

What is 5G and why do we care?

By Tim Schoechle, July 18, 2019

The term “5G” denotes the 5th generation of wireless cellular telecom technology that is still being defined. Over the past four decades, the wireless industry has introduced a new generation of their cellular phone technology roughly every 10 years. Today’s cellular networks support 2G, 3G, and 4G. 4G, though not yet fully built out, was given the nickname, LTE for “long term evolution”. 5G does not exist yet, except partially in a few trials, but plans are for it to be somewhat different insofar as it will not replace 4G, but will add to it. 5G will be a short-range companion to 4G LTE that uses new, much higher previously unused frequency bands that are capable of faster data transfer and shortened latency delay in response time for realtime applications. The longer-range 4G LTE will continue to provide voice service and will manage links to 5G devices.

Small cell rationale

5G will be different in other ways. The higher frequencies with faster downloads and quicker response come at a cost. 5G radio signal propagation characteristics are much different and not fully understood. They will employ millimeter waves such as those used by airport security scanners. These waves tend to have a very short range and can be blocked by walls, buildings, moisture, leaves, or even our bodies. They are getting closer to and behave similarly to light. This means that to provide effective service, cellular sites need to cover many more smaller spaces and be closer to the receivers. This necessitates “antenna densification” saturating our urban spaces with many “small cells” on lampposts, phone poles, street lights and the like—as close as every few hundred feet or so—in order to get reasonable coverage at the millimeter wave frequencies. These 5G/4G small cells may even need to be installed inside buildings. As with conventional larger cells, the small cells will also still need to have optical fiber “backhaul” connections to the core network.

Small cell reality

The wireless industry claims that its networks are getting congested and that faster and higher capacity service is needed. 2G, 3G, and 4G performance would all be improved by more smaller cells, simply by virtue of having fewer users using each cell. Part of the promotion of 5G may be simply about justifying improving existing cellular technology performance, especially since 5G will not be available initially. The 5G hype will provide a rationale for preempting local regulation to install small cells while actually just expanding 2G, 3G, and 4G services without tower approvals.

Why do we need 5G?

Predominantly, recent media accounts cast 5G as a miraculous advance that will not simply improve smartphone service, but may revolutionize the Internet itself. According to journalists such as New York Times writer Thomas Friedman, “5G could be as revolutionary as the Internet.” Framed by this myth-building narrative, 5G will somehow enable presumably important new technologies such as autonomous vehicles (AVs), virtual reality (VR), and artificial intelligence (AI). Often, breathless promoters also celebrate the opening of “new frontiers” in factory automaton, remote surgery, the Internet-of-things (IoT), and much more.

However, all of the foregoing examples are speculative and problematic, first with respect to their relevance to 5G, and none of them represent significant existing markets. One unfortunate consequence of such sweeping and celebratory rhetoric is to conflate the important distinction between the “access” and the “core” network, or the Internet, in the public mind. 5G is primarily an enhancement to wireless access for mobile devices such as smartphones and tablets, and has little if anything to do with the functionality of the core or Internet itself.

Looking behind this superficial mythology, we find some other reasons driving the 5G juggernaut. One reason may be declining smartphone sales and the need to sell a new generation of phones and networking gear. This may partly explain the boosterish enthusiasm of the IEEE (Institute of Electrical and Electronic Engineers) and some government agencies (e.g., NIST, NTIA, etc.), and universities where 5G is mostly about jobs and careers.

Colonizing the public space

Another reason behind the push for 5G relates to what has become a primary motivating force behind the Internet itself—advertising and data collection. What has emerged in the IT/big tech industry (e.g., beginning with Google, Facebook, Amazon, Microsoft, etc.) is a new economy of “surveillance capitalism”—monetizing our personal lives and predicting and shaping our behavior—as characterized by Harvard Business School Professor Shoshana Zuboff.¹ Basically 5G’s promise of faster downloads to portable devices is about faster ad delivery and response—which also enables even more and faster personal data collection. Thus, the 5G and Google’s *Android* smartphone become integral parts of a vast corporate surveillance infrastructure.

How did the industry pave the way for its new ecosystem of small cells? When it became obvious that so many cells would be needed in cities, towns, and communities across the nation if 5G was to work for private wireless carriers (e.g., Verizon, AT&T, T-Mobile, etc.) it might be prohibitively expensive for them to go through the normal local government procedures of siting cell towers or gaining access to public rights-of-way. Therefore, around 2015 the industry, with the help of the American Legislative Exchange Council (ALEC), a Koch brothers initiative, began to quietly put forward model laws in state legislatures to preempt and limit the normal ability of local municipalities to regulate small cell siting.

These ALEC-crafted laws were quietly passed in about 20 states under the guise of “facilitating advanced wired and wireless telecom services”. By 2018, a Verizon attorney had become Trump’s appointee to chair the FCC and the agency adopted an order mandating similar preemption of local small cell regulation—thus covering the remaining states. The new laws and regulations impose severe limits on the approval time and cost of small cell placement—thus creating a de facto subsidy for the industry at the expense of local taxpayers.

The wheels start falling off the 5G juggernaut

When communities began to see small cell permitting and construction in early 2019, many suddenly began to realize that their environment and their children were about to be saturated with a new form of “electrosmog” pollution—microwave and now millimeter wave radiation—

¹ Shoshana Zuboff. *The Age of Surveillance Capitalism: The Fight For a Human Future at the New Frontier of Power*. New York: Public Affairs/Perseus Books. 2019. (691 pages)

in their homes, schools, churches, recreation centers, parks, busses, and everywhere up and down their streets.

New studies were released in 2018, such as the NIH National Toxicology Program (NTP) study, confirming earlier evidence that cellphone radiation could cause cancer. Other studies have showed correlation of radiation with a range of symptoms and other disorders. But, national regulatory agencies like the FCC were not equipped to evaluate the biological or health effects of electromagnetic radiation, and so simply clung to their clearly out-of-date radiation exposure limits tied to false assumptions about non-thermal radiation. At the same time, local officials shrugged their shoulders, dodging the issue by saying that their “hands are tied” by the state ALEC laws and by the FCC policy. The carriers demurred that the FCC had certified their product as “safe”, and then continued to tout the marvels and economic growth their product would bring. Local citizens began to organize.

Suddenly, in early 2019 numerous lawsuits were filed challenging the new preemption laws and regulations. Demands by legislators to carriers and to the FCC for scientific evidence showing public health and safety of the networks and devices went unanswered. Legislation to reverse the FCC ruling was introduced and co-sponsored in the U.S. House of Representatives. At the same time, other aspects of Silicon Valley’s Internet communication technology and business strategy were called into question. Electronic social media was shown to have played a role in a variety of societal dysfunctions ranging from electoral failures and distortions, psychological and social disorders, phone and media addiction, terrorism and violence, suicide rates, and monopolistic market concentration and domination. Smartphones were in the middle of this chaotic picture and 5G had become an unpredictable wild card. And, things were about to become even more complicated.

By spring of 2019, international trade and politics entered the 5G picture with an offensive by Trump against China, and ironically also against his European allies. Trump’s first target was Huawei, the Chinese telecommunications firm and manufacturer of phones and network gear.

Over the previous decade Huawei had successfully played a careful strategic long-term game to dominate the world of telecom equipment, leaving only Ericsson and Nokia as rivals. The United States had no remaining manufacturing, with only Qualcomm to tout, a telecom firm that had reverted to be only a chip-maker and rent collector on intellectual property. Huawei had meanwhile become the principal champion of global 5G networking standards and owner of much of the 5G technology intellectual property. They had also become an indispensable equipment supplier for much of the world by offering customers generous financing and strategic assistance.

Trump’s abrupt ham-handed attack on Huawei claimed concern over the security and vulnerability of the U.S. and world telecom networks. However, telecom networks are all vulnerable to security and privacy invasions by manufacturers and carriers. Tapping into telecom networks is not unique to China. For example, in the United States, both the NSA and AT&T have a reputation for invading, monitoring, and diverting message traffic of all kinds, as revealed in part by the disclosures by Edward Snowden. The Trump and U.S. Congressional cyber-security concerns may have some validity, but they seem also disingenuous and

hypocritical. The recent Trump decree excluding Huawei from the U.S. market may partly be a canard covering trade and economic motives. It is likely too late for the United States to reclaim a significant role in the global telecom market or to avert Huawei from dominance in any emerging 5G market. Meanwhile, Trump's trade wars backfired on U.S. companies and consumers. The networking chipmaker Broadcom announced that Huawei's banishment will cost it \$2 billion in revenue.

But, privacy and security are not primarily problems of spying through "back doors". Rather, according to Professor Zuboff's research, spying has become the primary purpose of the networks and smart devices, as the entire IT industry has been "...drawn into the competitive maelstrom of surveillance revenues."

Conclusion

Some combination of 5G/4G may well become part of the wireless access network over the coming decade. However, for this to happen, several factors will influence this future. Technical standards will need to be completed and spectrum will need to be allocated. Mounting public concern over the health risks of electromagnetic radiation will need to be dealt with and new biological science-based exposure standards will need to be established. Otherwise, public pushback, litigation, and political action will continue to afflict the industry and its plans. It is likely that public skepticism over the flamboyant claims of the tech industry will continue to grow as practical and market realities confront the promises of AVs, VR, AI, and IoT.

The industry may need to bear more of the cost of its small cells as courts and legislators in response to political forces begin to unwind industry's private appropriation of the public rights-of-way and rein in their de facto public subsidy. A political change at the national level may enable a revitalization of antitrust policy and enforcement that could throttle back the corporate domination and political power of telecom network operators and social media technology giants.

At the local level, cities and towns can act to regulate cell siting and make sure that their communities have an alternative to private wireless and 5G networks, and that cell sites cannot become tools of corporate or government surveillance and social control. Perhaps most importantly, widespread deployment of local municipal fiber access networks providing far superior fiber service—all the way to the home or office—may mitigate much of the need for wireless access services, as described in the report, *Re-Inventing Wires: The Future of Landlines and Networks*. <<https://tinyurl.com/y89sfng8>>

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Emerging problems for the 5G bandwagon

Despite all the media advertising, journalistic gloss, and industry bravado, 5G wireless has encountered a growing number of problems at local, state, national, and international levels.

1. Lagging industry investment
2. Carrier reliance on coerced subsidization by local communities
3. Trade war turmoil, especially regarding China
4. Complaints over cyber-security risks and state spying
5. Public health concerns over RF radiation risks.
6. Trump's attack on Huawei and on China
7. Google's Trump disruption of the Android ecosystem
8. Qualcomm's loss of FTC antitrust challenge over its patents
9. NYT fake news story attack against radiation complaints blaming Russia
10. Safety concerns over mm waves and lack of research on large scale health effects (i.e., public as guinea pig)
11. Mounting widespread local grassroots opposition
12. Court challenges to state and federal preemption by cities, associations, and environmental groups
13. Incomplete spectrum allocation
14. Cost of spectrum and lack of cooperation among telecom operators
15. Internal industry squabble over "5G" misrepresentation (e.g., AT&T's "5Ge")
16. Incomplete technical standards
17. Huawei's patents on key 5G technology and standards (e.g., 2300 Huawei 5G patents)
18. Huawei's prominence in the standards setting process
19. Dearth of equipment and phone manufacturers (dependency on China)
20. Uncertainties over mm wave propagation characteristics and performance
21. Lack of credible applications requiring 5G
22. Lack of real need for 5G
23. Emerging public concerns over privacy, security, and surveillance
24. Emerging public concerns over smartphone social and political dysfunction
25. Conflicts with NOAA satellite earth data collection systems