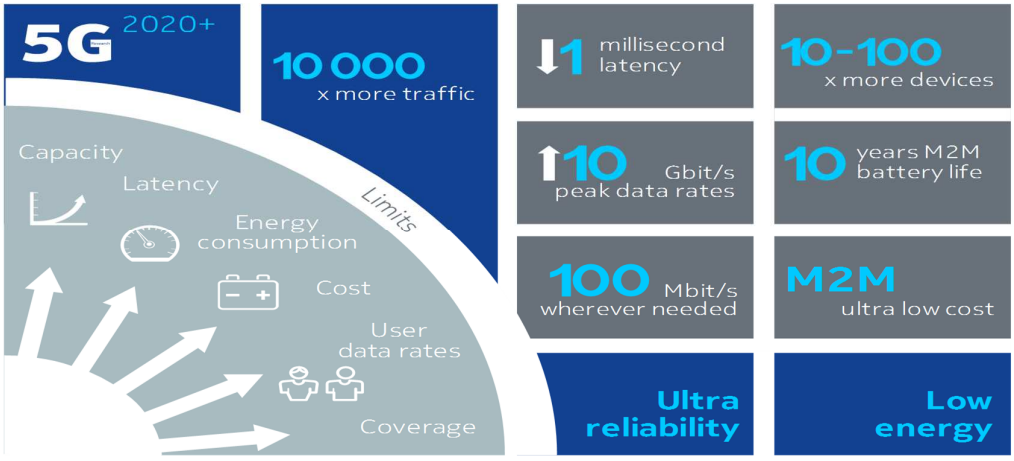
5th generation (5G) of communication networks a key enabler of the Internet of Things (IoT)

Background

The advancement of wireless networks in 4G has enabled an advancement in mobile applications and services. The appetite of consumers, however, for a new generation of capabilities, such as self-driving cars, healthcare and fitness "wearable" technologies, and the capability to control their home environment while on the move is placing increasing demands on existing networks. For the Internet of Things (IoT) to meet any of the lofty ambitions policymakers frequently cite, a future evolution of mobile broadband networks must take place utilizing technologies and techniques that are still largely aspirational or in their early development. We need to invest in and develop an entirely new network deployment approach and new, more capable equipment. For the mobile broadband ecosystem that is a critical part of the IoT to develop as technologists and policymakers imagine, key technology and policy enablers are needed to incent and facilitate the needed research and development.

What is at stake?

- **Jobs & growth:** 5G is a key technology for many growing business sectors including software, video, gaming, data analytics, and machine-to-machine (M2M) communications.
- **Investments:** significant early investment in 5G will help close the gap in ultrafast mobile broadband between the U.S. and other countries, particularly in advance a major 5G push expected from China.
- **Research:** sustained investment in 5G research will begin to address limitations in mobile broadband availability in rural areas.



Why 5G matters for citizens?

Demand: Consumers generate an increasing amount of mobile traffic, which necessitates more capacity and lower latency. 5G will offer an expected peak data rate higher than 2 Gbit/s initially and ultimately as high as 10-20 Gbit/s compared to the 300 Mbit/s LTE can offer today, combined with virtually zero latency, meaning that the radio interface will not be the bottleneck even for the most challenging use cases.

Societal innovations. 5G will support applications and industries of the future such as innovative health care services, self-driving cars and the next generation of industry automation. 5G will mean stepping away from best effort networks towards truly reliable communication.

Internet of things. 5G will be designed for use cases expanding from humans to machines, requiring more of networks. 5G supports the huge growth of machine-to-machine type communication, also called Internet of Things (IoT), through flexibility, low costs and low consumption of energy. At the same time, 5G will be reliable and quick enough for mission-critical wireless control and automation tasks such as self-driving cars.

Energy and cost. 5G will lower costs and the consumption of energy. Energy efficiency is an integral part of the design paradigm of 5G. Virtualized and scalable technologies will further facilitate global adoption. Taking these factors together, 5G could bring Internet access to a larger group of people and things while taking important steps towards a more environmentally responsible network architecture.

Technology Challenges and Policy Enablers

The research that must be undertaken by mobile broadband equipment companies like Nokia to bring 5G into reality is substantial. Multiple generations of technology already deployed must work seamlessly together under the 5G umbrella, which requires new approaches and capabilities, all with lower power consumption and lower deployment costs as key demands.

Intellectual property rights policy: 5G research activities become risky when genuine innovation is neither protected nor rewarded. Robust protections for intellectual property are an essential ingredient to the successful realization of 5G and the IoT. Congressional patent reform efforts should not make it more difficult for innovators to protect these rights, which are essential to the business case for undertaking the research and development risk.

Spectrum needs: Additional radio spectrum for mobile networks needs to be allocated and put into use quickly to meet the increased capacity and coverage demands of 5G. While U.S. operators currently hold significant spectrum, and will begin deployments in a range of bands including 600 MHz and mmWave bands, there are questions whether the amount of spectrum available will allow the evolution from early 5G (2 Gbit/s data rates) to full 5G that Nokia expects will have data rates upwards of 20 Gbit/s. China will be making huge blocks of mid-band spectrum available to operators (80-100 MHz each) while S. Korea is moving forward with both mid-band and mmWave auctions in 2018. For the U.S. to future proof 5G, operators in the U.S. will require substantially more spectrum.

Net Neutrality regulation: It is imperative that the FCC allow operators to innovate by offering specialized services that are necessary to emerging applications and services that require predictable service quality. Restrictions on legitimate network management and the development of specialized or prioritized services drain value creation from the mobile broadband ecosystem and will impair the development schedule for 5G. Open Internet rules that protect consumers while allowing for flexible network management and innovative service offerings is a sensible, balanced approach.

Density and siting reform: 5G we will need to use many more base stations to meet the performance needs of future applications. These dense networks will be deployed as heterogeneous networks, combining macro sites with smaller base stations and using a range of radio access technologies including LTE-A, Wi-Fi and any future 5G technologies. There are significant disparities in local siting rules for infrastructure. The FCC has made a good down payment with its infrastructure proposal relating to tribes, environmental, and historical preservation processes. However, further action to speed the siting of the hundreds of thousands of new small cells that are needed for IoT is necessary.

Recommendations for policy makers

- Quickly finalize the rules for 3.5 GHz band, allowing deployments in both GAA in 2018 and the PAL blocks in 2019. For this to happen, the FCC must wrap up the open further rulemaking and move toward auction rules for the PALs even as the GAA deployments begin. Completing the SAS and equipment certification process is critical to keeping on schedule;
- Move in 2018 to a Notice of Rulemaking in the 3.7-4.2 GHz band. Whether on an interim basis through sharing and eventual migration to a cleared band, or through other mechanisms, the FCC needs to be more aggressive with this band. The goal should be to provide each national operator up to 100 MHz of mid-band spectrum as China is doing;
- Schedule auctions for all mmWave bands previously identified by the FCC, potentially conducting more than one at a time rather than scheduling spectrum auctions *in seriatim*;
- Work with NTIA and government stakeholders on identifying a path forward for spectrum between 3.1 and 3.55 GHz; and
- Explore options to ensure that good policy is incorporated at every opportunity to facilitate deployment and economies of scale: 1) including dig once and other common sense measures in the infrastructure proposal, 2) review possible tax policy levers for possible inclusion in tax “clean up” bills to incent deployment of fiber and high capacity wireless technology in unserved and underserved areas, and 3) explore the opportunity to further reform FCC CAF funding eligibility rules to ensure a wide range of potential entities including system integrators can pursue projects in unserved and underserved areas.

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