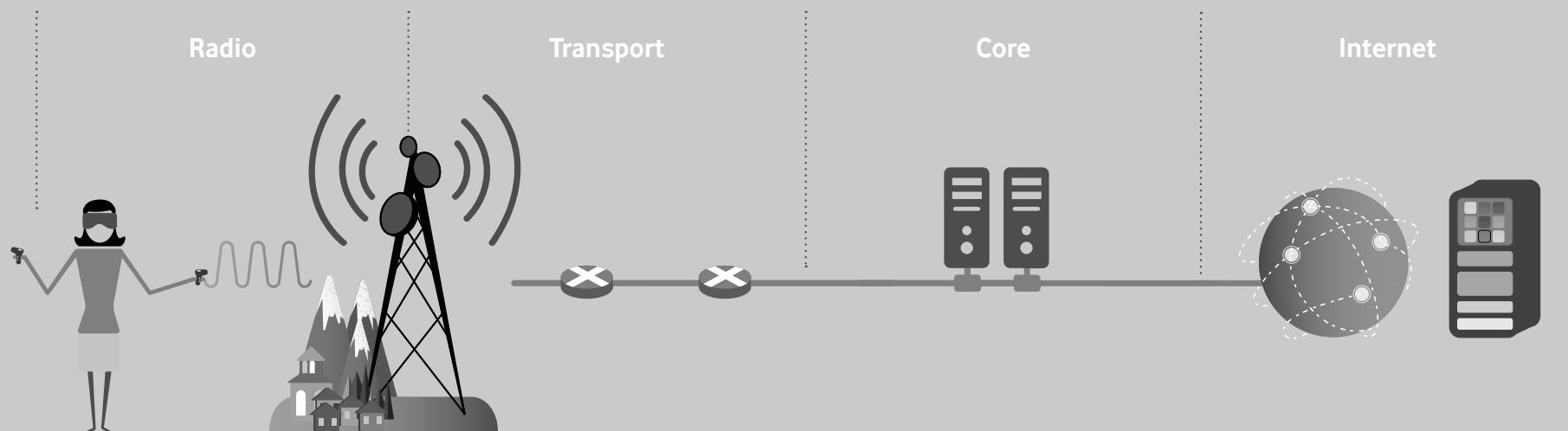
# Core

There are two phases for the Core Network to support the 5G New Radio.

- **Non Stand Alone (5G NSA).** In the first phase the existing 4G core network (EPC) will be used to support the 5G launch, with only minor changes expected for the current core. The first 3GPP standard was closed in Dec 2017.

- **Stand Alone (5G SA).** In the second phase the new 5G Core (5GCN) will be introduced. It's currently being standardized in 3GPP and it introduces more flexibility and more functionalities.

**Read more.**

3GPP **Read more.**

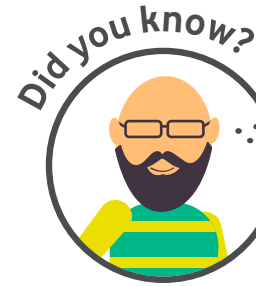| Radio | Transport | Core | Internet |
|-------|-----------|------|----------|

# An **architectural evolution** is ongoing

There are several important ongoing changes to our networks that will favour the introduction of 5G.
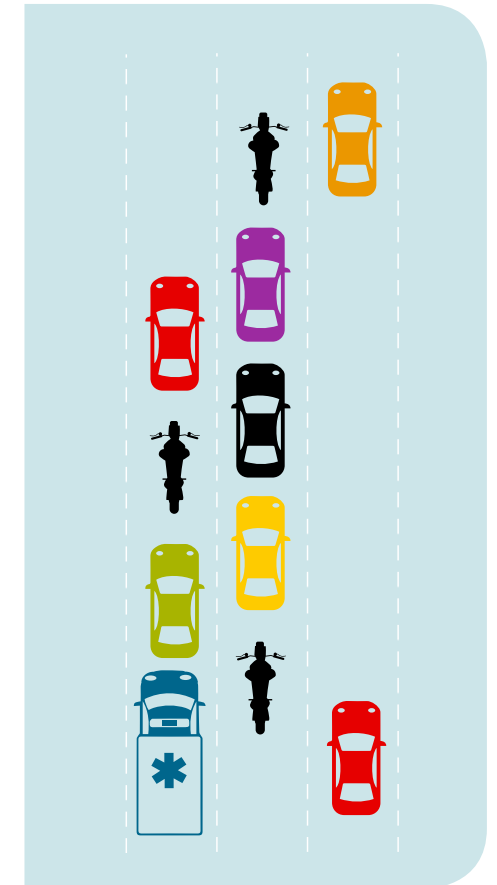
The first deployments of 5G networks will be capable of delivering improvements in both data rate and latency. In terms of end-user services, higher data rates will be delivered with 5G; while benefits of lower latency, in applications such as mixed reality, will require re-architecting the network through Virtualisation, Network Slicing and SDN. They will be offered with the 4GEvo network as well.

**Click on each of the coloured buttons for more information.**

# Voice

5G uses VoLTE capability to deliver voice services.

VoLTE enables 3G shut down and bands refarm to 4G/5G.

**With VoLTE:**

- Customers are able to make/receive calls and use data without interrupting 4G download speeds.

- Increased voice call quality and performance – clearer calls and less background noise, better than OTTs, e.g. WhatsApp & Skype.

- High quality video calling with less buffering or pixelation.

- Faster call setup time – connecting customers to their family and friends in an instant.

10:26 4G

Harry Peters

*Did you know?*

**VoLTE:
Voice over 4G is also known as "VoLTE"- that's Voice over Long-Term Evolution. It allows voice calls to be carried across our 4G data network instead of using 2G or 3G.**

# Data, Speed & capacity

With 5G we will move from Mbps to Gbps and we will increase network capacity up to 10x.

5G will enable an increase in data rate and capacity – although in the early days it will probably not cause significant changes in customer behaviour, as 4G did with video streaming and content sharing, for example. We are already seeing peak data rates around the 1Gbps mark in 4G networks, albeit in limited circumstances. By the time 5G comes, it will probably be experienced as a continuation of the current increase in mobile data speeds, rather than a revolutionary improvement.

Improvements in speed and capacity are mainly due to:

- Massive MIMO, already available in 4G Evo, which improves capacity, coverage and user throughput. **Read more**.

- New Spectrum: In 5G there will be a greater spectrum available. 3.5 GHz has the broadest support for 5G globally and also has been identified in Europe (by Radio Spectrum Policy Group) as the primary 5G band to bring necessary capacity for 5G

services. mmWave spectrum (in frequencies >24 GHz) is also identified for 5G for ultra-high capacity & innovative new services. 26 GHz band is a pioneer band identified by China & Europe for 5G in mmWave. The US, Korea and Japan have identified 28 GHz as their primary 5G mmWave band. 5G can also be launched on many existing bands including bands below 1 GHz (e.g. 700 MHz). **Read more**.

# Data, low latency

Multiaccess Edge Computing (MEC) brings low latency applications closer to customers, reducing average end to end latency by >60%.
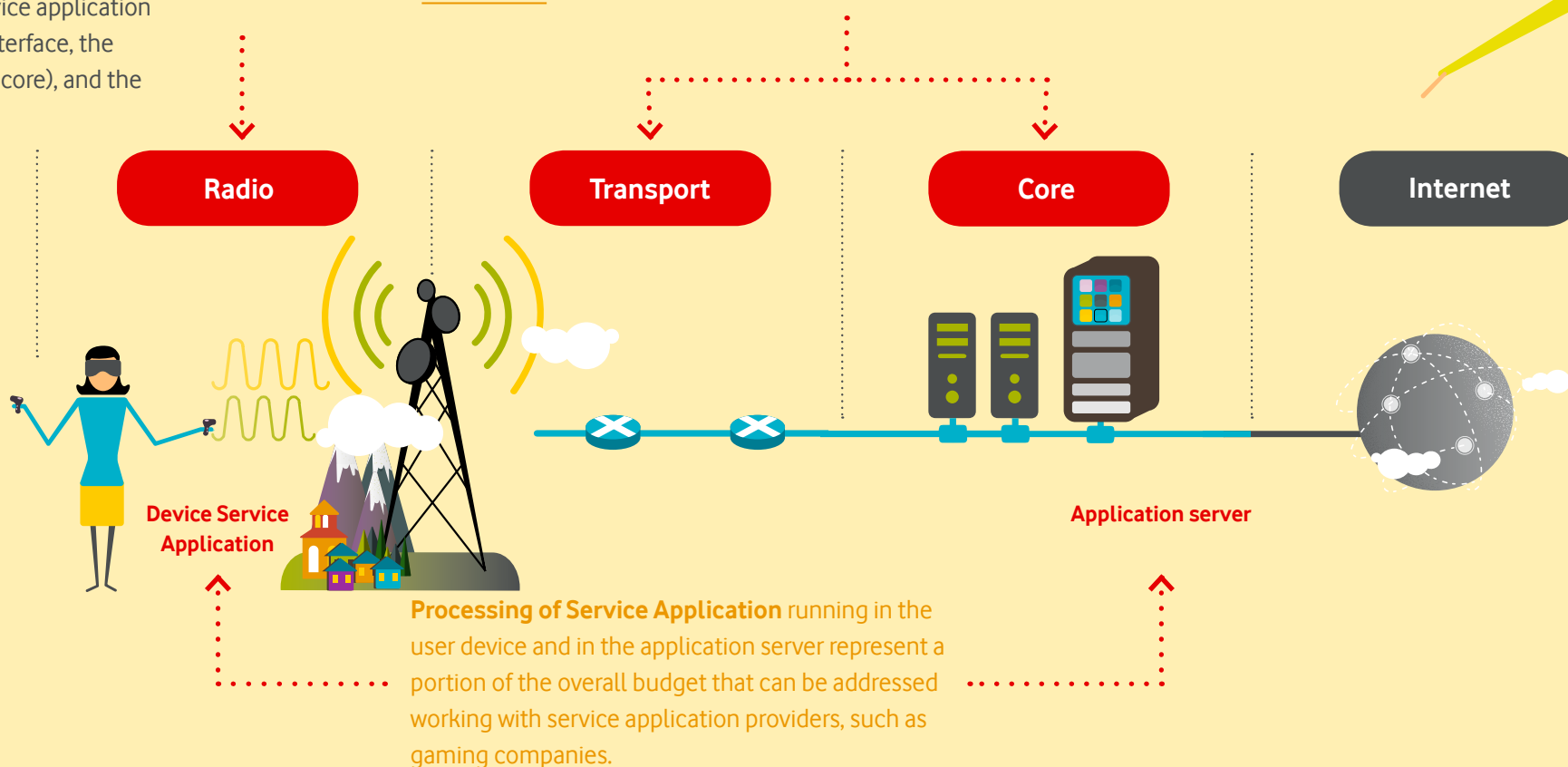
There are 4 main contributors to the end to end latency: the service application processing, the radio interface, the network (transport and core), and the Internet segment.

**Radio** latency can be reduced with new software features. **Read more.**

**Transport and Core Network** latency will be reduced via MEC, which basically means deploying the service application in our network closer to the customer, and implicitly also cancels the **Internet** segment latency. It implies a change in our architecture. **Read more**.

**4G Evo/5G + MEC will deliver lower latency than either 4G Evo or 5G alone.**

| Radio | Transport | Core | Internet |
|-------|-----------|------|----------|

**Device Service Application**

**Application server**

**Processing of Service Application** running in the user device and in the application server represent a portion of the overall budget that can be addressed working with service application providers, such as gaming companies.
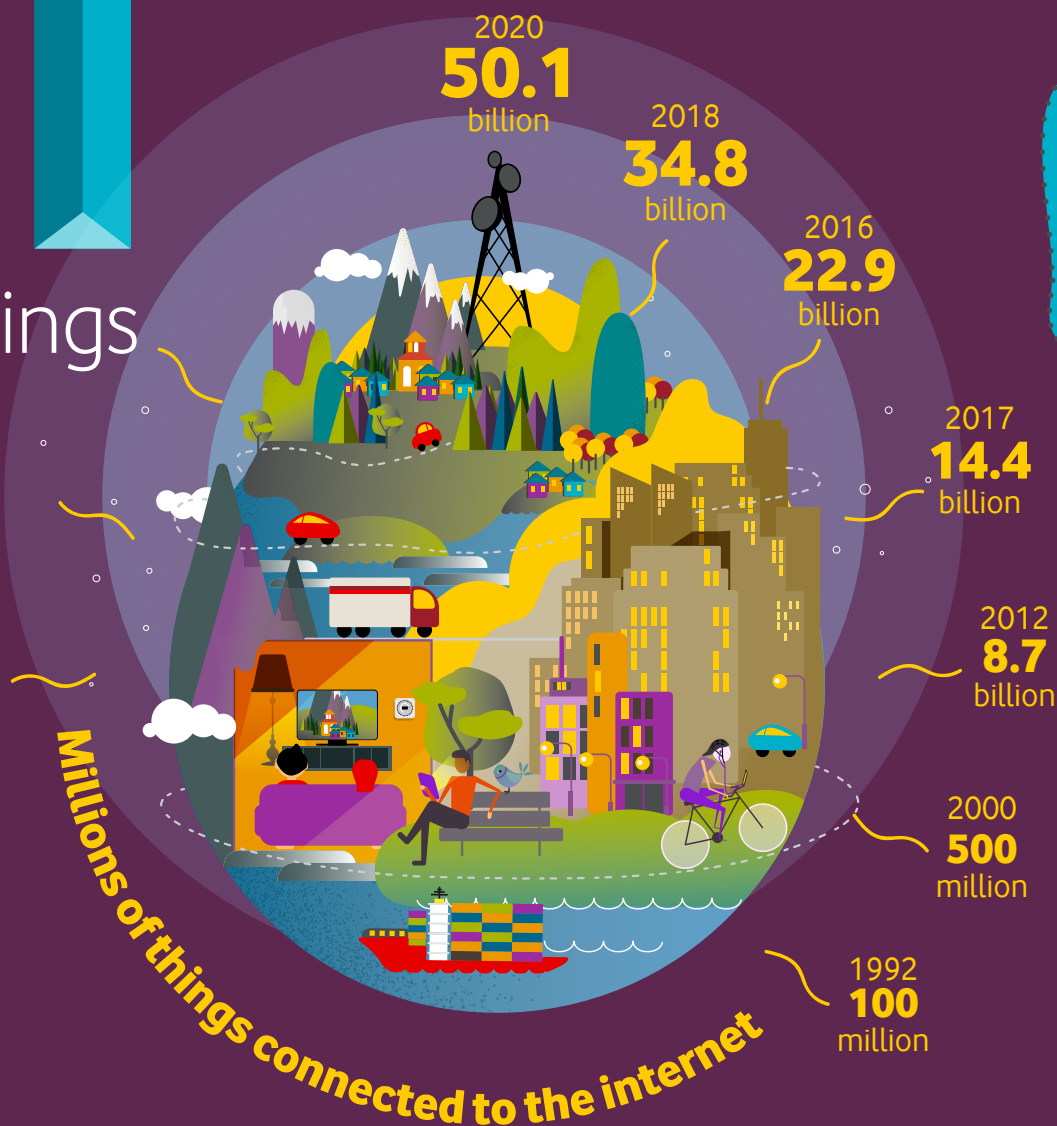
# IoT
## Internet of Things

A revolution in our lives is coming with an internet connected world.

There are two IoT technologies that have just started to change the way we currently understand the world: NB-IoT and CAT-M.

Narrow Band Internet-of-Things (NB-IoT) is designed to support services requiring low throughput, extended coverage and long battery life. It's designed to enable very low cost devices supporting new use cases such as car park management, water meters or waste bin management, among other uses.

**Millions of things connected to the internet**

2020
**50.1** billion

2018
**34.8** billion

2016
**22.9** billion

2017
**14.4** billion

2012
**8.7** billion

2000
**500** million

1992
**100** million

CAT-M, which is a simplified LTE design, complements NB-IoT supporting real time voice, mobility, lower latency and higher throughput but at the cost of reduced coverage compared to NB-IoT. It's the best solution for applications such as wearables, electricity meters or elevator emergency services.

Other LTE categories (e.g. CAT-1) are the most appropriate solution for high rate demands with very low latency, such as telemetry for cars.

The process of making Vodafone's networks more suitable for IoT devices is already well under way. **Read more.**

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# The 5G countdown has started!

Let´s recall the 5G steps needed in our Network. Read more.

Enjoy the journey!