GLOBAL CHINA
ASSESSING CHINA'S GROWING ROLE IN THE WORLD

NAVIGATING THE U.S.-CHINA 5G COMPETITION

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EXECUTIVE SUMMARY

The United States and China are in a race to deploy fifth-generation, or 5G, wireless networks, and the country that dominates will lead in standard-setting, patents, and the global supply chain. While some analysts suggest that the Chinese government appears to be on a sprint to achieve nationwide 5G, U.S. government leaders and the private sector have been slowed by local and federal bureaucracies, restrictive and outdated regulations, and scarcity of available commercial spectrum. Added to this are the current national security concerns of Huawei and ZTE, which are integral to the global supply chain for 5G equipment and software.

This paper lays out a three-point plan to accelerate U.S. global leadership in 5G. The three points include national adoption of more flexible and timely spectrum policies, scalable alternatives for 5G equipment, and long-term planning, inclusive of increased research and development (R&D) spending, to plan for and enable future platforms and applications powered over advanced mobile networks. On the last point, despite China's slight lead on spectrum and equipment, the U.S. can maintain its dominance over innovation, particularly in the applications and software enabled by next-generation mobile networks. But the country must shift the conversation away from catching up with the Chinese government to being more proactive in the planning around 5G to allow for expedient network deployments and a pathway for the quick accrual of the benefits that will arise from their use.

INTRODUCTION

The United States and China are in a race to deploy fifth-generation, or 5G, wireless networks, and each country has outlined its own plan to get there. The race involves which country will be first to fully implement a nationwide 5G network, lead in standard-setting and patents, and dominate the global supply chain. Some analysts have argued that the Chinese government appears to be on a sprint in the race to achieve this goal, largely due its ability to quickly relax regulatory burdens imposed on state-run telecom companies.[1] U.S. government leaders and the private sector seem to be more on a marathon to network deployment, especially as they have more to do to cut the red tape of local and federal government bureaucracies, update restrictive and outdated regulations, and make more spectrum available for commercial use. The U.S. faces another challenge, which is the lack of current U.S. commercial competition to Chinese telecom companies in the development of 5G networks.

Each country may ultimately end up at the same place when it comes to large-scale 5G rollouts. But how the U.S. and China internally manage their respective spectrum policies, network deployment costs, and expectations around the anticipated revenue models enabled over 5G networks will ultimately determine who is better positioned for global leadership. If the U.S. is going to maintain an edge over China, leaders must organize around a strategic and coordinated call to action, or a 5G blueprint, that facilitates faster and improved access to infrastructure assets, as well as more reasonable expectations of the supply chain needed for network build out.

In this paper, I argue that if the U.S. is going to stay competitive in the race to 5G, policymakers and private sector companies must focus on more flexible, robust, and timely spectrum policies, present scalable alternatives for 5G equipment, and offer a long-term plan, inclusive of increased research and development (R&D) spending, to plan for and enable future platforms and applications powered over advanced mobile networks. This paper argues that these actions will, at minimum, help the nation maintain global leadership in mobile markets.

SETTING THE 5G STAGE

Compared to 4G Long-Term Evolution (LTE), 5G mobile networks are expected to have peak download speeds as high as 20 gigabits per second and lower latency that will enable specialized and precise functions, including the Internet of Things (IoT), remote medicine, connected cars, as well as augmented and virtual realities (AR/VR). A recent World Economic Forum report concluded that 5G networks will contribute $13.2 trillion in economic value globally and generate 22.3 million jobs from direct network investments and residual services.[2] 5G networks and their related applications are expected to add three million jobs and $1.2 trillion to the economy in the U.S.[3]

China has assessed the economic potential of 5G networks. The country has reported more than 200 million 5G subscribers before the full deployment of the technology and anticipates growth in upwards of three million jobs over a five-year period.[4] Chinese hardware manufacturers and software companies also predict generous earnings from a 5G enabled economy.[5] Chinese telecommunications companies, like Huawei and ZTE, have become global, low cost alternatives for 5G equipment.[6]

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Compared to the U.S., China’s 5G aspirations are driven by the government and tied into the country’s overall Belt and Road Initiative (BRI) and strategy of increasing its global power.[7] In the U.S., the private sector has largely driven the capital investments in mobile infrastructure. U.S. companies have lobbied Congress for more spectrum — the airwaves needed for 5G networks and timely policy decisions that eliminate barriers to network build outs. The Federal Communications Commission (FCC), the agency that has oversight of national spectrum assets, has responded by continuing to identify more spectrum available for commercial 5G to meet future demand. In 2019, the FCC announced the 5G FAST Plan, which includes policies and programs intended to deliver a range of spectrum assets, update existing infrastructure policies, and modernize outdated regulations that impact 5G delivery.[8] Since then, additional initiatives have been announced by the agency, including a $9 billion rural 5G fund, to expand services nationwide.[9]

The U.S. and China are actively executing on 5G network architecture, which consists of both macro- and small-cell base stations with edge computing capabilities. Thousands of large cell towers and tens of thousands of small cell antennae will need to be deployed in local communities and cities to operationalize 5G networks. The Chinese government has exercised authority around the placement of these assets by mandating it, an option not available to the U.S. federal government, which has limited jurisdiction over localities. The federal government’s response to these challenges has been either blanket preemption of local and state laws or municipal redress on a case-by-case basis to maintain some level of urgency around siting and permitting approvals of 5G equipment, especially small cells.[10] Further, Chinese officials seem to be unencumbered by community activists who raise concerns about radiation from small cells, a stark contrast to local legislators in the U.S.[11]

President Donald J. Trump and his administration have also chimed in about potential Chinese 5G dominance and implemented their own ban on the use of Huawei products and applications in national communications networks. These actions came after a relatively unsuccessful bid to nationalize U.S. 5G networks, and accusations made against the company related to trade secrets and possible espionage.[12]

The White House has also demanded alignment with their actions from allies and partners, like the United Kingdom and Germany, who continue to do business with Huawei.

Less than 10 years ago, the U.S. dominated the 4G LTE marketplace after falling behind in 3G to European standards. The widely adopted "sharing economy" expanded under 4G LTE led to the prominence of companies that include Lyft, Uber, Airbnb, and a range of cloud-based services. What the future holds under 5G in terms of the next "killer apps" is largely unknown, except for the technology's known enablement of the latest innovations in artificial intelligence (AI) systems, AR/VR, and autonomous vehicles.

Moving forward, some level of consensus around three areas will largely shape either country's 5G leadership: *spectrum management*, *network supply chain*, and *plans for anticipated innovations*. Without a thoughtful approach to at the least the first two, the U.S. will likely lag in 5G deployments compared to China, which cannot solely be attributed to the latter's authoritarian leadership. Without some coordination around 5G's critical assets, mainly spectrum and equipment, coupled with focused leadership at both the federal and local levels, U.S. stakeholders, especially private companies, will not be able to maintain pace with the Chinese government, or other global competitors subjected to less red tape.

SPECTRUM

Electromagnetic spectrum is one of the key ingredients of advanced wireless networks and has become a highly valued asset as the demands from mobile users increase. Early on, the Chinese government opted to rely upon low- and mid-band spectrum for its 5G networks. Low-band spectrum, which travels in the 600 megahertz (MHz), 800 MHz, and 900 MHZ bands, can cover longer distances, penetrate through walls of buildings, and provide superior coverage over large geographic areas. Mid-band spectrum, which is in the 2.5 gighertz (GHz) and 3.5 GHz range, provides more balanced coverage and capacity due to its ability to cover a several-mile radius with 5G, despite needing more cell sites than lower-tiered spectrum bands.

Following this rationale, the Chinese government looked mainly to sub-6 mid-band spectrum over higher frequencies, like mmWave, which travels between the 24 GHz and 300 GHz bands. As a result of this decision, Chinese telecom companies, including China Mobile, China Telecom, and China Unicom, have long been experimenting in the low- to mid-band ranges as they develop a suite of 5G products and services. The Chinese government also cleared "C-Band" spectrum very early in their testing, which at 3.7 GHz to 4.2 GHz, brings even more geographic 5G coverage to its state-owned telecom companies. Compared to mmWave that cannot travel long distances or through the walls of buildings, C-band supports high capacity broadband and will enable advanced applications like AR and VR, without the line of sight challenges. Although granting access to the full range of C-band spectrum (with similar bitrates for uplink and downlink) will require more cell sites to be deployed, the Chinese government still maintains its advantage due to its ability to quickly adopt regulations favorable to the private sector.

U.S. companies, on the other hand, started with reliance on mmWave spectrum. Both AT&T and Verizon focused their initial 5G deployments in this band, citing to its viability in use at stadiums and for localized private networks. Compared to low- and mid-bands, mmWave's technical limitations make it less useful over wider coverage areas, especially in rural areas.

A recent Wall Street Journal article pointed to recent moves by U.S. telecom companies to employ a mix of low-, mid-, and high-band spectrum to facilitate 5G service, a strategy already considered by the Chinese government.[13] For example, Sprint launched its early 5G service using mid-band and with its acquisition by T-Mobile, who has traditionally operated within low-band tiers, their combined 5G service is purported to cover wide areas over long distances, especially those that are more rural and remote.

Unfortunately, the various methodologies in the U.S. have led to somewhat fragmented appeals to the federal government for more commercial spectrum.[14] For example, the FCC was recently lauded by the majority of wireless carriers for the release and auction of C-band assets, though this was long after the Chinese government's deployments and risks legal challenges from the satellite companies who primarily

license this band for delivering television programming to most U.S. households.[15]

These shifts in spectrum management have suggested that the U.S., despite leading in mmWave, is finally realizing that the country which effectively utilizes a combination of mmWave, low-, and mid-band spectrum will ease closer to leading the 5G race.[16] That leader will also influence network and equipment standards, as well as devices, software, security, and other applications.

But while China's authoritarian government can quickly accommodate the requests of its commercial sector, this is not the case in the United States. Even in the wake of the demand for more spectrum, the FCC still must identify it before clearing and auctioning what has become a valued national asset. In some instances, the FCC has been quick to complete spectrum auctions. For example, the agency's first 5G auction, Auction 101, in the 28 GHz band, went rather smoothly.[17] In other cases, bureaucracy can slow down the process for getting spectrum to market. While Auction 101 was successful, it took many years, including a host of technical challenges, before it was sold.[18]

However, the FCC has stayed the course when it comes to making more spectrum available. The agency's release of its 5G FAST plan is indicative of such commitment.[19] But timing matters in the race against China. Economist Roslyn Layton has argued that there will be a loss of value for providers and the public if the FCC takes too long to clear C-band for sale.[20]

Congress has been equally slow to repurpose government spectrum for commercial 5G use. When legislators introduced the Mobile Now Act, which was written to reduce the red tape associated in the procurement of gigabit wireless services like 5G, it took two years to get adopted.[21] After being introduced in 2016, it was reintroduced in 2017 and despite passing the Senate that same year, was ultimately passed as part of the Repack Airwaves Yielding Better Access for Users of Modern Services Act of 2018.[22]

Such insights into the slow U.S. approach to 5G may suggest some difficulty in keeping up with the expediency of the Chinese government's spectrum policy decisions. The U.S. is also mired by differences among telecoms around whether all or the majority of spectrum should be reapportioned to commercial uses. Michael Powell, the former FCC Chairman and current chief of NCTA – The Internet & Television Association, the association for American cable providers, wrote in a recent blog that fast-coming 5G regulatory proceedings and legislative directives may be placing U.S. priorities in the licensed spectrum market, which may restrict the use of unlicensed Wi-Fi. As previously mentioned, satellite providers impacted by the FCC's C-band ruling have threatened legal scrutiny over proposed changes.[23]

These debates within the U.S. private sector could negatively impact the wireless marketplace, stalling potential opportunities to move forward on 5G deployments. Too much time spent debating U.S. spectrum policy may see the Chinese moving forward with their plans to build around sub-6 GHz mid-band spectrum that, in the long run, will present a host of technical challenges, including network and device interoperability, as well as data security concerns for U.S. operators.

GLOBAL SUPPLY CHAIN

Added to the domestic call for more spectrum is the Trump administration's recent public thrashing of networks dependent on Huawei equipment and applications. Since 1987, Huawei has grown to be a leader in information and communication technologies (ICT) and most recently in 5G equipment and services. Despite the U.S. ban of Huawei in federal deployments as part of the 2019 National Defense Authorization Act and threats to withhold intelligence from countries that use Huawei equipment, many other governments have not necessarily followed suit.[24] To date, only five other partners have followed the U.S. lead in banning Huawei equipment in their communications infrastructures: Japan, Taiwan, Vietnam, Australia and New Zealand.[25] Other U.S. allies, including France, Germany, Italy, the Netherlands, and the U.K., are moving forward with their deployments with some restrictions, including the use of the equipment at the network's core.

After vigorous debate among its Cabinet members, the U.K. disregarded the U.S. ban on Huawei products and selected the firm to build out parts of its 5G network in January 2020.[26] Despite President Trump's disapproval

of U.K. Prime Minister Boris Johnson's decision, the country claimed that its choice was based on the cost of the equipment and their risk management capacity.[27] More specifically, London decided that Huawei will not build out the core of their 5G network where most of their information vulnerabilities reside, despite there still being significant risks since the edge and the core of 5G networks are somewhat interconnected.[28] The U.K. contract also chose to channel Huawei equipment away from military installations and other sensitive locations. Instead, base stations will be installed in areas of low risk, and limitations have been imposed on the market share that Huawei can have in their broader network.[29]

The decisions made by the U.K. are like other governments where existing Huawei equipment is already integrated into existing 3G and 4G mobile networks. In its reporting on the U.K. decision, the Wall Street Journal shared that British officials pointed to the significant time and money already invested.[30] While British officials acknowledged U.S. security concerns, they vowed to invest in their own research and explore alternatives to Huawei in the procurement of base stations, switches, and routers.

The Dutch faced a similar situation. Like the British government, they too have instituted better vetting processes to mitigate national security risks and pushed Huawei products outside of the Netherlands' 5G core network to avert any potential threats of espionage.[31] But network interdependence and reasonable cost structures kept them linked to Huawei.

In January 2020, the European Union (EU) also proposed a risk-based model for partner countries to provide a security baseline for 5G networks, but stopped short of a complete ban of equipment and software.[32] With the U.K. now having left the EU, it's unclear if they will follow the same protocols in their dealings with China.

Many African countries have already purchased products and services from China despite publicized cases of data security breaches. Africa has long negotiated bilateral trade relationships with China through the Belt and Road Initiative and, without wireless access, would regress in its digital advancements. Smartphone connections in Africa were at 250 million in 2017 and are expected to be at 440 million by 2025.[33] The success behind Africa's mobile market has been low-cost equipment, affordable pre-paid plans, multiple SIM cards and the tethering of applications with mobile providers, especially in the areas of banking and other forms of commerce. On this latter point, journalist Elo Umeh pointed to the backbone for phone technologies (USSD/SMS) that have made the cost of mobile cheaper for more remote parts of the continent because people do not have to rely upon the internet.[34] That is, customers can go directly to their provider for inquiries and set up accounts for digital financial services directly through mobile incumbents.[35]

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In the end, public bullying by the Trump administration on the use of Huawei products may backfire without coordination with other competitors who make up the global 5G supply chain.[36] Here is where improved relationships between U.S. telecoms and the handful of non-U.S. based competitors, including Europe's Ericsson and Nokia, and South Korea's Samsung, will be pivotal to progress. And with the recent passage of the Secure and Trusted Communications Network Act by both the House and the Senate, Nokia and Ericsson must quickly step in as viable alternatives, especially as legislators call for the replacement of any communications equipment deemed a security risk.[37] Norway's largest telecom operator, Telenor, moved forward and awarded their most recent 5G contract to Ericsson, which quickly elicited a critical response from the Chinese government.[38]

But one possible risk of completely alienating Chinese equipment makers from U.S. systems could pose some challenges in global network dependencies in the future. Japan's early experiences in the mobile market sheds light on this.[39] In 1999, the Japanese-made

mobile phone had email capabilities. In the 2000s, NTT would produce camera phones, which would eventually drive the demand for third generation, or 3G, networks in 2001. In 2004 and 2005, Japanese technology would enable electronic payments and digital television on mobile devices. But for all their rapid growth domestically, Japanese mobile device manufacturers struggled to gain an early foothold in global markets.[40] Consequently, over 45% of Japan's citizens are subscribers to the country's mobile products and services and with such high domestic penetration, telecom providers are constantly look for new customers or the relinquishment of old equipment for newer models.[41]

While it could be that the Trump administration's action to ban Huawei equipment would not generate similar results as Japan's mobile scenario, U.S. growth and market share could be impacted, especially in the global expansion of internet-enabled products into mainstreamed mobile markets. In November 2019, before the U.S. officially added Huawei to the Department of Commerce's Bureau of Industry and Security List, about 290 American companies requested exemptions from the adopted ban of the company's equipment from domestic networks.[42] U.S. trade associations like CTIA, which represents a range of incumbent mobile carriers, have generally supported the Huawei ban, but has urged the federal government to present compelling evidence on data security concerns.[43]

As scrutiny of Huawei continues in the U.S., it will be interesting to see how this ultimately affects 5G deployments. Earlier this year, Huawei's recent legal challenge to the U.S. ban was tossed out by a U.S. federal district court, which determined that Congress and the White House were well within their authority to restrict the company, as well as ZTE, from selling products to U.S. manufacturers. As tensions escalate, it will be important for U.S. companies to understand how the White House's actions will impact the global supply chain and existing local networks. where the equipment is in use, as well as what companies will step up to replace such procurements.[44]

INNOVATION

Finally, despite China's slight lead on spectrum and equipment, it's been argued that the U.S. will maintain its dominance over innovation, particularly in the applications and software enabled by these advanced mobile networks.[45] In a previous article on 5G and IoT, I wrote that each generation of mobile technology enables a new suite of functional innovations for users and the economy.[46] Mobile voice communications eventually took on mobile messaging, or short message services (SMS), with the introduction of 2G. Smartphone technologies, high-definition video and other robust multimedia applications were made possible through 3G and 4G.

The next and contemporary wave of mobile technologies enabled by 4G LTE have been significant game changers as seen in newly created digital industries, such as ride-sharing services like Uber, Lyft, and others. In addition to these innovations, the ability to bolster IoT, navigational technologies, and cloud-based software over mobile networks have been engineered and led by American innovators and companies, who are at the global forefront of intellectual property and investment. Added to the digital advancements emanating from the U.S. are a range of social media platforms, including Facebook, Twitter, and other applications that have expeditiously grown over advanced mobile networks.

While many new innovations can be enabled over 4G LTE networks, the promise of 5G's faster data transmission speeds and wider coverage areas (depending on the spectrum band) is imminent. Given the lower latency of 5G networks, applications and services that also encompass virtual and augmented realities, autonomous vehicles and AI systems will be better supported. In fact, both 5G and existing 4G LTE networks will lead to more robust digital sharing and networking environments that are able to accommodate applications where speed, latency, and precision matter.

Historically, the U.S. has led ideation, research and development, and execution in the high-tech sectors. But under the leadership of President Xi Jinping, the Chinese government has made a recent attempt to upgrade their industrial strength as part of the "Made in China 2025" strategic plan, which is targeting

resources and political prowess toward "innovation-driven development." While some have argued that this initiative is unsettling against the Trump administration's Make America Great Again (MAGA) economic aspirations, China is positioning itself to become a competitor in the high-tech industries, including AI. According to a report issued by the Carnegie Endowment for International Peace, "China has eclipsed the U.S. as the world's largest overall (public and private) R&D investor."[47] The article also points to the Chinese government's intramural funding in 2017 of $64.4 billion, compared to $47.1 billion in the U.S.[48]

Some digging by journalists have found that these huge investments are not automatically translating into immediate success for Chinese companies. Last year, the Los Angeles Times found that newly launched companies in China's self-driving cars business, like Baidu, Inc., Pony.ai, and Tencent, are early in their implementation of this new technology;[49] whereas U.S. companies, including Alphabet Inc.'s Waymo, General Motors, and Tesla, have been at this since 2014, working on road tests, integrated technology systems, and increased research and development.[50] While analysts suggest that China could become one of the largest global markets for autonomous vehicles, such utilization is probably nine to 10 years from full-fledged deployment, especially given China's traffic patterns, road conditions, and driver behaviors.[51]

What is important here is that attempts by the Chinese government to outspend the U.S. (and potentially the rest of the world) in digital platforms and services will largely come from its own consumers and businesses in the tech sector. There is also the possibility that Chinese officials will export their own standards using the Belt and Road Initiative, lock in other governments — including in Africa — to their technology, and create a split digital ecosystem worldwide.

Because the U.S. and some other countries may not have the same forced constraints as the Chinese when it comes to platforms, products, and services, they may be better positioned to create and distribute 5G outputs and related applications that will hand them a much greater global market share, especially in countries not already locked into a Chinese digital ecosystem.

But 5G innovation must not be divorced from the first two points — spectrum access and cost. Whereas the U.S. defined the standards of 4G LTE mobile technology, their technological advantage also allowed them to also lead the products and services enabled by the next generation of mobile services, encapsulated in their command of the technical standards, intellectual property, and interoperability/compatibility guidelines.

Any type of Chinese monopoly or dominance over 5G systems, therefore, will position the country to replicate the previous effectiveness of U.S. companies and go even further by asserting leadership over standard-setting for both the network, as well as related applications and software.

CONCLUSION

The mobile services that consumers are highly dependent on today are due to American ingenuity in the mobile space that ultimately contributed to a host of new businesses, expanded enterprises, applications, and consumer engagements. While the innovations associated with 5G are still being imagined, a new round of innovations will surface and be emboldened by systems that are better suited for 5G networks, including AI, IoT, AR/VR, and advanced manufacturing, among other things. In other words, the country that fully deploys 5G will lead the scope and direction of new applications and services, ushering in a period of catch up for other countries.

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The 5G marketplace is quickly maturing and the U.S. has lost some time in its attention to a range of regulatory and legislative directives that, at times, have constrained activities. If the U.S. is going to maintain global standing in areas that will drive the next wave of mobile innovations — standards, patents, applications,

and software — a more coordinated call to action that also involves more strategic spectrum management, and attention to the global supply chain will be required. And this approach must engage stakeholders at all levels — from the public and private sectors to the most appropriate levels of the federal and local governments. In fact, shifting the conversation away from catching up with the Chinese government to being more proactive in the planning around 5G will allow the U.S. to be more expedient in network deployments and create a pathway for the quick accrual of the benefits that will arise from their use.

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