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“5G: National Security Concerns, Intellectual Property Issues, and the Impact on Competition and Innovation”

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Chairman Graham, Ranking Member Feinstein, and Honorable Members of the Committee:

Thank you for inviting me to testify today on an issue critical to the future of the United States—ensuring America’s leadership in next generation 5G communications technologies. It is a privilege to appear before this Committee and to be joined this morning by such distinguished colleagues.

I study the issue of 5G in the context of the growing strategic competition between the U.S. and China. While the U.S. faces any number of immediate foreign policy challenges, from the crisis in Venezuela to turmoil across the Middle East, over the mid- and longer-term maintaining America’s competitiveness with China is arguably the greatest foreign policy and national security issue our country faces. 5G is a key part of America’s competition with China in the economic and technological domains. Winning the competition in 5G, or at the very least maintaining competitiveness, is critical to the United States maintaining our broad technological edge while protecting our communication networks and the networks of our allies.

Why 5G Matters in U.S.-China Competition:

Fundamentally, there are two major reasons that 5G matters in America’s competition with China. The first is the role that 5G will play in global economic growth and technological development, and the second is to protect U.S. and allied networks against cyber threats.

First, let me discuss the economic importance of 5G. Leading the development and deployment of 5G is not just about leading in a specific telecommunications technology: leading in 5G is an important element of maintaining America’s world-leading hi-tech development and innovation ecosystem.

As members of this Committee know, deploying 5G has implications far more profound than simply enabling tens of millions of Americans to stream reruns of Game of Thrones and other

Bold.

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popular TV shows in ever-higher resolution. The greatly increased transmission speeds and reduced latency (the delays in communications networks) of 5G will enable an entirely new universe of data-intensive internet connected devices to be developed and rolled out over the next decade or more. The IHS Markit research and data firm, for example, estimates that there will be 125 billion internet connected devices by 2030, and 5G is the technology that will connect the vast majority of those devices to the internet.¹

America's experience with 4G, the current mobile broadband technology, is illustrative of why cutting-edge telecommunications networks matter. The U.S. began rolling out 4G in in the early 2010s, and more than half of the U.S. market was served by 4G networks by the middle part of this decade. The rapid spread of 4G technology in the U.S. enabled America's entrepreneurial tech talent to develop a vast range of apps and devices that take advantage of 4G speeds. While there are many reasons that U.S. high-tech firms have proven so successful over the last decade (of global high-tech firms founded since 2000, U.S. companies' market capitalization accounts for nearly half the global total),² including a deep talent pool and strong venture capital, the fact that U.S. communications networks enabled the widespread, rapid deployment of new apps and new technologies was an important factor.

A similar dynamic is likely to occur with 5G. Take, for example, autonomous vehicles, which are likely to transform the transportation sector. Self-driving cars require the processing of vast amounts of data and reliable, speedy, low-latency ways for individual cars to communicate with both central facilities and with other nearby vehicles. Most experts assess that given the data needs of autonomous vehicles, 5G networks will be required before tens of millions of autonomous vehicles can be reliably deployed on the roads. If China (or Europe) opened up a material edge in developing and deploying 5G, autonomous vehicle companies could find it attractive to roll out autonomous vehicles in China earlier and more quickly than in the United States. Over time, that would encourage a shift in the underlying technological development away from the United States and towards U.S. competitors.

Leading the global 5G competition is by no means sufficient for the U.S. to lead the global development of autonomous vehicles, which will require tremendous private sector ingenuity and smart government regulation. But deploying 5G networks rapidly will strengthen the U.S. ecosystem in ways that encourage U.S. companies to continue leading the development and deployment of autonomous vehicles. The same dynamic will hold true for any number of other game-changing innovative technologies that will rely on the speed and low latency of 5G.

The second reason that 5G matters in U.S.-China competition is the need to protect our communications networks: the U.S. has an enormous strategic interest in reducing the vulnerabilities of communications networks in the United States and in allied countries to cyber espionage by China and other competitor nations. China engages in widespread espionage against both governmental and commercial targets, and U.S. intelligence officials and a number of allied

¹ IHS Markit, "Number of Connected IoT Devices Will Surge to 125 Billion by 2030, IHS Markit Says," press release, Oct. 24, 2017, <https://technology.ihs.com/596542/number-of-connected-iot-devices-will-surge-to-125-billion-by-2030-ihs-markit-says>.

² John Detrixhe, "Why Can't Europe Create Tech Giants Like the U.S. and China?" *Quartz*, July 5, 2018, <https://qz.com/1320983/why-arent-europes-technology-companies-as-big-as-in-the-us-and-china/>.

intelligence agencies have expressed sharp concerns that global 5G telecommunications networks that depend on Chinese equipment could pose significant cyber security risks.

Concerns about China's ability to use Chinese-made communications technology to facilitate espionage are not new. American intelligence officials have long worried that China can implant back-doors into telecommunications equipment to eavesdrop on sensitive government, private sector, and personal communications. In 2010, pressure from the Obama Administration and from Congress persuaded Sprint to exclude China's Huawei and ZTE from selling network infrastructure equipment to the company for use in U.S. telecommunications networks.³ In October 2012 the House Permanent Select Committee on Intelligence released a detailed, public *Investigative Report on the National Security Issues Posed by Chinese Telecommunications Companies ZTE and Huawei*.⁴ The United Kingdom first established its U.K. Huawei Cyber Security Evaluation Center in 2010.

But while concerns over Chinese communications technology goes back a decade, the level of attention that the issue has received in Washington and in foreign capitals has increased sharply over the last two years—driven largely by the need for countries to grapple with whether to allow Chinese equipment into 5G mobile communications networks.

Last summer, concerns about information security prompted Congress to include provisions in the 2019 National Defense Authorization Act (NDAA) that effectively prohibit telecommunications companies that contract with the federal government from using Huawei and ZTE equipment. However, I should note that while this effectively ensures that large U.S. telecommunications companies can no longer use Huawei and ZTE equipment in their networks, some smaller U.S. wireless networks, particularly in rural areas, still use Chinese equipment: a December 2018 regulatory filing by the Rural Wireless Association (RWA) estimated that 25% of its membership of rural wireless carriers use at least some Chinese equipment.⁵ The Trump Administration has been considering issuing an Executive Order to fully ban Chinese network infrastructure equipment from the U.S., but has yet to act, potentially due to concern that such an action would unsettle the ongoing U.S.-China trade talks.⁶

Much of the focus of the U.S.-China competition over 5G in recent months has been in the international arena, where Trump Administration officials are aggressively urging allied countries to bar Chinese equipment from 5G telecommunications networks. Beginning late last year and with increasing force in recent months, Trump Administration officials have pressed U.S. allies to ban Huawei and other Chinese equipment from 5G networks. In March, for example, U.S. Ambassador to Germany Richard Grenell warned the German government that a decision to allow Huawei

³ Joann S. Lublin and Shayndi Raice, "Security Fears Kill Chinese Bid in U.S.," *Wall Street Journal*, Nov. 5, 2010, <https://www.wsj.com/articles/SB10001424052748704353504575596611547810220>.

⁴ U.S. House of Representatives Permanent Select Committee on Intelligence, *Investigative Report on the National Security Issues Posed by Chinese Telecommunications Companies ZTE and Huawei*, Oct. 8, 2012, [https://republicans-intelligence.house.gov/sites/intelligence.house.gov/files/documents/huawei-zte%20investigative%20report%20\(final\).pdf](https://republicans-intelligence.house.gov/sites/intelligence.house.gov/files/documents/huawei-zte%20investigative%20report%20(final).pdf).

⁵ Mike Dano, "Huawei equipment currently deployed by 25% of U.S. rural wireless carriers, RWA says," *FierceWireless*, Dec. 11, 2018, <https://www.fiercewireless.com/wireless/huawei-equipment-currently-deployed-by-25-u-s-rural-wireless-carriers-rwa-says>.

⁶ Julian E. Barnes and David E. Sanger, Trump Announces 5G Plan as White House Weighs Banning Huawei," *The New York Times*, April 12, 2019, <https://www.nytimes.com/2019/04/12/us/politics/trump-5g-network.html>.

equipment could limit U.S. intelligence sharing.⁷ Speaking in London just last week, Secretary of State Mike Pompeo asked why countries considering allowing Huawei equipment in their networks would “grant such power to a regime that has already grossly violated cyberspace?”⁸

The Administration’s effort to mobilize allied governments against Chinese telecommunications equipment has achieved some success: Australia and New Zealand, for example, have said that they will not allow Huawei equipment in their networks. There has also been speculation that Canada may announce a ban on Huawei after Ottawa resolves its dispute with Beijing over Canada’s detention of Huawei CFO Meng Wanzhou, who is under house arrest in Vancouver while the U.S. seeks to extradite her to face criminal charges related to Iran sanctions violations.

But the reality is that many countries appear to be on a path to allowing Chinese equipment in at least parts of their telecommunications networks. Despite the U.S. pressure, for example, while U.K. Prime Minister Theresa May has said that the U.K. will ban Huawei equipment from “core” parts of telecommunications networks, the U.K. will allow the equipment to be used in “non-core” parts of the network such as antennas. Italy’s Prime Minister has said that Italy will not discriminate against Huawei in Italy’s 5G rollout.⁹ Bahrain, home to the U.S. Navy’s Fifth Fleet, has announced plans to roll out a 5G network this year using Huawei equipment despite U.S. pressure.¹⁰ Huawei’s financial results show that the company is winning support in global markets writ large: Earlier this year Huawei announced that 2018 revenues were up nearly 20% over 2017 to \$107 billion. However, that growth was driven by Huawei’s consumer business while core networking equipment revenue saw a very modest decline.¹¹

The competition from China is real

When the U.S. considers how to compete effectively in 5G, officials must keep in mind that the competition from China is real. Huawei has certainly benefited over the years from Chinese government subsidies and unfair and illegal trade practices: in 2014, for example, the European Union’s top trade official criticized China for providing subsidies to Huawei that gave the company

⁷ Bill Chappell, “U.S. Warns Germany: Using Huawei Could Crimp Intelligence-Sharing Between Agencies,” *NPR*, March 12, 2019, <https://www.npr.org/2019/03/12/702477741/u-s-warns-germany-using-huawei-could-crimp-intelligence-sharing-between-agencies>.

⁸ Stephen Castle, “Pompeo Attacks China and Warns Britain Over Huawei Security Risks,” *New York Times*, May 8, 2019, <https://www.nytimes.com/2019/05/08/technology/pompeo-huawei-britain.html>.

⁹ Mark Bendeich, “Italian PM assures Huawei it won't face discrimination,” *Reuters*, April 26, 2019, <https://www.reuters.com/article/us-italy-huawei-conte/italian-pm-assures-huawei-it-wont-face-discrimination-idUSKCN1S21R7>.

¹⁰ Alexander Cornwell, “Bahrain to use Huawei in 5G rollout despite U.S. warnings,” *Reuters*, March 26, 2019, <https://www.reuters.com/article/huawei-security-bahrain/bahrain-to-use-huawei-in-5g-rollout-despite-u-s-warnings-idUSL8N21D26N>.

¹¹ Arjun Kharpal, “Huawei tops \$100 billion revenue for first time despite political headwinds,” *CNBC.com*, March 29, 2019, <https://www.cnbc.com/2019/03/29/huawei-earnings-full-year-2018.html>.

an unfair competitive advantage in global markets.¹² In January of this year the U.S. Department of Justice indicted Huawei for attempting to steal trade secrets from T-Mobile.¹³

But China also has important structural advantages in developing and deploying communications networks. China has a massive consumer base of an estimated 788 million mobile internet users, creating an enormous domestic market for mobile communications technology.¹⁴ China has significant engineering and technological talent. Companies that can thrive in China's domestic mobile telecommunications market, including Chinese companies Huawei and ZTE, can grow rapidly, enabling them to bring down costs and compete effectively internationally.

Huawei itself should also be recognized as a savvy competitor. A 2018 European Union study of the global companies with the largest R&D budgets, for example, found that Huawei ranked 5th, behind Google parent Alphabet and Microsoft but ahead of other U.S. tech companies such as Apple and Oracle.¹⁵ While not all of the \$15 billion or more that Huawei spends annually on R&D is directed at 5G, Huawei's large R&D budget has enabled the company to develop equipment that mobile network operators find compelling in terms of performance as well as price. Huawei's R&D budget has also contributed to the company taking a lead in 5G patents: one recent study, for example, has found that China's share of 5G-related "standard essential patent" applications—applications for patents core to the technology and available to all companies on a royalty basis—is 34%, compared to 25% for South Korea and 14% for the U.S.; Huawei alone was responsible for 15% of the patent applications.¹⁶

How the U.S. is doing:

Against this backdrop, how is the U.S. faring in the race for 5G?

First, I will begin by commending the substantial steps that federal policymakers, the U.S. tech community, and other stakeholders have taken in the past two years to encourage the expansion of 5G in the U.S. A report that the U.S. wireless industry's trade association (CTIA) released last month found that the U.S. has moved aggressively to advance 5G over the past 12 months and that the "US has moved up to a tie with China as the leading nations in [the report's] '5G readiness' assessment."¹⁷

¹² Shawn Donnan, "EU commissioner attacks China's telecoms subsidies," *The Financial Times*, March 27, 2014, <https://www.ft.com/content/d6d0bcc6-b5cb-11e3-b40e-00144feabdc0>.

¹³ U.S. Department of Justice, "Chinese Telecommunications Device Manufacturer and its U.S. Affiliate Indicted for Theft of Trade Secrets, Wire Fraud, and Obstruction Of Justice," press release, Jan. 28, 2019, <https://www.justice.gov/opa/pr/chinese-telecommunications-device-manufacturer-and-its-us-affiliate-indicted-theft-trade>.

¹⁴ Niall McCarthy, "China Now Boasts More Than 800 Million Internet Users And 98% Of Them Are Mobile," *Forbes*, Aug. 23, 2018, <https://www.forbes.com/sites/niallmccarthy/2018/08/23/china-now-boasts-more-than-800-million-internet-users-and-98-of-them-are-mobile-infographic/#4d20c9687092>.

¹⁵ The 2018 EU Industrial R&D Investment Scorecard, p. 63. <http://iri.jrc.ec.europa.eu/scoreboard18.html>

¹⁶ Akito Tanaka, "China in pole position for 5G era with a third of key patents," *Nikkei Asian Review*, May 3, 2019, <https://asia.nikkei.com/Spotlight/5G-networks/China-in-pole-position-for-5G-era-with-a-third-of-key-patents>.

¹⁷ David Abecassis, Janette Stewart, and Chris Nickerson, "Global Race to 5G-Update," Analysis Mason for CTIA, April 2019, p. 1, <https://api.ctia.org/wp-content/uploads/2019/03/Global-Race-to-5G-Update.pdf>.

As part of the Federal Communication Commission’s “5G FAST” plan, the FCC has already held auctions for the wireless spectrum that carriers need to roll out 5G across the U.S., and last month announced a major spectrum auction for late this year. The FCC is also taking steps to free up additional “mid-band” spectrum for 5G, which will allow 5G to be deployed over larger distances.

The FCC has taken important steps to reduce local bureaucratic and regulatory delays that could slow 5G rollout. Ultimately, deploying 5G nationally requires the installation of tens of thousands of individual 5G cell sites, and most of those cell sites require local regulatory approval. Local communities have legitimate reasons to retain oversight to make sure that cell sites do not disrupt local neighborhoods. But last September the FCC announced new rules that will require communities to make decisions on cell site applications with 90 days (or within 60 days for upgrades to existing cell sites), ensuring that 5G doesn’t simply get mired in endless delay.¹⁸

U.S. industry also deserves credit. AT&T and Verizon both launched 5G services last year, albeit in quite limited markets. U.S. carriers are likely to quickly scale up their deployments of 5G service over the course of 2019 and next year. Qualcomm and other U.S. firms have continued to innovate in 5G chip technology, and Apple and Qualcomm’s recent decision to settle their long-running patent dispute opens the door to ensuring that Apple, the leading U.S. mobile device maker, is able to use best-in-class 5G technology in its future handsets.

Unfortunately, the Trump Administration’s global diplomatic campaign against Huawei in recent months appears to be less successful than the Administration’s domestic 5G agenda. As I said earlier, the U.S. has had a handful of successes to date, and may yet prevail on other countries to exclude Huawei and other Chinese equipment. But as the views of governments from Germany to Bahrain indicate, the odds are that many countries will allow Chinese equipment in 5G networks, ultimately forcing the U.S. and U.S. allies to rely more on encryption and other mechanisms to improve security on networks where the security of some of the infrastructure is in doubt.

The U.S. campaign has suffered from several challenges. The first is the circumstantial nature of the case that the U.S. government has made. The core concern for national security is that China will be able to use Chinese-made network equipment to access, or disrupt, information flowing across telecommunications networks. In arguing against Huawei, U.S. officials have pointed to China’s 2017 National Intelligence Law and China’s 2014 Counter-Espionage laws as requiring Chinese companies, including telecommunications companies, to support China’s espionage activities if asked.¹⁹ U.S. officials have also pointed to Huawei’s opaque ownership structure, the military ties of founder Ren Zhengfei, and alleged Huawei ties to the Chinese military and intelligence services.²⁰ But both private discussions with foreign government officials and public press reports suggest that

¹⁸ See, e.g., Kris Holt, “FCC gives cities 90 days to process 5G carrier applications,” *Engadget*, Sept. 26, 2018, <https://www.engadget.com/2018/09/26/fcc-5g-rollout-cities-shot-clock-carriers/>.

¹⁹ Arjun Kharpal, it would never hand data to China’s government. Experts say it wouldn’t have a choice,” *CNBC*, March 4, 2019, <https://www.cnbc.com/2019/03/05/huawei-would-have-to-give-data-to-china-government-if-asked-experts.html>.

²⁰ Zak Doffman, “CIA Claims It Has Proof Huawei Has Been Funded By China’s Military And Intelligence,” *Forbes*, April 20, 2019, <https://www.forbes.com/sites/zakdoffman/2019/04/20/cia-offers-proof-huawei-has-been-funded-by-chinas-military-and-intelligence/#22863a7e7208>.

the U.S. government has not been able to point at “smoking gun” evidence that China has been able to use Huawei equipment to engage in espionage. Similarly, while the U.K.’s Huawei Cyber Security Evaluation Center Oversight Board’s 2019 annual report sharply criticized Huawei’s failure to address past security issues and said that it “continued to identify concerning issues in Huawei’s approach to software development” that brought “increased risk to UK operators,” the report attributed the lapses as likely being the product of poor engineering and not willful attempts to facilitate espionage.²¹ Many foreign governments simply have not found the circumstantial case against Huawei sufficiently compelling to justify prohibiting Huawei’s equipment.

The second challenge for the U.S. diplomatic campaign is the lack of competition in the 5G market. Only a handful of telecommunications firms including Huawei, Nokia, and Ericsson, make a full range of mobile network infrastructure equipment, and foreign governments are wary of banning Chinese companies out of fear that the lack of competition will drive up costs and, at least as important as costs, delay rollout. This is a problem that the U.S. government is unlikely to be able to address in the near- or mid-term.

Policy Recommendations: Where Does the U.S. Go From Here?

I will largely defer to my esteemed colleagues to offer recommendations on further domestic policy steps the U.S. should take to foster 5G development in the U.S., such as providing more mid-band spectrum for 5G. I would, however, like to note that fundamentally the U.S. needs to encourage additional R&D investments in 5G and related technologies in order to ensure America’s advantage—as I noted earlier, China is a formidable competitor and beating China in 5G will fundamentally require the U.S. to out-innovate and out compete Chinese companies.

I would like to offer several recommendations on diplomatic, foreign-policy, and trade-policy related steps that the U.S. government should take to strengthen our position in 5G.

First, the Trump Administration needs an effective strategy for 5G within the context of its trade war with China. I have generally been supportive of the Trump Administration’s increased pressure on China over the past 18 months as a tool to press China to agree to significant economic reforms and to promote a level playing field between U.S. companies and their Chinese competitors. That should include pressure on China to eliminate unfair subsidies and other unfair advantages that the Chinese government provides Huawei and other Chinese firms to develop and deploy 5G and other communications technologies at the expense of international competitors. That said, President Trump’s recent announcement that he plans to increase tariffs on imports of Chinese-manufactured consumer goods including cellphones and other electronics could actually hinder the deployment of 5G in the U.S. by raising the costs of 5G handsets and deterring American consumers from purchasing them: Ultimately mobile network operators will not make compelling investments in 5G if they do not think that U.S. consumers will quickly purchase 5G handsets and other mobile devices. While President Trump has argued in recent days that his tariffs will simply drive supply

²¹ U.K. Huawei Cyber Security Evaluation Center Oversight Board, “Annual Report 2019,” March 2019, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/790270/HCSEC_OversightBoardReport-2019.pdf.

chains to other countries rather than increasing U.S. consumer costs, transitioning supply chains can take significant time. Similarly, the U.S. will not benefit if China retaliates for the latest tariffs by further discriminating against U.S. companies that make key 5G technologies and sell them into the Chinese market, and China has announced plans to retaliate for President Trump's tariff hike. The Trump Administration needs to tread cautiously in its just-announced tariff hikes on Chinese-made goods to avoid inadvertently impacting other U.S. goals, including U.S. goals related to 5G.

Second, the U.S. needs to refine its diplomatic campaign against allied countries' use of Huawei. The U.S. should be more forward-leaning in disclosing additional evidence of specific security vulnerabilities, if the U.S. government has such information, in order to make a more compelling case to allied governments. Given that countries fear barring Huawei will drive up costs, the Trump Administration should also consider whether there are ways to offer incentives to countries that decline to allow Huawei equipment into their networks to complement the Administration's existing approach of threatening to curtail intelligence cooperation with governments that do allow Huawei equipment to be used in mobile communications networks. This may be particularly relevant with respect to large emerging markets—both Brazil and Mexico are beginning to develop 5G plans, for example—where financing via China's Belt and Road Initiative (BRI) for BRI countries and via other bilateral mechanisms for non-BRI developing countries may make Chinese offers even more attractive.

Thank you again for inviting me to testify today. I look forward to your questions.