sagentia

6G? I haven't even got 5G!

Author: Simon Prentice, Consultant

In recent months the potential of 6G has been gaining increased attention, but what is behind this latest development?

Who is involved?

It was announced recently[1] that China had launched "the world's first 6G satellite" into space.

The New York Post reported[2] that, according to Thyagarajan Nandagopal of the National Science Foundation, the satellite, called Star Era-12, has frequency bands so high that they have to be tested in space so the signals won't be lost as easily as in air. These bands are in the 100 to 500Ghz frequency range, 100 times faster than 5G.

In recent months the potential of 6G has been gaining increased attention. The governments of Japan and China have launched 6G projects[3] while Nokia in Finland, Samsung and LG in South Korea, and Huawei in Canada have all started research into the technology. The second 6G Wireless Summit[4] took place in March this year with keynote speakers from companies such as Ericsson, Nokia, Huawei. It even hit the Twitter-verse in February 2019 with President Donald Trump[5] stating: "I want 5G, and even 6G, technology in the United States as soon as possible."

Why now?

This is exciting news but, if like me you struggle to get a decent 4G signal let alone 5G, you may be wondering what is behind this new development.

There is nothing wrong with 5G but its design has opened the door to a roadmap it cannot sustain. 5G can meet the demand for video-centric applications but only up to a point. According to Alan Carlton[16], VP of InterDigital Europe "Current generation 360° 4K video needs 10-50Mbps [to reach the consumer] and next generation 360° 8K needs 50-200Mbps. That is already more than 5G can deliver." When considering the future of precision remote control of robotics in healthcare and industry, sub-millisecond time-slicing is required yet 5G can only offer a latency of 10s of milliseconds. The aim of 6G is to meet these challenges; providing a higher data capacity and a considerably lower latency.

What is 6G?

The reported statistics of 6G are staggering, with predicted download speeds of 1TB per second or 8,000,000 megabits per second[6]. To put this into context that would allow you to download an entire Blu-Ray disc (100GB) in 0.1 seconds.

The increased bandwidth-rate of 6G is achieved using higher-energy frequencies than 5G. Both 5G and 6G occupy higher frequencies on the wireless spectrum[10] and, while 5G occupies broadband frequencies at sub-6 gigahertz (GHz) and above 24.25 GHz, 6G will operate at 95 GHz to 3 terahertz (THz). And it's this difference that will provide one of the many challenges[11]; with higher frequencies come shorter range connections and reduced signal propagation through walls.

How is it possible?

According to Dr Shirvanimoghaddam[6], an expert in wireless communications at the University of Sydney, significant improvements in "material science, computing architecture, chip design and energy use" would be required. In April of this year scientists from Nanyang Technological University in Singapore and Osaka University in Japan published a paper in Nature Photonics[14] announcing a technology that could tackle two of the biggest physical issues, posited as "material defects and transmission error rates found in conventional waveguides such as crystals or hollow cables"[13]. Using a new material to transmit terahertz waves, called photonic topological insulators (PTIs), the team's research showed the chip was able to transmit terahertz waves error-free[12].

All-silicon chips like this which can handle THz waves are an essential part in bringing connected 6G devices to reality, for example the "intra-chip and inter-chip communication to support artificial intelligence and cloud-based technologies, such as interconnected self-driving cars".

When will we see 6G?

However, while 5G is a reality within reach, the prospect of 6G is somewhat further away. It took ten years to develop the 5G standard[15] and in a white paper[8] Japan's NTTDoCoMo puts forward the idea that 6G technology "will support industry and society in the 2030s".

I don't expect you'll be able to pick up a 6G mobile straight-away though as it's probable that 6G will be initially reserved for medical, business, military, and industrial use[10].

Where will we see 6G first?

The advantages provided by the phenomenal data speeds of 6G are undoubtedly an attraction to national military forces. In a reported article[17] published by the PLA's China National Defence News titled "If 6G Were to be Used in the Future Battlefield" the potential advantages for military applications are discussed. It stated that "it will surely have a major impact on military practices, such as war formation, equipment development and battlefield communications." The U.S. Army too has been open about its interest in this emerging technology with the Army Research Office funding a team of researchers from government, industry and academia to establish new semiconducting transistor technology[18]. The initial focus is likely to be on improved communication and location services on the battlefield, as well as smarter and more autonomous devices,[19] but we have seen in the past with things like GPS, Freeze drying, EpiPen, Duct tape, microwave ovens and even the computer that military inventions have a way of finding their way into our everyday lives[20].

At the other end of the spectrum, the effect of 6G on Intelligent Healthcare could be equally dramatic. The increased data-rates and reduced delay could lead to a revolution in the role of augmented and virtual reality and telesurgery within healthcare. Remote control of surgical robotics become a genuine possibility with the potential for live high-definition video combined with precise control and instant haptic feedback to the surgeon. Consider also the possible advances in connected devices Intelligent Wearable Devices (IWD)[21]. These complex wearable/implantable devices will monitor our physical and physiological data as well as interacting with everyday objects. This data, will be analysed in connected monitoring centres, providing quick test results and will minimize the burden on medical staff and reducing hospital visits.

The development of 6G enabled systems and the infrastructure to support them will not be cheap and the initial cost of such devices will be expensive but, as with all things, these prices will decrease over time to a point where they will become more accessible.

What does the future hold?

While smartphones were integral to the proliferation of 4G and 5G, 6G will see a move towards an increase in integrated wearable and implantable devices. According to a paper[22] discussing the future of 6G applications, trends and technologies "the core network the Internet of Things (IoT) will be replaced by the Internet of Everything (IoE). It is expected that 6G will enable and revolutionize many technologies in [the] coming future. We will evidence the transitions of IoT to IoE, Smart Devices to Intelligent Devices, and other numerous possibilities."

There will be a shift from smart to intelligent, with devices capable of prediction and decision making eventually leading to the end of the smartphone era.

I remember an episode of The Outer Limits[23] from 1997 in which "a virus starts killing people hooked up neurally to a worldwide information network". At the time it seemed quite far-fetched but could we be on the cusp of this symbiosis between man and cyber-machine.

Final thoughts

While we may not see 6G in the home any time soon it is a technology that we will definitely be hearing a lot more about and is certain to build upon the capabilities brought by 5G. In an increasingly connected world, it's time to strap in and get ready for serious acceleration.

Simon Prentice

[1] BBC News accessed 18th November 2020 https://www.bbc.co.uk/news/av/world-asia-china-54852131
[2] New York Post accessed 18th November 2020 https://nypost.com/2020/11/14/china-pushes-forward-on-6g-while-us-still-working-on-5g/
[3] digitaltrends accessed 18th November 2020 https://www.digitaltrends.com/mobile/what-is-6g/
[4] 2nd 6G Wireless Summit accessed 18th November 2020 https://www.6gsummit.com/
[5] @realDonaldTrump accessed 18th November 2020 https://twitter.com/realDonaldTrump/status/1098581869233344512
[6] ABC Net Australia accessed 18th November 2020 https://www.abc.net.au/news/2019-08-22/huawei-reportedly-entering-into-6g-research/11427056
[7] IBM accessed 18th November 2020 https://www.ibm.com/downloads/cas/0WOR6ORJ
[8] NTT DOCOMO accessed 18th November 2020 https://www.nttdocomo.co.jp/english/binary/pdf/corporate/technology/whitepaper_6g/DOCOMO_6G_White_PaperEN_20200124.pdf
[9] Digital Fortress of Information accessed 18th November 2020 https://dficlub.org/difference-5g-and-6g/
[10] What Is 6G accessed 18th December 2020 https://whatis6g.com/difference-5g-6g
[11] 6G Summit accessed 18th November 2020 http://www.6gsummit.com/2019/wp-content/uploads/2019/04/Day3_Session8_Latva-aho_University_of_Oulu.pdf
[12] SingularityHub accessed 18th November 2020 https://singularityhub.com/2020/08/21/6g-will-be-100-times-faster-than-5g-and-now-theres-a-chip-for-it
[13] All About Circuits accessed 18th November 2020 https://www.allaboutcircuits.com/news/researchers-create-wireless-chip-data-rates-faster-than-5g/
[14] Nature.com accessed 18th November 2020 https://www.nature.com/articles/s41566-020-0618-9
[15] IEEE ComSoc Technology Blog accessed 18th November 2020 https://techblog.comsoc.org/2018/11/18/with-no-5g-standard-imt-2020-china-is-working-on-6g/
[16] G's Future Is Broken. Here's Why We Need 6G accessed 19th November 2020 https://www.streamingmediaglobal.com/Articles/Editorial/Featured-Articles/5Gs-Future-Is Broken.-Heres-Why-We-Need-6G-143447.aspx
[17] South China Morning Post accessed 19th November 2020 https://www.scmp.com/news/china/military/article/3080235/chinas-military-draws-6g-dream-modernise-fighting-forces-and
[18] The National Interest accessed 19th November 2020 https://nationalinterest.org/blog/buzz/6g-wireless-internet-already-here%E2%80%94if-youre-army-126792
[19] What is 6G accessed 19th November 2020 https://whatis6g.com/6g-and-the-military-the-future-of-warfare/
[20] Mental Floss accessed 19th November 2020 https://www.mentalfloss.com/article/31510/9-things-invented-military-use-you-now-encounter-everyday-life
[21] Cornell University Archive accessed 19th November 2020 https://arxiv.org/pdf/2005.07532.pdf
[22] Cornell University Archive accessed 19th November 2020 https://arxiv.org/pdf/1902.10265.pdf
[23] IMDb accessed 19th November 2020 https://www.imdb.com/title/tt0667957/fullcredits

About Sagentia

Sagentia is a global science, product and technology development company. Our mission is to help companies maximize the value of their investments in R&D. We partner with clients in the medical, consumer, industrial and food & beverage sectors to help them understand the technology and market landscape, decide their future strategy, solve the complex science and technology challenges and deliver commercially successful products.

Sagentia employs over 150 scientists, engineers and market experts and is a Science Group company. Science Group provides independent advisory and leading-edge product development services focused on science and technology initiatives. It has ten offices globally, two UK-based dedicated R&D innovation centers and more than 400 employees. Other Science Group companies include OTM Consulting, Oakland Innovation, Leatherhead Food Research, TSG Consulting and Frontier Smart Technologies.

For further information visit us at:

www.sagentia.com
or email info@sagentia.com
www.sciencegroup.com

sagentia

Sagentia Ltd
Harston Mill
Harston
Cambridge
CB22 7GG
UK

Sagentia Ltd
First Floor
17 Waterloo Place
London
SW1Y 4AR
UK

Sagentia Inc
One Beacon Street
15th floor, Suite 1500
Boston
MA 02108
USA