

The Challenges of 5G

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There is currently a growing public debate about 5G. Anyway for a lot of people in the world, who still do not have access to 4G, this seems to be relatively irrelevant. Let us see what is exactly 5G and why we should care about it.

5G is a term that refers to the fifth-generation technology standard for internet mobile networks.

It is now a custom to denote each new version of such technology by an increment following the term 'G' (as for Generation)

Most Mobile Network Operators in the Western world - and especially in the USA - have begun deploying 5G worldwide in 2019.

Let us recall the different versions of the Internet mobile network technology:

0G: Mobile radio-telephone systems, active in the 80's-90's

1G : Analogue network data communication for mobile phones

2G : Digital network data communication for mobile phones (GPRS, EDGE)

3G : High-speed improvements of 2G (2.5G in fact) (UMTS, HSPA+, CDMA....)

4G : 4th version of the broadband cellular network technology, using MIMO principle and with speeds up to gigabytes per second for low mobility users. (Mobile WiMAX, LTE)

Why 5G is different

5G could be different from the previous mobile broadband technologies. Home Internet - cable or Wi-Fi - could be replaced by 5G. It is believed that 5G will be able to reach speeds of 10 Gbps, which would make it 100 times faster than 4G.

5G - in the final stage - would consist of no more than five new technologies allowing it to perform much more complicated tasks than 4G and at faster speeds:

- Millimeter waves;
- Small cells;

- Massive MIMO (multiple input multiple outputs);
- Beamforming;
- Full duplex.

Here are the most important differences with 4G and the others:

Frequency bands

5G operates on frequencies up to 600GHz, which are far beyond the limits of 6GHz used by 4G LTE. The bigger the frequency, the bigger the power and the bigger the speed. This means that 5G needs Higher Spectrum bands. This is one of the most controversial aspects of 5G as some have voiced against such wild deployment in the higher energy frequency spectrum.

Deployment

5G antennas can provide access for many more users but have less range than typical 3G or 4G antennas. Therefore, there will need to be more antennas and repeaters and a lot of extra locations to put these antennas (towers, tall buildings, skyscrapers, etc...)

New techniques will have to be used to create the cellular division which is needed for 5G coverage. This will be especially costly for rural areas.

Costs

Costs for 5G are already considered to be huge. Around 100 billion US dollars for building the initial worldwide 5G network. This is because 5G will be used for serving the vast network of IoT, the self-driving cars for instance.

5G, the network for the Internet of Things

5G is the data network that will be used for the Internet of Things. The Internet of Things needs a fast and efficient network that can provide seamless connectivity. The dramatic increase in the faster wireless data transfer will provoke unprecedented growth for the Internet of Things (IoT) technology projects.

5G is disrupting the IoT ecosystem

It is estimated that over the 5 next years, more than 75 billion devices will be connected to the Internet.

IoT is often divided into two distinct categories: 'Massive IoT' and 'Critical IoT'.

'Critical IoT', with relatively a small amount of devices, needs low latency, high speed, and reliability while 'Massive IoT' (e.g. non-mission-critical IoT, the vast majority of IoT devices) requires massive power and massive internet support with low cost and low energy.

5G provides a sort of "fluid" data environment for IoT, a bit like water for the fish...

The debate over 5G

The debate

There is a very important debate about how 5G could revolutionize our daily lives:

- Such a giant and omnipresent wireless data network can provoke a mutation of our daily lives because of unknown effects of the high-frequency spectrum over our bodies and/or our natural environment;
- 5G will allow robotic systems to work in a very efficient manner but this also implies maximal efficiency of surveillance drones, wireless cameras, and face detection systems that could become faster and faster and create an oppressive social atmosphere;
- The costs involved in the 5G network are gigantic and could be used for other projects. 4G is fast enough for most applications and 5G isn't needed;
- 5G will require a lot of new places for the antennas which will destroy even more the urban landscape.

There are no compressive medical studies to prove the criticism against 5G, especially the bad biological effects of 5G... There is no global consensus about proof, at the moment, that 5G would deregulate ecosystems or animal or biological organisms on our planet. Yet, despite this, the construction of a worldwide ultra-high-speed network using a higher-frequency spectrum could maybe raise, indeed, legitimate concerns.

5G and the ecology

According to its detractors, the 5G network may inevitably trigger a bigger increase in energy consumption among the 5G consumers, and a bigger energy consumption is de facto the main contributor to climate change. In addition, the manufacturing and maintenance of 5G technologies would create important wastes and would require relatively important resources with consequences for the degradation of the natural environment.

Some opponents of 5G claim that it has adverse effects on birds and thus could create a cascading effect on local ecosystems, mainly destroying these ecosystems partially or even totally.

There are billions of smartphones and IoT devices worldwide. Making them all 5G powered would require mining a lot of rare elements for the need of semiconductors and clocks used by 5G technology (gallium, cobalt, and especially cesium), and the use of millimeter waves which may have consequences on the global health of the world population. This would also increase the level of carbon emission because of the amount of production of the specific electronic components required.

[In a study performed by the Centre for Environment and Vocational Studies of Punjab University](#), it has been proved that millimeter waves can also harm the population of birds, as mentioned previously. Exposure of bird eggs for around 30 minutes to millimeters of waves equivalent to the ones produced by 5G antenna, results in producing 'disfigured' birds.

The Competitors

5G isn't the only project to create a worldwide high-speed high-capacity wireless internet. Other projects do exist.

Starlink versus 5G

One of them is the Starlink project, developed by Elon Musk. The Starlink project aims at building a constellation of mini communication satellites in such a huge amount that they would provide wireless internet to virtually every point of the globe. There are pros and cons to such a system. One big advantage over 5G is that Starlink does not require antennas and that rural or even extremely remote locations could be covered all the same as cities.

The Zigbee Mesh Network versus 5G

The Zigbee standard is defined by physical radio specifications such as the ones covered by IEEE 802.15.4.

Zigbee operates in the 2.4 GHz, 900 MHz, and 868 MHz unlicensed bands.

The ZigBee protocol is fuzzy and uses a cloud of IoT devices to connect devices and through the internet and as such offers a competitive alternative to 5G or Wi-Fi. Of course, ZigBee being versatile by essence, can often offer the "better of both worlds" and use Wi-Fi or 5G as a vector.

Wi-Fi 6 versus 5G

Wi-Fi 6 - a.k.a. IEEE 802.11ax - is the latest evolution of the Wi-Fi norm. Wi-Fi 6 works in a greater spectrum, beyond the 6 GHz band. Transfer rates can go up to 10 Gigabytes per second.

Conclusion

5G is considered to be potentially extremely disruptive for a vast amount of businesses. It may bring high-speed online video games everywhere for example and boost mobile games platforms for Android for instance.

It is also used as a "unification" network for the giant network of IoT devices, making them much more efficient.

There are also concerns about the potential biological and ecological effects of such a technology. It has been shown to potentially wipe out birds in a zone around the antennas.

The next few years should enlighten us about the destiny of 5G.