SiqueiraCastro*

5G – S. Korea

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Sumário das Matérias:

Micro-ondas e a onda milimétrica para o transporte 5G

A evolução do 4G para o 5G traz novos desafios para todas as tecnologias de transporte: e as redes sem fio não são exceção. Atualmente, as plataformas MW e mmW são capazes de atender às exigências do 5G, tanto para o transporte quanto para a rede (ponta a ponta).

Renato Lombardi, presidente do ISG mWT Grupo de Especificação Industrial sobre Transmissão de Ondas Milimétricas do ETSI. Este artigo foi preparado com contribuições de toda a equipe do ISG mWT

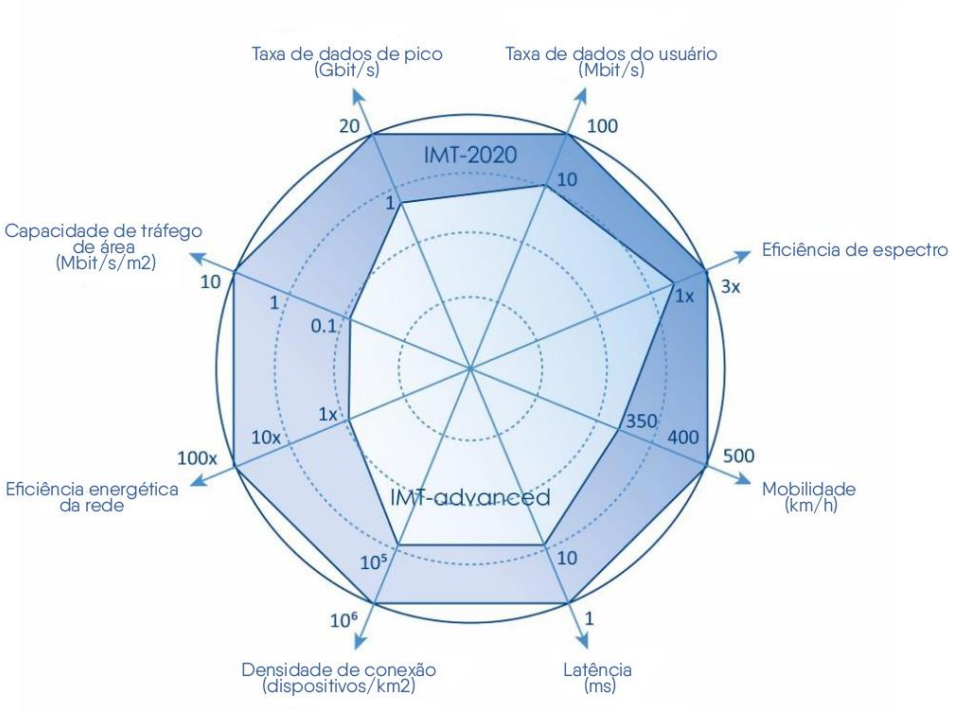
Há mais de 20 anos, a micro-ondas é a principal solução para a implantação rápida e econômica da infraestrutura de backhaul móvel, com mais de 50% dos sites móveis em todo o mundo conectados por meio de links de rádio de micro-ondas (MW) ou ondas milimétricas (mmW), chegando a 90% em algumas redes. Agora, a evolução do 4G para o 5G traz novos desafios para todas as tecnologias de transporte: e as redes sem fio não são exceção. Atualmente, as plataformas MW e mmW são capazes de atender às exigências do 5G, tanto para o transporte quanto para a rede (ponta a ponta).

Uma visão geral das exigências do 5G

Para começar, é preciso conhecer as várias fontes que servem para descrever e analisar os serviços e os requisitos que definem uma rede 5G, incluindo, principalmente, a ITU-R [Recomendação ITU-R M.2083-0], conforme as figuras abaixo.

A qualidade do serviço pode ser afetada por demandas em diferentes setores, como na capacidade de transporte (throughput); planejamento de rede (tráfego por área), que se traduz em densidade do site (e densidade de link MW/mmW); e na própria rede (latência, fatias da rede e agilidade – SDN etc.).

Já entre as áreas que não afetam diretamente o transporte MW/mmW estão o número de dispositivos conectados, mobilidade etc.



Definições da ITU para serviços 5G

Requisitos de capacidade para o transporte móvel 5G

Para determinar os requisitos de transporte em toda a rede é necessário iniciar pelas exigências de capacidade dos macro-sites típicos e depois combinar essas informações com a topologia de rede, para obter as demandas de transporte dos links MW/mmW em diferentes segmentos da rede, como tail links e links de agregação.

A evolução das tecnologias mmW e a disponibilidade de novos espectros permitirão o suporte a aplicativos front-haul, com capacidades que variam de 10 a 100 Gbps.

Características de transporte de micro-ondas e mmW

A engenharia de um link MW ou mmW envolve encontrar a combinação ideal entre comprimento de link, capacidade, banda de frequência e disponibilidade.

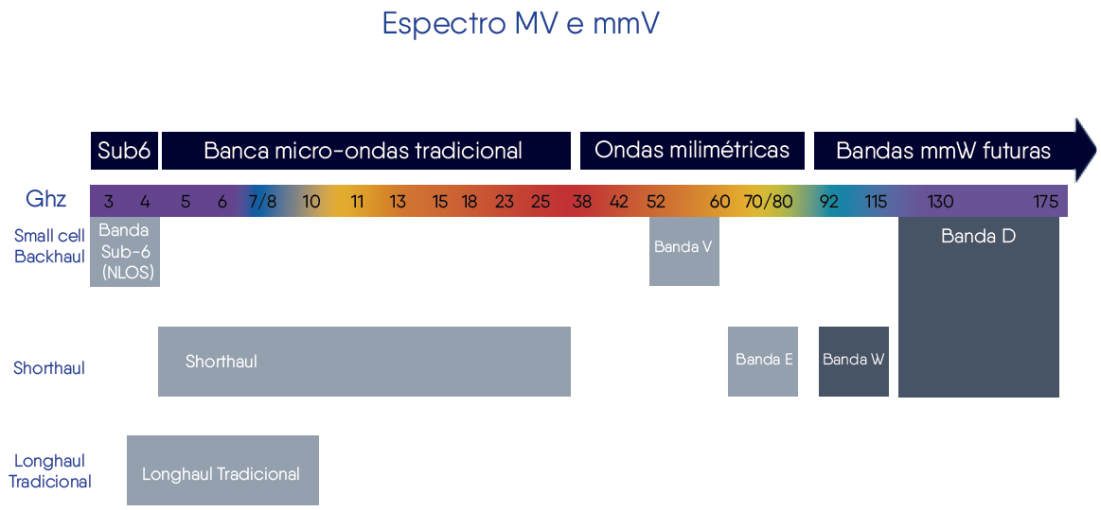
Visão geral do espectro MW e mmW

Ao longo de várias décadas, o aumento da capacidade de transporte e a maior densidade de locais promoveram o uso de bandas de frequência cada vez mais altas, como mostra a figura abaixo.

A física da propagação de ondas de rádio determina a relação entre capacidade, disponibilidade e comprimento de link. Como o espectro disponível é proporcional à frequência central, as frequências mais altas são também aquelas de maior capacidade, mas também cobrem os comprimentos de link comparativamente mais curtos.

Como regra geral, as frequências de 13 GHz não são afetadas pela intensidade das chuvas, já as frequências acima de 13 GHz são cada vez mais enfraquecidas por causa da chuva. Dessa forma, como princípio geral as frequências mais altas são usadas para links mais curtos.

A combinação de diferentes bandas de frequência no mesmo link de rádio, BCA- Multi-band aggregation, permite combinar o melhor dos dois mundos em termos de capacidade, disponibilidade e comprimento de link.



Topologia de rede de transporte MW e mmW

O alcance da fibra até a borda da rede e o aumento da densidade de sites têm dois efeitos principais:

• Encurtamento em cascata das cadeias de links de rádio, aproximando o limite de um link de rádio ao limite da fibra.

• Aumento do número de links originados em uma topologia na forma estrela a partir de um hub site.

A topologia em árvore tipicamente MW/mmW significa que é preciso distinguir entre tail links, conectando apenas um site móvel terminal e links de agregação, que transportam o tráfego de diferentes sites terminais.

Uma topologia em malha também pode ser usada. Nesse caso, os links de rádio são a maneira mais rápida e eficiente para garantir a conexão secundária, cobrindo os requisitos relacionados ao fatiamento de rede, tanto por caminho quanto por serviço e fazendo a proteção de link, com diferenciação das mídias no caminho mais curto/mais rápido entre os sites adjacentes. Em geral, essas considerações definem diferentes segmentos de rede.

• Cenários de alta e média densidade urbana: onde antes a rede se baseava em uma topologia hub-and-spoke, há um forte aumento nos pontos de presença de fibra (PoP), a partir dos quais se origina uma topologia do tipo estrela com links de ponta de alta capacidade; o nível de espalhamento de tais hubs tende a ser alto. A profundidade da rede MW/mmW tende a ser de 1 … 1,5 saltos da fibra PoP.

• Cenários de baixa densidade urbana: a tendência é a mesma, mas aqui a profundidade da rede MW/mmW está indo para uma média de 1,5 … 2 saltos da fibra PoP.

• Cenários de áreas rurais: aqui a variação será maior devido às condições geográficas amplamente diferentes. Espera-se que a profundidade média da rede deva estender para 2,5 saltos da fibra PoP.

• Cenários mistos: em alguns lugares, pode acontecer que um pequeno aglomerado de áreas urbanas ou suburbanas esteja situado a certa distância da fibra PoP, de modo que o comprimento do link MW/mmW para o link de agregação em direção ao PoP não esteja diretamente relacionado o raio de alcance da célula.

Disponibilidade de espectro MW e mmW

A disponibilidade do espectro MW/mmW depende de fatores tecnológicos e regulatórios. Já existe tecnologia disponível e em desenvolvimento para fazer uso total do espectro existente (6-86 GHz) e futuro (90-300 GHz): a E-Band (80 GHz) foi explorada comercialmente por vários anos. Já há testes implementados há mais de um ano, com a W-Band (100 GHz) e a D-Band (150 GHz), que são as bandas mais promissoras.

Há também canais mais amplos (112MHz, até 224MHz, onde for possível) em frequência tradicionais e com disponibilidade bruta de espectro (10GHz em E-Band, 18GHz em W-Band e 30GHz em D-Band), que fornecem os principais recursos para expandir a capacidade de MW e mmW em sistemas de rádio.

Além dos fatores tecnológicos, a regulamentação e o licenciamento do espectro, que são diferentes de país para país, são pontos chave:

• Bandas de MW/mmW não estão disponíveis para os operadores em qualquer lugar, incluindo aqueles que são considerados “tradicionais” na maior parte do mundo (especialmente acima de 23 GHz).

• Frequência mais baixas foram regulamentadas há muitas décadas com base na capacidade de transmissão e disponibilidade criadas na época do TDM, antes que recursos como modulação adaptativa estivessem disponíveis. Em alguns casos, isso dificulta estabelecer a regulamentação, o planejamento e o preço da rede de backhaul de MW/mmW.

• Técnicas como XPIC (cancelamento de interferência polar-cruzada) e linha de visão MIMO, que abordam a eficiência do espectro de links, devem ser mais atraentes do ponto de vista de licença de uso.

• Antenas de diretividade mais altas e novas técnicas de cancelamento de interferências ativas devem ser encorajadas, com esquemas de licenciamento que incentivem a eficiência do espectro geográfico para um maior grau de reúso do canal.

Requisitos de rede 5G

Um dos requisitos mais importantes para a rede de próxima geração é gerar novas receitas e reduzir o TCO. Entre os meios para alcançar esse objetivo estão:

• Ativar e implantar novos tipos de serviços (mMTC, uRLLC), além dos tradicionais serviços de voz e eMBB, em uma rede de transmissão comum.

• Implantar e gerenciar esses serviços (e novos ainda não previstos) com maior rapidez do que hoje.

• Automatizar o maior número possível de processos (configuração, solução de problemas, otimização multicamadas, resiliência, etc.).

Os aspectos da tecnologia MW/mmW impactados pelos requisitos acima podem ser resumidos da seguinte forma:

• Latência de transmissão ultra-baixa, determinística (algumas dezenas de µs) e com jitter. Isso afeta principalmente o design das interfaces de dados, o processamento de pacotes e o modem de rádio, além do design da interface aérea.

• Precisão ultra-alta em toda a largura de rede, com pacotes baseados em tempo e fase de sincronização.

• Suporte para SDN e pacotes para redes avançadas (L2 / L3, L3 VPN, roteamento de segmentos, etc.).

• Suporte para múltiplas interfaces 10G e capacidades nodais adequados ao aumento da densidade de rede.

Todos os requisitos de rede são endereçados em MW/mmW, com aproveitamento do que é desenvolvido para todos os demais segmentos de rede.

A tecnologia MW/mmW é capaz de cumprir o desafio de capacidade e distância de 5G em todos os cenários. Mesmo que a extensão de fibra seja ampliada, uma parcela muito significativa de sites de acesso móvel e fixo ainda exigirá uma conexão de MW/mmW à infraestrutura de fibra.

Para tanto, a indústria de MW/mmW está desenvolvendo a solução em vários modelos.

Recursos de espectro

• A expansão para novas bandas: E, W, D oferecem, no total, cerca de 50 GHz novos não utilizados.

• Aumento da eficiência do espectro: com MIMO, modulações mais altas e cancelamento de interferência.

• Trabalho cooperativo entre entidades tradicionais e todas as partes interessadas para promover novidades, eficiência e efetiva regulação para licenciamento.

Tecnologia de transmissão

• Solução para atrasos na transmissão ultra-baixa, determinística e segura.

• Novas tecnologias de encaminhamento de pacotes.

• Precisão ultra-alta para pacotes baseados em sincronização de tempo e fase.

Agilidade operacional e eficiência

• Desenvolvimento e implantação de SDN em toda a rede.

• Suporte para protocolos de transmissão de pacotes atuais e futuros.

Atividades ETSI ISG mWT na indústria de MW e mmW

O ISG mWT – Grupo de Especificação Industrial sobre Transmissão de Onda Milimétrica foi criado em janeiro de 2015, dentro do ETSI – European Telecommunications Standards Institute. Essa equipe tem a tarefa de disponibilizar uma plataforma e oferecer oportunidades para que as empresas e organizações envolvidas na indústria de transmissão de micro-ondas e milimétricas micro-ondas possam trocar informações técnicas e preparar artigos científicos, com o objetivo de aumentar o nível de confiança dos operadores em todo o mundo no uso dessas tecnologias.

Este artigo é um dos muitos resultados técnicos produzidos pelo ISG mWT sobre os diferentes aspectos da tecnologia, aplicações, gerenciamento do espectro, regulamentação e licenciamento, que podem ser encontrados no site dedicado do ETSI.

print

https://infranewstelecom.com.br/micro-ondas-e-onda-milimetrica-transporte-5g/

The 5G network – From technical requirements to legal challenges

08 April 2019 | blog

1. The 5G network for Europe

In September 2016, the European Commission invited[1] the Member States to develop national 5G strategies as part of their broadband plans. The Austrian Federal Government has set itself the goal of implementing the 5G strategy in three ambitious phases:

Phase 1: By mid-2018, preliminary commercial 5G tests were to be implemented.

Phase 2: By the end of 2020, the Federal Government set its interim goal of achieving almost nationwide availability of ultrafast broadband connections.

Phase 3: By the end of 2023, 5G services will be available on the main traffic connections, and by the end of 2025, the goal of almost nationwide availability of 5G will be achieved.

At the beginning of March 2019, the competent supervisory authority (RTR) conducted the procurement procedure for the 5G "pioneer band" auction. The three major Austrian mobile operators (A1, T-Mobile and Drei) acquired licences for the frequencies in all 12 regions put to tender. Based on these frequencies, one of the companies has already commissioned the first 5G mobile stations in some selected Austrian regions.

2. But what exactly does 5G mean?

5G stands for the fifth generation of mobile communication standards. With the first generation we were able to talk to each other; the second generation (which was considered a big breakthrough), allowed us to send text messages. This was approximately in 1992. 3G in the early 2000s was a game changer which gave us broad data and allowed us to use the internet. We are currently surfing and telephoning on a 4G network, also known as Long Term Evolution (LTE), which is basically a faster version of 3G. However, with 4G we are still managing content (e.g. e-mails, news, blogs, etc.). With the next generation 5G we will also be managing objects (e.g. self-driving cars, IoT devices, smart homes). The new 5G technology transmits data significantly faster and offers remarkably shorter response times than previous mobile communication standards. The fields of application include industry 4.0 and automated driving, among others.

3. Technical requirements for the implementation of 5G

5G technology uses a mix of frequencies combined with shorter wavelengths (millimetres instead of centimetres, as used in 4G networks). The problem with shorter waves and higher frequencies is that the range is not as far. Thus, the technical implementation for the rollout of the 5G network requires a drastic increase in the number of transmitters. In addition, fibre optic expansion is important, because in the absence of a connection between the mobile radio stations and the fibre optic network, the many benefits of the new technology cannot be fully exploited.

The advantage of 5G will be a high-quality band capable of transmitting more data in less time. 5G will increase the (theoretical) data rate from 1 Gbit/s to 20 Gbit/s. In theory, latency (i.e. the time interval between cause and effect, or the delay between sending and receiving information) will decrease from approximately 50 – 100 milliseconds to one millisecond. This almost real-time communication is key to enabling smart cities, smart workspaces or smart homes. It is also crucial for autonomous driving, where cars communicate not just with each other, but also with sensor traffic lights or drones. The short latency will also increase the number of "smart factories", since it enables better coverage of IoT[2]-based technology (e.g. all machines from a factory connected to the network can align their processes).

4. How to improve frequency efficiency

The current 4G network mainly uses special frequency bandwidth (800, 1800 and 2600 MHz). Since frequency bandwidth is limited and must be shared with other technologies (such as terrestrial television DVBT-2), frequency optimising methods are essential. Fifth generation technology will offer very high bandwidth and various new advanced features, making it more powerful than 4G. To achieve the 5G standard, a bundle of improved technology was necessary, introducing methods for a better and more efficient use of frequencies. For example, the "Information Centre Mobile Radio" controlled by Telekom Deutschland and Telefónica Germany provides an excellent overview[3] of the following methods for optimising the use of frequencies:

4.1. Carrier aggregation

From a technical standpoint, ultra-high bandwidth can be achieved by so-called carrier aggregation. The bundling of the radio frequency ranges used by a network operator (channels in a frequency block) allows the data rate per user to be increased. Several individual carriers, i.e. frequency blocks, are assigned to one user. The maximum data rate per user is increased by the number of frequency blocks. The total data rate per cell is also increased by improved utilisation of the frequencies available to an operator. The disadvantage is that the high capacity is accompanied by a low range, since frequencies with a lower range are also used for bundling. Overall, these frequency bundling concepts are already implemented in 4G and will be further developed in 5G.

4.2. Small cells

Small cells are already being used today, especially in places with high user density. For example, small cells can eliminate bottlenecks in the existing network in pedestrian zones or in highly frequented squares. Small cells do not replace the classic mobile radio rooftop locations but complement them and intensify the network at locations with particularly high demand (so-called hotspots). More cells in a small area also indicate that the capacity, i.e. the number of possible simultaneous users with simultaneously high data rates, is significantly increased. Small cells are thus suitable for very high capacity requirements in small areas (city centres, event venues, fairgrounds, stadiums, etc). A small cell is a mobile radio cell with low transmission power and thus a resulting small coverage area, similar to a WIFI hotspot, but with integration in the general mobile radio network. The coverage radius is about 150 metres. Since these are installed very close to the users, a corresponding number of cells must be installed for an uninterrupted supply in an area such as a pedestrian zone. The antennas used are significantly smaller than conventional mobile radio antennas. They can be mounted on house walls, advertising pillars or public telephone systems. In the future, such cells may also be installed in lines along traffic routes, for example in street lamps.

4.3. Massive multiple input multiple output (MIMO)

Larger multi-antenna systems are used to increase capacity. Multi-antenna systems enable the use of multiple transmit and receive antennas for wireless communication. A special coding method uses both the temporal and the spatial dimension for information transmission (space-time coding). In this way, the quality and data rate can be significantly improved, while still using the same number of frequencies.

4.4. Beamforming

Beamforming means that the antenna direction is changed so that a maximum signal arrives at the desired location (end device). By bundling the radio waves, the signal is precisely aligned in the direction of the customer or the device instead of the usual circular propagation of the radio signals. During beamforming, the main transmission direction is aligned spatially so that each terminal device is addressed with the signal assigned to it.

4.5. Network slicing

Network slicing allows the distribution of a network for different purposes at the level of the entire network. A network operator can therefore provide certain quality features for a customer category; for example, with an assured data capacity or a certain reaction time (latency).

5. Legal aspects of G

Naturally, with new technology comes a need to re-examine the law, which will need to be adapted to the constantly changing world. A much-discussed example is the issue of liability when 5G networks allow self-driving cars to communicate with each other and their surroundings. Ethical regulation for algorithms is already discussed on an EU level. Nevertheless, the legal challenges should be addressed one at a time, beginning with the current frequency auctions, forming joint ventures to bundle know-how or installing the network, where property rights and ownership issues will need to be hurdled. There will also be greater complexity in cybersecurity, with 5G being broadly used for IoT services. Lastly, in-depth and cross-border knowledge of data protection and telecommunications regulations will help pave the way.

Authors: Nicolaus Neumann & Veronika Wolfbauer

Useful Links for "deep dives":

European Commission, 5G for Europe: An Action Plan (2016):

https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52016DC0588&from=EN

Federal Ministry Republic of Austria Digital and Economic Affairs, 5G Strategy: Austria's way to become a 5G pioneer in Europe (2018):

https://www.bmvit.gv.at/en/service/publications/downloads/5Gstrategy.pdf

Futurezone, 4G, 5G und LTE: Das sind die Unterschiede (2018):

https://www.futurezone.de/digital-life/article213993981/Die-Unterschiede-zwischen-4G-5G-und-LTE-im-Ueberblick.html

Informationszentrum Mobilfunk (managed by Telekom Deutschland and Telefónica Germany), Wissenswertes zu 5G:

http://www.informationszentrum-mobilfunk.de/technik/funktionsweise/5g

The European Commission's High-level expert group on Artificial Intelligence, Draft Ethics Guidelines for Trustworthy AI (Dec. 2018):

https://ec.europa.eu/futurium/en/system/files/ged/ai_hleg_draft_ethics_guidelines_18_december.pdf

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Footnotes:

(1) "5G for Europe: An Action Plan", link copied below.

(2) Internet of Things.

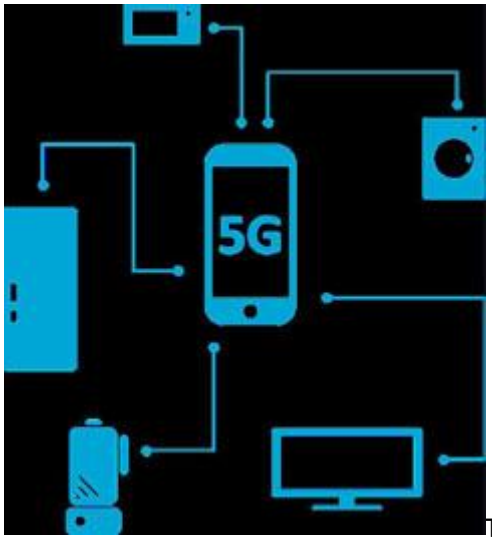
(3) http://www.informationszentrum-mobilfunk.de/technik/funktionsweise/5g.

https://www.schoenherr.eu/publications/publication-detail/the-5g-network-from-technical-requirements-to-legal-challenges/

Mobile 5G and Small Cell 2019 Legislation

Heather Morton7/17/2019

Mobile fifth-generation (5G) wireless systems are the next upgrade of wireless technology, offering faster speeds, greater capacity and better reliability.



To deploy this technology, new infrastructure, called small cells, must be used. Small cells generate less power, collect and transmit signals in a short range from one another and require collocating the cells on other infrastructure. Small cell wireless facility deployment requires streamlined federal, state and local permitting, rights of way, application timelines and other siting and application fees, and application review timelines and appeals processes to make it economically feasible for wireless companies to deploy the technology across communities.

Prior to 2019, 21 state legislatures—Arizona, Colorado, Delaware, Florida, Hawaii, Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, New Mexico, North Carolina, Ohio, Oklahoma, Rhode Island, Tennessee, Texas, Utah and Virginia—have enacted small cell legislation that streamlines regulations to facilitate the deployment of 5G small cells.

These laws take into consideration the unique circumstances of their state and local environment, but baseline principles can be established and are consistent with wireless industry standards, including:

- Streamlined applications to access public rights of way.
- Caps on costs and fees.
- Streamlined timelines for the consideration and processing of cell siting applications.

Twenty-three states have introduced mobile 5G and small cell-related legislation in the 2019 legislative session. Alabama, Arkansas, Connecticut, Florida, Georgia, Kansas, Louisiana, Maine,

Nebraska, North Carolina, West Virginia and Wisconsin enacted legislation or adopted resolutions in 2019.

The box allows you to conduct a full text search or type the state name.

State	Bill Number	Bill Summary
Alabama	SB 264	Authorizes the installation and deployment of small wireless facilities and poles on public rights of way; establishes a permitting process; provides exemptions; provides indemnification, insurance, and bonding requirements.
Alabama	SJR 32 *Signed by governor 6/4/19, Act 353*	Establishes an advanced small wireless facilities deployment task force.
Alaska	None	
Arizona	None	
Arkansas	HB 1874 *Signed by governor 4/8/19, Act 797*	Establishes the Small Wireless Facility Deployment Act in order to develop strong wireless and broadband communications networks through the state.
Arkansas	SB 602 *Signed by governor 4/15/19, Act 999*	Establishes the Small Wireless Facility Deployment Act.
California	None	
Colorado	None	
Connecticut	HB 6424 *Failed Joint Favorable deadline 3/21/19*	Requires the Public Utilities Regulatory Authority to develop standards for the process for attaching equipment to utility poles for owners of utility poles and people who occupy and use utility poles.
Connecticut	HB 7152 *Signed by governor 7/9/19, Public Act 19-163*	This bill establishes a Council on 5G Technology and tasks it with (1) reviewing wireless carriers' requests to place personal wireless service facilities and small wireless facilities, as defined in federal law, on state-owned real property and (2) determining which state-owned properties may be made

State	Bill Number	Bill Summary
		available to the wireless carriers for these facilities. Among other things, the bill requires the council to (1) adopt guidelines for safely placing personal wireless service facilities and protecting open space land and (2) perform due diligence and review comments from any entities that own property within a 500-foot radius of any state-owned real property under the council's review. The bill requires the Office of Policy and Management (OPM) to jointly develop, with certain other state agencies, licensing agreements, forms, and fee structures for placing the wireless facilities on state-owned property. The bill also specifies that it does not supersede existing rules and requirements requiring the review and approval of permits for proposed personal wireless service facilities under the Public Utilities Regulatory Authority's (PURA) and the Connecticut Siting Council's jurisdiction. Lastly, the bill requires OPM, in consultation with PURA and the Siting Council, to work with municipalities to establish a process for siting small wireless facilities on municipal property and, when using utility or light poles is insufficient, private property with the property owner's permission.
Delaware	None	
District of Columbia	None	
Florida	HB 693 *Laid on table 5/1/19*	Revises provisions related to registrations and renewals of communications service providers; specifies limitations on municipal and county authority to regulate and manage municipal and county roads or rights-of-way; prohibits certain municipalities and counties from electing to impose permit fees; prohibits municipalities and counties from actions relating to aerial or underground communications facilities; adds prohibited acts by authorities relating to small wireless facilities; prohibits authorities from actions relating to registrations, applications, permits, and approvals in small wireless facilities; authorizes civil action for violations.

State	Bill Number	Bill Summary
Florida	SB 1000 *Signed by governor 6/25/19, Chapter 131*	Relates to communications services taxes; reduces the communications services tax rate levied on sales of communications services; revises the authority for municipalities and counties to impose permit fees on providers of communications services that use or occupy municipal or county roads or rights-of-way; deletes the procedures, requirements, and limitations with respect to such fees; conforms provisions to changes made by the act; provides applicability.
Georgia	HB 184 *Passed House 2/14/19*	Enacts the Streamlining Wireless Facilities and Antennas Act; streamlines the deployment of wireless broadband in the public rights of way; addresses any perceived conflicts between this act and Chapter 66B of Title 36; provides that nothing in this act relieves any person of any duties provided for in Chapter 9 of Title 25.
Georgia	HB 556	Amends Title 46 of the Official Code of Georgia Annotated, relating to public utilities and public transportation, so as to provide limitations on fees that may be charged for installation of telephone facilities; to provide for the due compensation to be paid to municipal authorities by telephone companies; to revise terminology for purposes of conformity.
Georgia	SB 66 *Signed by governor 4/26/19, Act 53*	Enacts the Streamlining Wireless Facilities and Antennas Act; streamlines the deployment of wireless broadband in the public rights of way; addresses any perceived conflicts between this act and Chapter 66B of Title 36; provides that nothing in this act relieves any person of any duties provided for in Chapter 9 of Title 25.
Guam	Not available	
Hawaii	HCR 197 HR 178	Requests a study that summarizes the published reports and studies on the effects of 5G wireless technology on biological life.
Idaho	None	

State	Bill Number	Bill Summary
Illinois	None	
Indiana	None	
Iowa	None	
Kansas	SB 68 *Signed by governor 4/11/19, Chapter 32*	Amends law relating to valid contract franchise ordinances and their application to wireless service providers and wireless infrastructure providers. The bill allows a city to govern wireless services providers' or wireless infrastructure providers' use of the public right-of-way by requiring a small cell facility deployment agreement or a master license agreement, or through permitting requirements, municipal ordinances or codes, or any combination of such mechanisms in a manner consistent with federal and state law. The bill allows a city to assess a wireless services provider or a wireless infrastructure provider a fixed right-of-way access fee for each small cell facility a provider deploys that requires the use of the city's right-of-way. The fee cannot be based on such a provider's gross receipts derived from services provided within a city's corporate limits. The bill specifies the above provisions apply only to a wireless infrastructure provider in its deployment of small cell facilities in a city's right-of-way, used for the provision of wireless services. The bill further clarifies nothing is construed to apply to such a provider's other operations and services as a utility or have any effect on any franchise related to other operations and services.
Kentucky	None	
Louisiana	HR 145 *Adopted 5/29/19*	Requests the Department of Environmental Quality in conjunction with the Louisiana Department of Health to study the effects of evolving 5G technology.
Maine	LD 1517 *Signed by governor 6/6/19, Chapter 223*	This bill provides that a small wireless facility must be a permitted use within the public right-of-way, subject to any duly adopted, nondiscriminatory conditions otherwise applicable to permitted uses

State	Bill Number	Bill Summary
		within the municipality and consistent with state and federal law, including, without limitation, any permitting requirements in the Maine Revised Statutes, Title 35-A, chapter 25.
Maryland	HB 654 SB 937	Establishes procedures and requirements for the deployment, installation and regulation of certain wireless telecommunications facilities in the state; prohibits an authority from entering into an exclusive agreement for the use of certain rights of way for certain purposes; authorizes an authority to impose certain rates and fees for use of certain rights of way in a certain manner and subject to certain limitations; authorizes a wireless provider to collocate certain facilities and use certain rights of way; etc.
Massachusetts	HB 383	Requests formation of a task force (including members of the General Court) relative to the economic and regulatory impacts of fifth generation (5G) cellular mobile communications.
Massachusetts	HB 2885	Establishes a special commission to study the environmental and health effects of evolving 5G technology.
Massachusetts	HB 1272	Registers wireless facilities to allow for monitoring and to ease access to contact information.
Massachusetts	HB 1273	Bans especially dangerous wireless facilities, emissions, and products.
Michigan	None	
Minnesota	None	
Mississippi	SB 2003 *Died in committee 2/5/19*	Creates the Wireless Facilities Deployment Act to allow a wireless provider to deploy a small wireless facility and any associated utility pole within a right of way under certain conditions; defines certain terms used in the act; provides for the scope of the act; provides that the act only applies to a wireless provider deploying, within a right of way, a small

State	Bill Number	Bill Summary
		wireless facility or a utility pole associated with a small wireless facility.
Missouri	None	
Montana	HB 496 *Missed deadline for general bill transmittal 3/2/19*	Revises telecommunications siting law; restricts the siting of small cell network equipment near schools.
Montana	HJR 13 *Passed House 2/25/19*	Urges Congress to amend the federal Telecommunications Act to account for health effects of siting small cell network equipment in residential areas.
Nebraska	LB 184 *Signed by governor 5/17/19*	Adopts the Small Wireless Facilities Deployment Act.
Nevada	None	
New Hampshire	HB 393 *Conference committee report adopted 6/27/19*	This bill: I. Establishes a committee to study child care costs, affordability, and accessibility in the state of New Hampshire. II. Increases the number of tuition waivers for persons who are or were in state foster care or under guardianship. III. Clarifies the penalties for violations related to obtaining public assistance. IV. Amends RSA 417-F:4, relative to reimbursement for emergency room boarding. V. Revises the membership of the commission to study the environmental and health effects of 5G technology established in HB 522. VI. Clarifies that the moratorium on health facilities licensure does not apply to certain continuing care facilities.
New Hampshire	HB 52 *Enrolled 6/27/19*	Establishes a commission to study the environmental and health effects of evolving 5G technology.
New Jersey	AB 4422 SB 3752	Enacts the Small Wireless Facilities Deployment Act; provides for uniform regulation of small wireless facility deployment in New Jersey.

State	Bill Number	Bill Summary
New Jersey	AB 4888	Clarifies that application to collocate wireless communications equipment be reviewed by administrative officer.
New Jersey	AB 5260	Requires the Office of Information Technology to conduct study on deployment and impact of fifth generation wireless telecommunications technology in state.
New Jersey	AB 5431	Establishes "5G Network and Development Task Force."
New Jersey	AB 5560 SB 3953	Provides for uniform regulation of small wireless facility deployment in this state.
New Jersey	AR 144	Urges federal government and telecommunications service providers to collaborate in the development of 5G wireless network.
New Mexico	None	
New York	AB 1459 SB 1949	Enacts the Wireless Broadband Eligible Facility Permitting Act to provide for uniform regulation of certain wireless facilities.
New York	AB 1503 *Passed Senate 6/19/19* SB 1607 *Substituted 6/19/19*	Requires the office of information technology services to study and evaluate the future implementation and possible impact of 5G technology in the state.
New York	AB 4066 SB 3046	Relates to notice requirements and municipal cooperation in wireless facility siting; requires notification be provided to municipalities in which wireless facilities are to be sited and to residents within2,500 feet of proposed wireless facilities.
New York	SB 6071	Relates to small wireless facility development.
North Carolina	HB 448 SB 442	Reorganizes, consolidates, modernizes, and clarifies statutes regarding local planning and development regulation, including micro and small wireless facilities.

State	Bill Number	Bill Summary
North Carolina	SB 355 *Signed by governor 7/11/19, Chapter 111*	Clarifies, consolidates, and reorganizes the land-use regulatory laws of the state, including micro and small wireless facilities.
North Dakota	None	
Northern Mariana Islands	Not available	
Ohio	None	
Oklahoma	None	
Oregon	HB 3375	Requires the Oregon Business Development Department to conduct a study on proposals and options for facilitating the deployment of small wireless facilities in this state. Requires the department to submit a report on the study to interim committees of the Legislative Assembly related to economic development no later than Sept. 15, 2021. Sunsets Jan. 2, 2022.
Pennsylvania	HB 1400	Provides for small wireless facilities deployment.
Puerto Rico	None	
Rhode Island	None	
South Carolina	HB 4262 *Passed House 4/4/19*	Adds article 5 to chapter 11, title 58 so as to enact the "South Carolina Small Wireless Facilities Deployment Act"; makes legislative findings; defines relevant terms; provides, among other things, that certain agreements or enactments pertaining to the deployment of small wireless facilities that do not comply with certain provisions of this act must be deemed invalid and unenforceable beginning Oct. 1, 2019; provides that certain units of local government "authorities" with control over rights of way may not prohibit, regulate, or charge for the collocation of certain small wireless facilities; provides that small wireless facilities must be classified as permitted uses and

State	Bill Number	Bill Summary
		not subject to zoning review and approval under specified circumstances; provides requirements for applications, fees, application review, and issuance of permits for collocation of small wireless facilities; requires authorities to allow the collocation of small wireless facilities on authority utility poles under specified circumstances; prohibits authorities from regulating the design, engineering, construction, installation, or operation of any small wireless facility in specified circumstances; provides that the administrative law court has jurisdiction to resolve all disputes arising under the act; and prohibits an authority from requiring a wireless provider to indemnify the authority or its officers or employees and from naming the authority as an additional insured on a wireless provider's insurance policy.
South Carolina	SB 638	Adds article 5 to chapter 11, title 58 so as to enact the "South Carolina Small Wireless Facilities Deployment Act"; makes legislative findings; defines relevant terms; provides, among other things, that units of state or local government "authorities" with control over rights of way may not prohibit, regulate, or charge for the collocation of certain small wireless facilities; provides that small wireless facilities must be classified as permitted uses and not subject to zoning review and approval under specified circumstances; provides requirements for applications, fees, application review, and issuance of permits for collocation of small wireless facilities; requires authorities to allow the collocation of small wireless facilities on authority utility poles under specified circumstances; prohibits authorities from regulating the design, engineering, construction, installation, or operation of any small wireless facility in specified circumstances; provides that the administrative law court has jurisdiction to resolve all disputes arising under the act; and prohibits an authority from requiring a wireless provider to indemnify the authority or its officers or employees and from naming the authority as an additional insured on a wireless provider's insurance policy.

State	Bill Number	Bill Summary
South Dakota	None	
Tennessee	None	
Texas	None	
Utah	None	
Vermont	None	
Virginia	None	
Virgin Islands	None	
Washington	None	
West Virginia	HB 2005 *Passed House 1/29/19*	Adds a new article, designated §11-6L-1, §11-6L-2, §11-6L-3, §11-6L-4, and §11-6L-5, adds three new sections, designated §31G-4-4, §31G-4-5, and §31G-4-6, 3, and adds thereto a new chapter, designated §31H-1-1, §31H-1-4 2, §31H-2-1, §31H-2-2, §31H-2-3, and §31H-2-4, all relating to wireless telecommunication technology facilities generally. Provides a special method for valuation of certain wireless technology property for property taxes; defines terms; provides mandated salvage valuation of certain wireless businesses' property; specifies method for valuation of certain property; requires initial determination and specifies procedure for protest and appeal of determination. Establishes Public Service Commission jurisdiction over make-ready pole access within the state; relates to the determination of the feasibility of electric utilities constructing and operating middle-mile broadband internet projects to serve certain unserved and underserved areas; defines certain terms; delineates the factors that must be contained in certain feasibility studiesl and requires the Broadband Enhancement Council and the Public Service Commission to assist electric utilities in the determination of the feasibility of certain proposed middle-mile broadband development projects. Requires that the Broadband Enhancement Council render a judgment as to the feasibility of middle-

State	Bill Number	Bill Summary
		mile broadband internet projects within a certain period of time; requires certain reports be submitted to certain officials and committees; and provides for severability. The establishment of the West Virginia Small Wireless Facilities Deployment Act; makes legislative findings; defines terms; provides for access to public rights of way for the collocation of small wireless facilities; provides for certain permit requirements; authorizes and limits access to collocation sites, structures and equipment; requires permits to be issued on a nondiscriminatory basis; provides for the collection of fees and sets the amount of fees; and provides for certain zoning, indemnification, insurance and bonding requirements.
West Virginia	SB 3 *Signed by governor 3/27/19, Act 42*	Provides a special method for valuation of certain wireless technology property for property taxes; defines terms; provides mandated salvage valuation of certain wireless businesses' property; specifies method for valuation of certain property; requires initial determination and specifies procedure for protest and appeal of determination; establishes and delineates Public Service Commission jurisdiction over make-ready pole access within the state; determines the feasibility of electric utilities constructing and operating middle-mile broadband internet projects to serve certain unserved and underserved areas; defines certain terms; delineates the factors that must be contained in certain feasibility studies; requires the Broadband Enhancement Council and the Public Service Commission to assist electric utilities in the determination of the feasibility of certain proposed middle-mile broadband development projects; requires that the Broadband Enhancement Council render a judgment as to the feasibility of middle-mile broadband internet projects within a certain period of time; requires certain reports be submitted to certain officials and committees; provides for severability; establishes the West Virginia Small Wireless Facilities Deployment Act; makes legislative findings; defines terms; provides for access to public rights-of-way for the collocation of small wireless facilities; provides for certain

State	Bill Number	Bill Summary
		permit requirements; authorizes and limits access to collocation sites, structures, and equipment; requires permits to be issued on a nondiscriminatory basis; provides for the collection of fees and setting the amount of fees; and provides for certain zoning, indemnification, insurance, and bonding requirements.
West Virginia	SR 19 *Adopted 1/23/19*	Designates Jan. 23, 2019, as West Virginia for Broadband Day at the Capitol.
Wisconsin	AB 234	This bill creates a regulatory framework for the state and political subdivisions (cities, villages, towns, and counties) for the following: 1) the deployment by wireless services and infrastructure providers (wireless providers) of wireless equipment and facilities, including the placement of such items in rights-of-way (ROW); 2) the permitting process for certain activities by wireless providers; 3) the regulation of access to certain governmental structures by wireless providers; and 4) the resolution of disputes. The bill also authorizes political subdivisions to impose setback requirements for certain mobile service support structures.
Wisconsin	SB 239 *Signed by governor 7/10/19, Act 14*	Limits the authority of the state and political subdivisions to regulate certain wireless facilities; authorizes political subdivisions to impose setback requirements for certain mobile service support structures.
Wyoming	None	

Mobile 5G and Small Cell 2019 Legislation

Heather Morton is a program principal in Fiscal Affairs. She covers financial services, alcohol production and sales and telecommunications issues for NCSL.

Additional Resources

- NCSL State Legislatures Magazine—It's 5G Time (Nov.-Dec. 2018)
- NCSL LegisBrief—5G: The Future of Wireless Technology (June 2018)
- Mobile 5G and Small Cell 2018 Legislation

http://www.legis.ga.gov/Legislation/en-US/display/20192020/SB/66

When Is 5G Coming to South Korea? (Updated for 2019)

5G launched in South Korea, but it's not available everywhere just yet

by **Tim Fisher**
Updated October 01, 2019

South Korean 5G networks have been available since late 2018, but like most 5G networks around the world, only select customers have access...for now.

The mobile network operators in the country began offering 5G services to customers in April 2019. Coverage started off limited but will expand throughout the year and into 2020 and beyond.

The South Korean government's Ministry of Science and ICT predicts that by 2020, 30 percent of the country's mobile users will have access to a 5G network, with 90 percent coverage by 2026.

Here's a quick primer on 5G if you're not familiar: Every decade or so, a new mobile networking technology standard is developed to improve upon the older one—4G in this case. 5G's speed is the primary advantage it has over 4G, which is what will allow 5G networks to change the way we live our everyday lives.

5G is currently working its way around the globe in countries like the United States, China, the UK, and others. You can follow along with the biggest 5G news releases to stay up to date with when it's coming to your area and how it will change things for the better.

South Korea 5G

There are three companies that agreed to bring 5G to South Korea: SK Telecom (SKT), KT, and LG Uplus. The official launch was on December 1 2018, but it brought 5G to only a few customers.

On April 3, South Korean 5G services went live for the general consumer. They could begin using 5G on April 5, 2019, with the launch of the country's first 5G phone, the Samsung Galaxy S10 5G.

5G Challenges: Why It Isn't Rolling Out Faster

SKT 5G access began as a service only for a manufacturing business in Ansan called Myunghwa Industry. In April, the company opened 5G services to other users, too, via various 5G plans, some with unlimited data and others with data caps. SKT's 5G plans range anywhere from $48 USD to $110 USD per month.

SK Telecom started its path to 5G in 2017 with an outdoor 5G trial in Seoul, and shortly after built out 5G technology in their autonomous driving city called K-City. In 2018, their 5G test network enabled two cars to communicate with each other, and in early 2019, they made their first live 5G TV broadcast. This 5G rollout marks the end of their 2G services.

SKT is also part of a 5G smart factory alliance with over a dozen other companies. Announced in late 2018, the alliance was formed for two reasons: to investigate how 5G can improve factory performance and to support the government's plan to build tens of thousands of smart factories by 2022.

South Korean 5G provider LG Uplus is live with its unlimited 5G network plans in Seoul and some other nearby locations, and is on their way to wider coverage, having erected over 7,000 5G base stations in 2018. LG Uplus plans to provide 5G infrastructure in major cities before 2020. Their first 5G customer was LS Mtron.

KT Corporation's 5G plans are called KT 5G Super Plans and come in three packages: Basic, Special, and Premium. KT's 5G plans come with unlimited 5G data with no speed caps and data roaming in over 180 countries.

KT first launched their 5G network at Lotte World Tower in Seoul, and aims to provide 5G coverage for over 80 cities before 2020. Before their 5G rollout, KT and Intel showcased 5G at the 2018 Olympic Winter Games. They've committed to a $20 billion investment through 2023 to research how to best utilize 5G.

https://www.lifewire.com/5g-south-korea-4583813

OpenSignal reports on 5G Speeds and 4G LTE Experience in South Korea & Other Countries

Posted on June 22, 2019 by Alan Weissberger

Introduction:

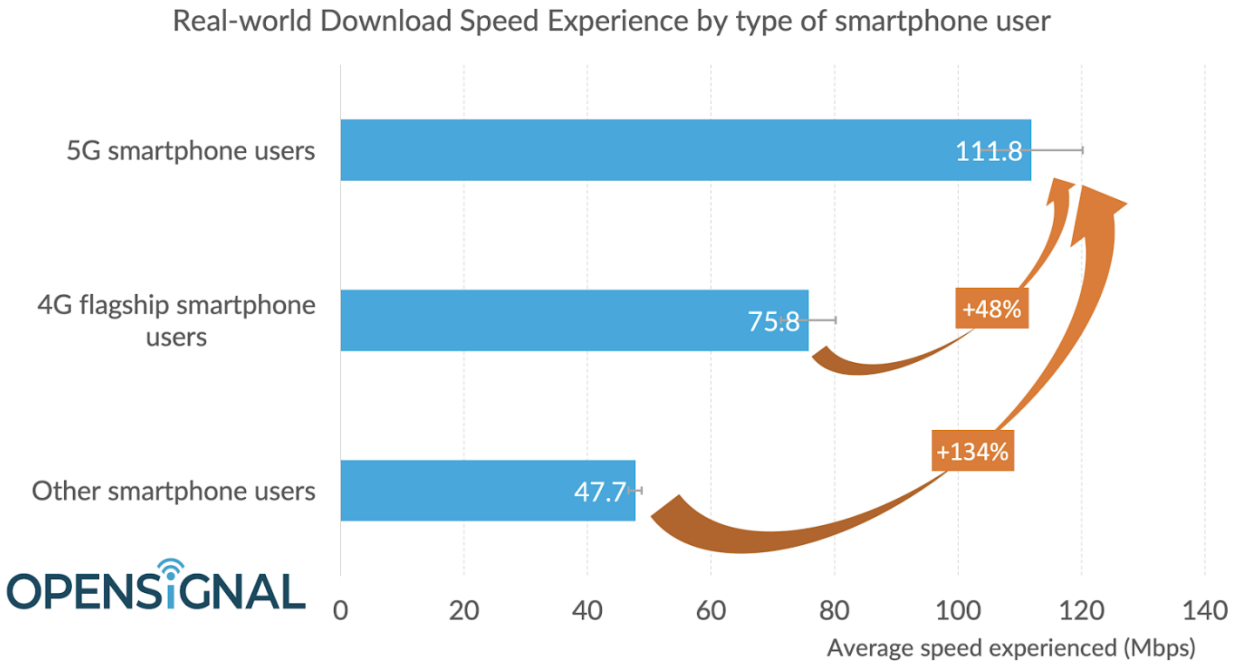
South Korea wireless telcos have all deployed pre-standard versions of "5G," based on 3GPP Release 15 NR NSA. That relies on a "LTE anchor" for signaling, mobile packet core, etc. Are those "5G" speeds significantly greater than 4G LTE Advanced Pro which AT&T claims is 5GE?

Opensignal has published what it says is the first "real analysis" of 5G download speeds as of June 20, 2019. Their latest report (June 2019) is on the performance of various 4G LTE wireless carriers and devices in **South Korea**.

5G Speeds in South Korea:

The market research firm reveals that the average 5G download speeds in South Korea (for the Samsung S10 5G and LG Electronics V50 ThinQ 5G) is 111.8 Mbps (see illustrations below), or 48% faster than comparable recent 4G smartphones, and 134% faster than other 4G LTE phones.

While those average 5G speeds outpace what 4G devices obtain, Opensignal's results show that those averages track well behind the maximum capabilities supported by 5G in South Korea. The vast majority of South Korean 5G smartphone users currently have either the Samsung S10 5G or LG V50 smart phone. Therefore, we compared these 5G users with owners of 4G flagship smartphone from those two brands released in 2018 and 2019, this includes: Samsung S9, S9+, Note 9, S10e, S10, S10+ and LG G7 range, V40, and G8.



Data collection period April 1 – June 12, 2019. Geography: South Korean cities where 5G has launched.

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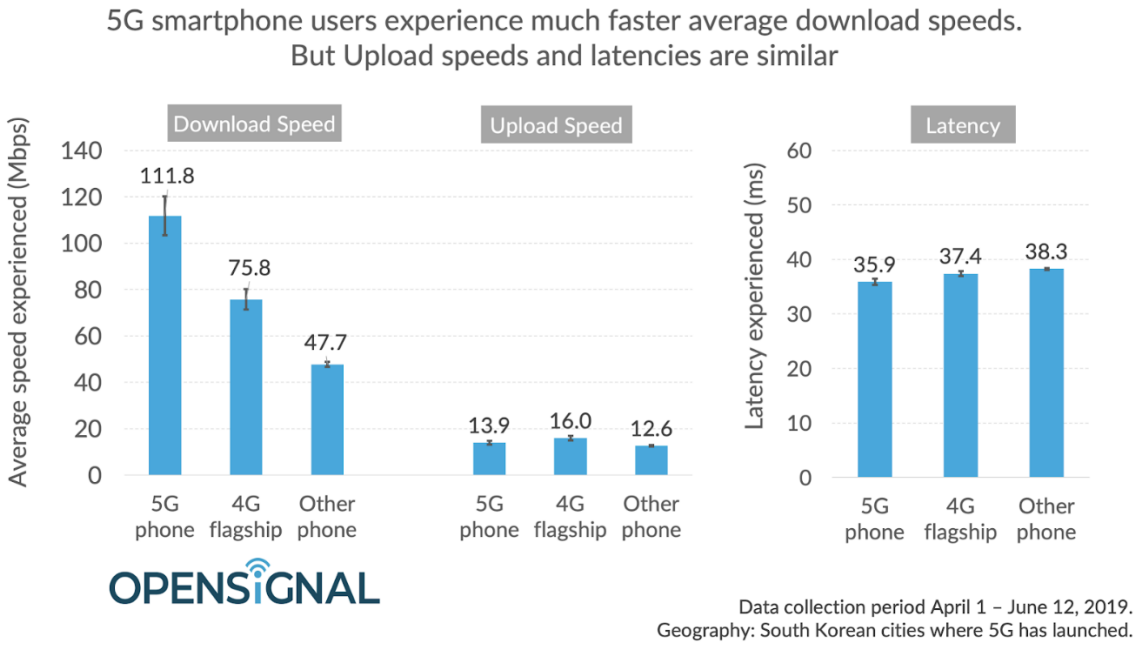
Opensignal lists **maximum 5G download speeds** of 1.2 Gbit/s in the U.S. and 988 Mbit/s in South Korea.

"While 1.2 Gbps is the maximum (download) speed experienced by **Opensignal** users in real-world conditions, Opensignal has seen speeds as high as 1.5 Gbps in the U.S. using our software but in test conditions that do not reflect the real-world experience."

Currently, 5G smartphone users connect to both a 4G spectrum band and a (3GPP Release 15) **5G New Radio (NR) band** simultaneously in what is called Non-Standalone Access (NSA) mode. Effectively, the system is using 5G for raw download bandwidth, but uses 4G for other network functions. When operators launch services based on Standalone Access, 5G smartphones will be able to connect exclusively to a 5G NR signal and latencies should decrease significantly, improving the experience for consumer applications such as online multiplayer games like Fortnite or PUBG, as well as internet-based voice communication like FaceTime, Tango, WhatsApp, KakaoTalk, LINE, etc. **Opensignal** expects the experience of 5G users to change during the course of 2019 as 5G's coverage improves and vendors resolve initial 5G problems.

While there is a significant increase in the average download speeds experienced by 5G smartphone users, both upload speeds and latency — a measure of the responsiveness of the network — are similar between 4G smartphone users and 5G smartphone users. This upload and latency finding is what Opensignal would expect at this early stage of the 5G era because initial 5G technology does not yet seek to improve either characteristic.



As vendors fix 5G teething issues and refine their solutions, peak and average 5G speeds will improve. And, while some 5G frequency bands are not available in particular countries yet – for example 3.5Ghz in the U.S., mmWave in Europe – they will be over the next few years and experience gained from other countries will help carriers improve these later 5G roll outs.

4G LTE Speeds in South Korea and other countries:

South Korea was the only country where smartphone users enjoyed **average mobile Download Speeds** over 50 Mbps, although Norway was close behind with 48.2 Mbps. Then there was a bit of a drop in speeds to the next two countries, Canada and the Netherlands, where OpenSignal measured Download Speed Experience at just over 42 Mbps. The remaining six of the top 10 markets scored in the 33-40 Mbps range. The global average score of the 87 countries analyzed was 17.6 Mbps — barely a third of the top score.

Canada's impressive third place is little surprise. Users experienced over 35 Mbps in Download Speed Experience, while speeds of over 60 Mbps weren't uncommon in the country's biggest cities.

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4G LTE Mobile Experience in South Korea:

OpenSignal said there was a wide variety of of their metrics in Download Speed Experience, with average speeds ranging from over 50 Mbps to less than 2 Mbps. There were 13 countries with Download Speed Experience scores over 30 Mbps, while 35 of the 87 markets measured fell into the 10-20 Mbps range, and 20 scored under 10 Mbps.

For **4G Availability, LG U+** achieved a near-perfect score. All three South Korean wireless operators were able to deliver a 4G signal to their users more than 95% of the time, putting them among the global elite in 4G reach. **LG U+** went further. Its 4G Availability score of 99.5% means that there was practically no instance where our users couldn't find a 4G connection during our data collection period.

South Korea rates highly in Video Experience. U+ and SK telecom both landed in the Very Good range (65-75 in our 100-point scale) in Video Experience, while **KT** was less than a point shy of achieving the same rating. That indicates that the consumer Video Experience in South Korea is commendable, exhibiting short load times and little stalling during playback. But South Korea's operators didn't score as highly in Video Experience as operators in many other countries, despite their superiority in most of our other metrics. Extremely fast speeds and ubiquitous 4G reach don't always translate into an Excellent consumer Video Experience.

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Conclusions:

Opensignal believes that these early results will improve and change as 5G matures. The firm notes that early 5G networks, like those in South Korea, use the non-standalone 5G spec (3GPP Release 15 NR NSA), which relies on the 5G data plane for downloads, but utilizes 4G LTE for control plane functions.

Opensignal says that average speeds will improve as standalone 5G is deployed and more 5G frequency bands are used.

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Verizon CTO Upbeat on 5G Millimeter Wave vs Lack of mid band spectrum?
GSA Silicon Summit: Focus on Edge Computing, AI/ML and Vehicle to Everything (V2X) Communications

- TECH

Verizon, South Korea Launch Smartphone 5G

Global carriers see being first in 5G as a way to flex their technical prowess, though few consumers are influenced by such distinctions when choosing a provider

Technicians working for South Korean telecom operator KT check an antenna for the 5G mobile network service in Seoul on Thursday. PHOTO: JUNG YEON-JE/AGENCE FRANCE-PRESSE/GETTY IMAGES

By
Timothy W. Martin,
Sarah Krouse *and*
Na-Young Kim
Updated April 3, 2019 10:36 pm ET

The 5G era for smartphones began on Wednesday, providing the world's first glimpses at what the much-hyped network technology can offer consumers and how much the speed upgrade will cost.

Verizon Communications Inc. launched 5G wireless service in parts of Chicago and Minneapolis on Wednesday, a week ahead of its planned start date, while carriers in South Korea deployed their service in the Seoul metropolitan area the same day.
It is unclear which country struck first. South Korea's large carriers, which had eyed a Friday start, hustled to switch on 5G services at 11 p.m. local time. Both SK Telecom Co. and KT Corp., the two largest operators, claimed to have the world's first 5G smartphone subscribers. Verizon said its customers in those two cities were the first.
Global carriers see being first in 5G as a way to flex their technical prowess, though few consumers are influenced by such distinctions when choosing a wireless provider.

South Korea's 5G launch, which covers about half the country's population, promises to facilitate online experiences that would exhaust the mobile networks of today: eight-way video calls, holograms, virtual "star dates" with K-pop idols and streaming live sports at a screen resolution triple that of an IMAX movie.

The mobile industry is betting 5G service, with speeds up to 100 times faster than current networks, will replicate the breakthroughs enjoyed from 4G—which reshaped the way people order takeout and hail taxis and helped spawn services such as Uber and Instagram. The ultimate vision is for the faster speeds to enable self-driving cars, power smart cities and birth immersive digital worlds.
At first, 5G's offerings will focus on refining some of the tech world's niche activities, such as augmented reality and high-powered mobile gaming. Most countries—including the U.S.—are still building out 5G network infrastructure that for the most part won't be ready for at least another year.

To tap into the 5G network, Verizon users will need a Motorola phone with a clip-on modem that upgrades the device from 4G networks. The carrier plans to sell Samsung Electronic Co. 's 5G-enabled Galaxy S10 handset in the first half of the year.
Verizon, the largest U.S. carrier by subscribers, is charging users of its unlimited data plans an additional $10 a month per phone for 5G, with the first three months of service being free.

0:00 / 4:59

There are a lot of myths about what the fifth generation of wireless connectivity can and can't do. WSJ's Spencer Macnaughton debunks five common 5G myths. Photo: Associated Press

Korean early adopters, for now, will be limited to Samsung's Galaxy S10 handset, which starts around $1,225. To entice buyers, South Korea's carriers are offering monthly data plans as low as $36, comparable to current 4G pricing. They are also giving away home appliances, virtual-reality headsets and fried-chicken coupons.

On a recent afternoon, Hwang Hae-ryung, a 22-year-old college student, visited a pop-up 5G store in downtown Seoul opened by LG Uplus Corp. , one of South Korea's largest carriers. She went on a 10-minute virtual-reality "star date" with a K-pop idol that the faster streaming speeds made possible.

"My heart was fluttering," said Ms. Hwang, who now plans to upgrade to a 5G-enabled device. The data, however, would have consumed nearly one-fifth of LG Uplus's low-cost monthly 5G plan.

Hundreds of Verizon employees have spent recent weeks driving and walking around downtown Chicago and Minneapolis testing the performance of the faster network, including inside U.S. Bank Stadium. The Minneapolis arena is scheduled to host the Final Four of the NCAA men's college basketball this weekend.

The results of network tests were strong enough in recent days to move up the launch, Verizon CEO Hans Vestberg said in an interview.

"When the quality is on the level that customers expect and that we are expecting, we go," said Mr. Vestberg, who owns both the Motorola phone with the clip-on modem and the yet-to-be released Samsung device. Verizon has sold tens of thousands of the Motorola devices since the end of last year, a spokesman said.

The adoption of 5G devices will be gradual, projected to account for just over one-quarter of global smartphone shipments by 2023, according to market researcher International Data Corp. The embrace is likely to pick up next year with the expected launch of Apple Inc. 's first 5G-enabled iPhone.

An employee of South Korean telecom operator KT demonstrates 5G services on a VR device during a press conference in Seoul. PHOTO: JUNG YEON-JE/AGENCE FRANCE-PRESSE/GETTY IMAGES

South Korea, known for its ultrafast internet, will boast the world's highest 5G penetration this year and next, when ownership reaches 11%, according to Strategy Analytics, a market researcher. But larger markets, like the U.S., Japan and China, are expected to start leapfrogging South Korea by 2021.

About 10 to 20 phones enabled for 5G will launch world-wide this year, and users are likely to encounter "teething problems," as they did during prior introductions of next-generation network phones, said Neil Mawston, an analyst at Strategy Analytics.

"Expect high prices, short battery life, heavy device weight, or outsize hardware," Mr. Mawston said.

South Koreans will get the first look using phones that can stream five online channels simultaneously. Samsung will have the 5G phone market to itself until April 19, when hometown rival LG Electronics Inc. releases its handset.

"We are excited to see what's possible," D.J. Koh, Samsung's mobile chief, said in an emailed statement.

Out of the gates, half of South Korea's roughly 50 million residents will live in 5G-ready areas. LG Uplus uses network equipment from four major global suppliers, including Huawei Technologies Co. The country's two other main carriers source from Nokia Corp., Ericsson AB and Samsung.

China's Huawei has been fending off American accusations around the globe that its 5G network gear poses a cybersecurity threat—which the Chinese company forcefully denies.

South Korea's big carriers have concocted a labyrinth of pricing tiers to woo buyers. The priciest data plans cost around $115 a month, on a two-year contract, and don't include the phone's cost.

Carriers in the U.S. have largely been quiet about their pricing plans. They have also sparred over the branding of the faster networks and what type of service qualifies as "real" mobile 5G service.

Sprint Corp. in February sued AT&T Inc. over a branding campaign. Sprint said AT&T has falsely told customers they are receiving 5G service on their smartphones by adding a "5GE" label to screens to indicate higher-bandwidth service, when subscribers are in fact still experiencing 4G LTE. The E in the new tag stands for evolution.

AT&T has said the tag is an "evolutionary step" in building out its 5G network. "We are going to fight this lawsuit. In the meantime, we will continue to deploy 5G Evolution for our customers," an AT&T spokesman said.

Verizon has also faced criticism from rivals for its 5G advertising. The National Advertising Division of the Council of Better Business Bureaus, an advertising industry self-regulator, last month recommended the carrier change or scrap a series of television ads that the industry group says send the "unintended message that Verizon has launched 5G mobile wireless network."

Verizon has said it thinks the group "failed to properly evaluate the net impression" of the commercials.

"We absolutely plan to appeal," a Verizon spokesman said.

Write to Timothy W. Martin at timothy.martin@wsj.com and Sarah Krouse at sarah.krouse@wsj.com

Appeared in the April 4, 2019, print edition.

https://www.wsj.com/articles/5g-is-here-starting-with-the-final-four-and-south-korea-11554333341

Ministry of Science and ICT
I-KOREA 4.0
사람 중심의 4차산업혁명 실현
194, Gareum-ro, Sejong-si, 30121, Republic of Korea

Laws

ICT KOREA

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Title
FRAMEWORK ACT ON NATIONAL INFORMATIZATION
BROADCASTING ACT
FRAMEWORK ACT ON BROADCASTING COMMUNICATIONS DEVELOPMENT
SOFTWARE INDUSTRY PROMOTION ACT
INTERNET ADDRESS RESOURCES ACT
INTERNET MULTIMEDIA BROADCAST SERVICES ACT
FRAMEWORK ACT ON TELECOMMUNICATIONS
TELECOMMUNICATIONS BUSINESS ACT
FRAMEWORK ACT ON ELECTRONIC DOCUMENTS AND TRANSACTIONS

Title
DIGITAL SIGNATURE ACT
RADIOWAVES ACT
INFORMATION AND COMMUNICATIONS CONSTRUCTION BUSINESS ACT
ACT ON THE PROTECTION OF INFORMATION AND COMMUNICATIONS INFRASTRUCTURE
ACT ON PROMOTION OF INFORMATION AND COMMUNICATIONS NETWORK UTILIZATION AND INFORMATION PROTECTION, ETC.
INFORMATION AND COMMUNICATIONS TECHNOLOGY INDUSTRY PROMOTION ACT
SPECIAL ACT ON PROMOTION OF INFORMATION AND COMMUNICATIONS TECHNOLOGY, VITALIZATION OF CONVERGENCE THEREOF, ETC.
MOBILE DEVICE DISTRIBUTION IMPROVEMENT ACT
ACT ON THE DEVELOPMENT OF CLOUD COMPUTING AND PROTECTION OF ITS USERS
PROTECTION OF COMMUNICATIONS SECRETS ACT

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