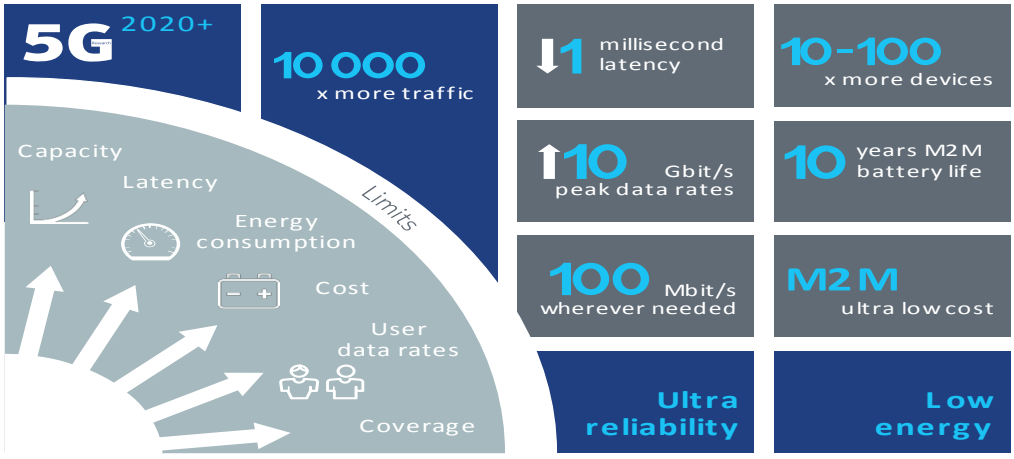
5th generation (5G) of communication networks a key enabler of the Internet of Things (IoT)

Background

The United States has been an early adopter in each generation of wireless technology including the current generation called 4G, or Long-Term Evolution (LTE). This has been a major driver of innovation and employment. The advancement of wireless networks in 4G has enabled a similar 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. 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.

What is at stake for the United States?

- **Jobs & growth:** 5G is a key technology for many growing U.S. 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.
- **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 10 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 towards truly reliable communication. Flexible integration of existing access technologies such as LTE and Wi-Fi with new technologies creates a design that is future proof at least until 2030.

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 even 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 all of these factors together, 5G could bring Internet access to a larger group of people and things.

Technology Challenges and Policy Enablers

The research that must be undertaken by mobile broadband equipment companies like Nokia in order to bring 5G into reality is substantial. Multiple generations of technology already deployed must work seamlessly together under the 5G umbrella that 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. Current proposals in Congress for "patent reform" are allegedly focused on abusive patent trolls not engaged in true innovation, however, *the proposals do not limit the litigation reform provisions to trolls*. These provisions make it more time consuming and expensive for real innovators to pursue legitimate infringement claims by imposing additional filing requirements, building in delay, and providing tools for infringers to avoid liability for the unlicensed use of others' technology. 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.

Similarly, efforts to limit the rights of companies that hold standards-essential patents (SEPs) to obtain compensation for the use of these technologies diminish incentives for innovators to contribute time and technology to the development of important technical standards that underlie the development and deployment of mobile broadband infrastructure.

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. This means looking at new spectrum bands such as millimeter wave and centimeter wave, and using available spectrum efficiently. Nokia supports U.S. efforts to establish a pipeline of spectrum for auction to wireless operators and timely action on making bands above 3 GHz available including through sharing arrangements with federal agency users where appropriate.

Net Neutrality regulation: Nokia supports an open Internet and provisions that prevent blocking of apps, devices, or content. It is imperative, however, that in adopting protections to ensure an open Internet, regulators 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 services drain value creation from the mobile broadband ecosystem and will impair the development schedule for 5G.

Density: 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.

Performance: In 5G the best possible network performance will not be just about peak speed. There will be a wide range of performance measures to meet individual requirements imposed by each use case. Some real-time applications, such as driverless cars, will require virtually zero latency, while others, such as 3D video capture, will be more tolerant to latency but will require high capacity upload instead.

Recommendations for U.S. policy makers

- Allocate more low band spectrum quickly for wireless operator use, and put a plan in place for spectrum for mobile broadband between 3.5 and 100 GHz that includes clearing and reallocating bands where appropriate and sharing frameworks in bands where reallocation is costly or impractical.
- Do not allow technology aggregators to utilize the abuses of trolls to weaken the IP rights of legitimate innovators. Limit litigation reform efforts to the actual problem: patent trolls.
- Any overhaul of telecommunications legislation should have the goal of increasing investment and reducing regulatory barriers to innovation. Clear, stable, and predictable rules of conduct backed by enforcement are preferable to ongoing rulemakings that regularly change the regulatory environment.

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