

To the Editor June 15, 2020

What the heck is 5G?

First the Blue Pill

5G is the fifth generation wireless technology for digital cellular networks, in which the service area covered by providers is divided into small geographical areas called cells serviced by individual antennas. The local antennas are connected with the telephone network and the Internet by a high bandwidth optical fiber or broadband wireless backhaul connection.

As in other cell networks, a mobile device crossing from one cell to another is automatically "handed off" seamlessly to the new cell.

Analog signals representing sounds and images are digitized in your cellphone, converted by an analog to digital converter chip, and transmitted as a stream of bits." Virtually every major telecommunication service provider in the developed world is deploying antennas or intends to deploy them soon. There are three levels of this technology.

5G millimeter wave is the fastest, with actual speeds often being 1–2 Gb/s down.

5G mid-band is the most widely deployed. Speeds are usually 100–400 Mb/s down. Some areas can be covered simply by upgrading existing towers.

5G low-band offers similar capacity to advanced 4G. Speeds on this 5G may be as low as 25 Mbit/s down and usually deliver less than 100 Mbit/s in 2019. The performance will improve, but cannot be much higher than good 4G in the same spectrum.

Then the Purple Pill

The download speed is fast, but the signal reach is short, so more cells are required. Millimeter waves also have difficulty traversing many walls and windows, so indoor coverage is limited. You can think of this as being like 5 GHz Wi-Fi, which is faster but has less distance reach than the slower 2.4 GHz spectrum. 5G will be expensive because it requires many cells or access points, even in say, a subdivision. The fast speeds advertised will be geographically limited to mostly urban areas, but they will still call all of them 5G for their typical deceptive marketing purposes.

5G could require cell towers on every street corner

The upcoming 5G wireless is expected to deliver speeds up to 10 times faster than what consumers see on today's 4G LTE networks, but 5G could also mean millions of new cell phone towers.

Already, 200,000 or so cell phone towers are scattered across the United States, but unlike the current LTE (sometimes called 4G) technology most carriers use to beam data to and from smartphones, 5G requires a denser network of towers to handle the traffic. This is why the industry figures the towers will multiply like Tribbles on the Starship Enterprise.

Residents of many communities have blocked the construction of cell phone towers in their neighborhoods, some citing concerns over potential health problems. Others are simply put off by the sheer ugliness of the towers. Gaining approval from local governments can also be very slow, and if a small cell takes as long and costs as much as siting a cell tower, few communities will ever have the benefits of 5G.

<https://www.cio.com/article/3117705/5g-could-require-cell-towers-on-every-street-corner.html>

5G phones and your health: What you need to know

The rollout of 5G using super high-frequency radio airwaves has ignited old fears about cellphone radiation risks. There are concerns that the very high-frequency spectrum known as millimeter wavelengths used to make 5G a reality, could pose adverse health effects for the public. Several leaders in Congress have written to the Federal Communications Commission expressing concern about these potential health risks.

The deployment of new 5G networks requires many smaller cell towers to be deployed much closer to where people live, work and go to school, is reigniting those fears.

The Food and Drug Administration and the FCC say there is nothing to be worried about. Most studies have not found a link between radio frequency signals from cellphones or cell towers and disease, the agencies say. But in 2011, the World Health Organization said cellphones might cause some brain cancers, leaving open the possibility that a link exists between cancer and cellphone radiation.

Critics say the safety of using millimeter wavelength for 5G technology has not been tested and more information is needed before the US and the rest of the world race to deploy these next-generation networks. It is this so-called "high band" spectrum that is of most concern, because it will require denser radio deployments. There is also less research on the effects of radiation at these higher frequency bands.

<https://www.cnet.com/news/5g-phones-and-your-health-what-you-need-to-know/>

Interference issues

The airwave spectrum used by 5G will be close to that of passive remote sensing such as by weather and Earth observation satellites, particularly for water vapor monitoring. Interference will occur and will potentially be significant without effective controls. An increase in interference already occurred with some other prior proximate spectrum band usages. Interference to satellite operations impairs numerical weather prediction performance with substantially deleterious economic and public safety impacts in areas such as commercial aviation.

The concerns prompted U.S. Secretary of Commerce Wilbur Ross and NASA Administrator Jim Bridenstine in February 2019 to urge the FCC to delay some spectrum auction proposals. The chairs of the House Appropriations Committee and House Science Committee wrote separate letters to the FCC asking for further review and consultation with NOAA, NASA, and DoD, and warning of harmful impacts to national security. Acting NOAA director Neil Jacobs testified before the House Committee in May 2019 that 5G out-of-band emissions could produce a 30% reduction in weather forecast accuracy and that the resulting degradation in ECMWF model performance would have resulted in failure to predict the track of Superstorm Sandy in 2012. The United States Navy in March 2019 wrote a memorandum warning of deterioration and made technical suggestions to control band bleed-over limits, for testing and fielding, and for coordination of the wireless industry and regulators with weather forecasting organizations. <https://en.wikipedia.org/wiki/5G>

Now for the Red Pill

Keeping untrusted Chinese companies like Huawei out of Western Internet infrastructure is not enough to secure 5G. Neither is banning Chinese microchips, software, or programmers. Security vulnerabilities in the standards, the protocols and software for 5G, ensure that vulnerabilities will remain, regardless of who provides the hardware and software. These insecurities are a result of market forces that *prioritize costs over security* and of governments, including the United States that *want to preserve the option of surveillance* in 5G networks. If the United States is serious about tackling the national security threats related to an insecure 5G network, it needs to rethink the extent to which it values corporate profits and government espionage over security. To be sure, there are significant security improvements in 5G over 4G in encryption, authentication, integrity protection, privacy, and network availability. But the enhancements are not enough.

The 5G security problems are threefold.

1. First, the standards are simply too complex to implement securely. This is true for all software, but the 5G protocols offer particular difficulties. Because of how it is designed, the system blurs the wireless portion of the network connecting phones with base stations and the core portion that routes data around the world. Additionally, much of the network is virtualized, meaning that it will rely on software running on dynamically configurable hardware. This design dramatically increases the points vulnerable to attack, as does the expected massive increase in both things connected to the network and the data flying about in it.
2. Second, there's so much backward compatibility built into the 5G network that older vulnerabilities remain. 5G is an evolution of the decade-old 4G network, and most networks will mix generations. Without the ability to do a clean break from 4G to 5G, it will simply be impossible to improve security in some areas. Attackers may be able to force 5G systems to use more vulnerable 4G protocols, for example, and 5G networks will inherit many existing problems.
3. Third, the 5G standards committees missed many opportunities to improve security. Many of the new security features in 5G are optional, and network operators can choose not to implement them. The same happened with 4G; operators even ignored security features defined as mandatory in the standard because implementing them was expensive. But even worse, for 5G, development, performance, cost, and time to market were all prioritized over security, which was treated as an afterthought.

Bruce Schneier [comments on the issues surrounding 5G security](#)

So just like anything else...your mileage may vary, batteries, usb and hdmi cables are not included, some settling of content may occur in shipment, objects are closer than they appear, and above all, buyer beware of what color pill you choose to take.