

THE NEXT GENERATION OF CELLULAR TECHNOLOGY

A Federal Policy Primer for a 5G-Connected Future

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Introduction

The proliferation of fifth-generation (5G) cellular network technology is poised to transform mobile technology on a massive scale. Significant expansions in network capabilities are expected to unlock device connection at a largescale. While much of the discourse around 5G technology has primarily centered on national security issues, as China and the US vie for global supremacy in the 5G space, the complexities surrounding 5G deployment will create unique challenges and opportunities for local governments. While federal and state-level policymakers have tended to favor policies that encourage 5G deployment by reducing regulation, local stakeholders have sought to maintain their municipal zoning authorities. Friction between local zoning decisions and federal and state preemption policies aimed at spurring 5G proliferation is likely to continue as 5G technology spreads throughout the US. As the federal government begins to mold a regulatory framework and policies to encourage 5G development, this report provides a robust outline of 5G technology and its implications for local governments.

5G Technology

5G is the fifth installation of network technology. Each generation of network technology has delivered significant expansions to mobile capability. Introduced in the early 1980s, first-generation (1G) provided mobile phone users limited voice services at a relatively high cost. Second-generation (2G), which became available in the 1990s, expanded mobile coverage and introduced text messaging. Introduced in the 2000s, third-generation (3G) provided mobile users internet access for the first time along with the ability to utilize multimedia applications. Fourth-generation (4G), which has proliferated over the past decade, introduced mobile users to unlimited data plans and high-speed data usage.






After the release of 4G, mobile companies introduced customers to Long-Term Evolution (LTE). While LTE can be more accurately described as a path to 4G utilization, as opposed to unique technology, its deployment is often considered to be the predecessor to 5G. 4G and LTE network technology dramatically expanded mobile users' internet access. As the number of connected devices has soared, however, 4G and LTE network capacity has been strained.

While the full potential of 5G technology remains difficult to definitively outline, 5G will provide users access to mobile networks with faster speeds, improved capacity for user density, and reduced latency times. It is anticipated that 5G technology will increase network speeds by a factor of 10-100.¹ Significantly faster network speeds and the ability to handle more devices simultaneously will create the opportunity for advanced technologies like the Internet of Things (IoT), Smart cities, and Autonomous Vehicles (AV) to be operationalized at scale.

¹ C. Merull, *5th Generation (5G) Technology White Paper*, Cyber Security & Information Systems Information Analysis Center, January 2019.

Generations of Mobile Communications Technology

Table I. Generations of Mobile Communication Technologies

	1G	2G	3G	4G	5G
DEPLOYED DEVICES	1980s 	1990s 	2000s 	2010 - 	2018 - 
FUNCTIONS	<ul style="list-style-type: none"> • First mobile phone • Basic voice services • Limited coverage • Expensive 	<ul style="list-style-type: none"> • Voice and some text • Digital standards offered higher quality voice • More coverage • More affordable 	<ul style="list-style-type: none"> • Voice, data and access to the internet (email, audio and video) • First mobile broadband • iPhone was introduced • People begin using their phones as computers 	<ul style="list-style-type: none"> • Voice, data, high-speed access to the internet on smartphones, tablets, laptops • True mobile broadband; unlimited plans; devices used as hotspots • Streaming, new applications, online gaming 	<ul style="list-style-type: none"> • Smart/Autonomous Vehicles • Remote Controlled Devices (Drones) • Faster Phones • Connected wearable devices • Broadband Access Everywhere • Smart Homes • Increased capacity and reliability in stadiums <p>Interconnected devices, sensors, and systems for consumers, governments, and industries</p>
SPEED	0.002 Mbps	0.064 Mbps	2-10 Mbps	10-100 Mbps	1000-1400 Mbps
TIME TO DOWNLOAD 2-HR MOVIE	N/A	N/A	10-26 hours	6 minutes	3-4 seconds

Source: CRS

Potential Benefits

5G has the potential to benefit local transportation systems by facilitating advanced technologies that improve efficiency, enhancing infrastructure development, and expanding public safety capabilities. As lawmakers, local leaders, and related stakeholders map out the deployment and implementation of 5G technology, a regulatory and policy framework that facilitates economic development while avoiding cybersecurity risks and allows local zoning authority remains critical.

Lawmakers and other stakeholders must orient their public policies around a 5G implementation that ensures societal and economic benefits. A comprehensive policy framework should balance the interests of all mobile network users and local governments while promoting robust development and deployment.

Smart City Applications

5G could improve transportation systems by facilitating Smart city applications, including advanced technologies like vehicle-to-vehicle (V2V) communications, enhanced ridesharing, advanced traffic and accident analysis, autonomous vehicles (AVs), and efficient parking identification. By allowing these technologies to operate on a broader scale in real-time, 5G could improve transportation efficiency.² Researchers at MIT produced a study on ridesharing in New York City demonstrating that efficient,

² AT&T Business Editorial Team, *How 5G will impact the transportation industry*, AT&T Business.

widely utilized ridesharing could dramatically reduce congestion.³ This analysis indicates that a more efficient transportation system has the potential to reduce congestion, which could bolster economic development; as traffic congestion generates substantial economic costs.⁴ Additionally, emergency vehicles could travel more effectively, utilizing real-time control over traffic lights and access to traffic flow data.⁵

Improved data acquisition technology may provide local governments with information to more efficiently manage their public infrastructure networks. Optimizing transportation infrastructure utilization could diminish future infrastructure costs for local governments.⁶ Additionally, existing commercial infrastructure may be utilized more efficiently using 5G technology. Ports and terminals provide an instructive example of 5G technology's potential impact on economic efficiency within the infrastructure sector. 5G-enabled connection will allow for real-time communication between assets, machines, and people to create an extremely integrated system. This integration could both improve cargo-handling operations and reduce safety concerns among workers.⁷

5G technology also has the potential to enhance public safety in communities. Real-time device connections and advanced analytics software could support the work of law enforcement agencies, emergency responders, and healthcare workers and create safer communities. Advanced facial recognition software and real-time video analytics, facilitated by 5G technology, could benefit law enforcement officials' crime prevention efforts, as technologies like license plate reading continue to improve. Additionally, superior data quality will support law enforcement agencies' efforts to maximize resource allocation efficiency. 5G will also improve the ability of body cameras to provide real-time information regarding ongoing public safety threats.⁸

With an aging population and ever-growing healthcare expenditures, 5G deployment has the additional potential to benefit healthcare provision. Telehealth, the distribution of healthcare services and information through telecommunication technologies, could be radically transformed by 5G technology. Improved device connection and expanded network coverage will allow for greater access to medical care, allowing medical professional real-time remote monitoring.⁹ The proliferation of telehealth could also increase the amount of personalized care patients receive by reducing the need for in-person checkups that may turn out to be superfluous. Improved ability to communicate with medical professionals, without the need for a time-consuming visit, could improve efficiency throughout the healthcare system.

³ J. Alonso-Mora et al., *On-demand high-capacity ride-sharing via dynamic trip-vehicle assignment*, Proceedings of the National Academy of Sciences of the United States of America, January 2017.

⁴ B. Schneider, *Traffic's Mind-Boggling Economic Toll*, City Lab, February 2018.

⁵ P. Goldstein, *The Benefits of 5G Network Slicing in Public Safety*, State Tech, March 2019.

⁶ CIMCON Lighting, *The Roadmap for Smart Cities*, CIMCON Lighting.

⁷ Port Technology International, *Insight: The Dawning of 5G*, Port Technology International, February 2019.

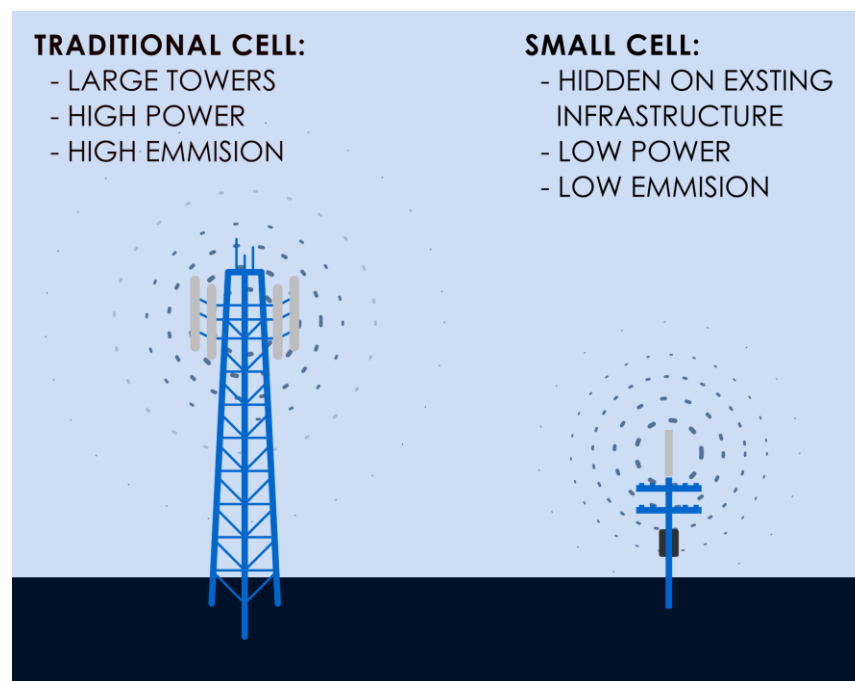
⁸ Coolfire Solutions, *Why Public Safety Needs To Prepare For 5G*, Coolfire Solutions, December 2018.

⁹ AT&T Business Editorial Team, *5 ways 5G will transform healthcare*, AT&T Business.

5G Deployment

To deploy 5G technology, telecommunications companies must develop small cell infrastructure. Small cells are significantly smaller and use less energy than traditional cell towers, called macro cells. Macro cells are often larger than 50 feet tall, compared to small cells which are roughly the size of a pizza box.¹⁰ Small cells require fiber optic cable connection, which is why they are often attached to existing physical infrastructure like utility poles. 5G's use of high-band spectrum, which allows for higher network density and reduces range, necessitates a significant number for a 5G network to be operational.

The CBR Group: Small Cell



Source: The CBR Group

Wireless technologies utilize the electromagnetic spectrum to facilitate communication between devices. Spectrum refers to the specific radio frequencies that enable mobile connectivity. In the US, spectrum for non-federal users is allocated by the Federal Communications Commission (FCC), while the National Telecommunications and Information Administration (NTIA) manages spectrum for federal users. Telecommunications companies are assigned specific frequencies and build the corresponding infrastructure to facilitate their mobile networks.

5G rollout has been slow and deployment is anticipated to remain incremental over the next two decades.¹¹ The private sector facilitates domestic 5G development and deployment in the United States. While telecommunications heavyweights AT&T, Sprint, T-Mobile, and Verizon have recently launched their 5G networks, 5G network access remains minimal and only mobile users with select devices in a

¹⁰ A. Sullivan, What is a Small Cell? A Brief Explainer, CTIA, March 2018.

¹¹ J. Gallagher, M. DeVine, Fifth-Generation (5G) Telecommunications Technologies: Issues for Congress, Congressional Research Service, January 2019.

few cities can access 5G network capabilities. While 5G network access eludes the vast majority of Americans, dubious marketing campaigns and limited knowledge of mobile technology have led roughly one-third of mobile users to believe they already have 5G access.¹² Telecommunication firm led 5G marketing campaigns have drawn criticism and spurred legal disputes over deceptive messaging.¹³ Key factors stalling 5G deployment include a lack of 5G capable devices, challenges with spectrum management, and the need for physical infrastructure. The relatively slow pace of deployment creates opportunities for savvy policymakers, particularly at the local level, to impact the proliferation of this revolutionary technology.

Zoning, Infrastructure, Spectrum, and other Concerns for Local Governments

The proliferation of 5G technology will require large-scale deployment of physical infrastructure, with some experts predicting nearly 1 million small cell installations over the next decade.¹⁴ As a result of their limited range and increasing demand for mobile network access, many densely populated areas will need to add numerous small cells. With small cell size allowing for placement on existing infrastructure, like utility poles¹⁵, balancing the interests of local, state, and federal governments as well as those of mobile companies in the context of a robust 5G deployment remains essential. 5G deployment will challenge policymakers at all levels of government to consider issues of public and private control in localities, particularly through the lens of zoning ordinances.

FCC Regulations

As mobile service providers have begun small cell deployment, local elected officials have expressed apprehension regarding the prospect of small cells dotting the landscape in their communities. Industry leaders have sought federal preemption and regulations that facilitate 5G infrastructure deployment beyond what municipal stakeholders desire.¹⁶ The FCC, under the directive of Chairman Ajit Pai, has taken action to spur 5G deployment by streamlining regulation around mobile infrastructure through the FCC's 5G FAST Plan.¹⁷ The FAST Plan updates mobile infrastructure policy by curtailing the review process for small cell deployment at the federal, state, and local levels, increasing the amount of spectrum being allocated to telecommunications firms, and modernizing the broader telecommunications regulatory framework.^{18 19}

¹² I. Sherr, *About one in three Americans think they have 5G*, CNET, July 2019.

¹³ S. Salinas, T. Haselton, *Sprint is suing AT&T for labeling its network '5G' when it's actually 4G*, CNBC, February 2019.

¹⁴ A. Scott, Z. George, *Next Generation Local Zoning Authority 5G Wireless Broadband 101*, National Association of Counties, August 2019.

¹⁵ National League of Cities, *Small Cell Wireless Technology in Cities*, National League of Cities, 2018.

¹⁶ K. Shaver, *Wireless firms seek to preempt local authority to install 5G equipment in neighborhoods*, The Washington Post, March 2018.

¹⁷ Federal Communications Commission, *5G FAST Plan*, Federal Communications Commission, 2018.

¹⁸ Federal Communications Commission, *Accelerating Wireless Broadband Deployment by Removing Barriers to Infrastructure Investment, Second Report and Order*, Federal Communications Commission, March 2018.

¹⁹ Federal Communications Commission, *Accelerating Wireless Broadband Deployment by Removing Barriers to Infrastructure Investment; Accelerating Wireline Broadband Deployment by Removing Barriers to Infrastructure Investment*, Federal Communications Commission, September 2018.

The FCC released the Declaratory Ruling and Third Report and Order on September 27, 2018, which seeks to facilitate wireless infrastructure deployment.²⁰ Cities now face a 60-day time limit—if units will be mounted on existing infrastructure—or 90-day time limit – if equipment will be placed on new infrastructure – to approve or reject projects before telecommunications companies have the right to take legal action. Additionally, the new regulations limit localities to an annual fee of \$270 for receiving site stations. The FCC argues capped receiving site fees and a shortened consideration window for local officials to consider small cell placement will likely increase the pace of 5G physical infrastructure development. Industry advocates similarly contend the new regulatory framework will generate growth and benefit mobile users. However, local leaders and policymakers have raised legitimate concerns over the loss of autonomy in their jurisdictions.²¹ A shift towards a one-size-fits-all regulatory framework could hamper local authorities from implementing community-oriented zoning that can mitigate equity and environmental concerns.

Local Pushback to FCC Regulations

The current federal approach to advancing the deployment of 5G has limited municipal control over 5G infrastructure regulation. Municipal governments have taken legal action against the FCC in hopes of countering these regulatory changes, arguing they are losing vital autonomy that could be used to ensure equality in 5G deployment and environmental standards are adhered to.²² In January 2019, the U.S. Court of Appeals for the Tenth Circuit sided with the FCC against a coalition of municipal governments led by San Jose, California. Despite the ruling, local leaders have continued to pushback against the FCC's efforts to streamline 5G infrastructure regulation.²³

On issues ranging from building density zoning to public education, local governments play a vital role in shaping public policy in localities across the nation, and the deployment of 5G is no different. Small cell deployment requires significant resource allocation from local governments. Local governments must evaluate proposed small cell sites, which create labor and administrative costs burdens, coupled with capped fees, further burdens local governing bodies.

Robust small cell deployment additionally creates important environmental and equity concerns. Limited ability to challenge small cell deployment reduces municipal governments' ability to protect public health through potential environmental damages associated with small cells. Within the context of current mobile network disparities,²⁴ inequality between highly developed and less developed areas within localities may be exacerbated with local governments' ability to promote equality mitigated by the FCC's new regulatory framework. In response to a loss of autonomy for local governments to control

²⁰ Federal Communications Commission, *Accelerating Wireless Broadband Deployment by Removing Barriers to Infrastructure Investment; Accelerating Wireline Broadband Deployment by Removing Barriers to Infrastructure Investment*, Federal Communications Commission, September 2018.

²¹ S. Emerson, *Reader Forum: One size does not fit all for small cell zoning and regulation*, RCR Wireless News, November 2016.

²² S. Descant, *Rolling Back Local Government 5G Regulation Power, Court Rules in Favor of FCC*, *Governing*, January 2019.

²³ C. Oliver, *Dalton City Council Vies for Greater Control in 5G Rollout*, *Governing*, September 2019.

²⁴ J. Leber, *Poor Areas Of Cities Have Really Terrible Mobile Service*, *Fast Company*, May 2016.

5G infrastructure deployment, organizations like the National Association of Counties (NACo)²⁵ and the National League of Cities (NLC)²⁶ have expressed concerns with the FCC's regulatory changes.

Spectrum Sharing

Spectrum allocation is one of the key factors slowing 5G deployment. As the FCC continues to allocate spectrum, telecommunications firms delay infrastructure buildouts awaiting their allocation. To facilitate spectrum allocation through the 5G FAST Plan, the FCC has prioritized the auctioning of high-band frequency spectrum. On May 28, 2019, the FCC finalized its first round of high-band spectrum auctions for more than \$2.7 billion.²⁷ Aside from high-band spectrum, the FCC is creating opportunities in unlicensed areas, including at the 6 GHz frequency. An emphasis on spectrum allocation will likely play an important role in encouraging telecommunication industry investment in 5G deployment.

Cybersecurity

While the potential benefits of 5G are numerous, increasingly integrated systems have increased cybersecurity concerns. Fully integrated systems, where many devices operate on the same network, can create vulnerabilities to hacking and cyber-attacks. The consequences of disrupted or hacked networks could be catastrophic for economic activity and privacy.

Although most cybersecurity concerns relating to 5G have focused on national security, with many observers worrying about privacy and intelligence issues relating to Chinese state-operated telecommunications firms, local governments and other stakeholders face cybersecurity concerns as well. In May 2019 Baltimore was hacked, as anonymous hackers breached the city's servers. Without the ability to provide online services, businesses and citizens suffered from reduced municipal activity.²⁸ Ensuring the federal legislation and regulation addresses security concerns with a local perspective would help bolster municipal cybersecurity and reduce risks associated with 5G adoption.

Rural Network Development

Less densely populated rural areas have consistently lacked high-quality internet access.²⁹ The dynamics of costly capital investment and smaller consumer bases in relatively low-density population regions reduce the economic efficiency for mobile companies to develop infrastructure in rural areas.

²⁵ S. Descant, *Rolling Back Local Government 5G Regulation Power, Court Rules in Favor of FCC*, Governing, January 2019.

²⁶ National League of Cities, *Counties, Cities Voice Concern Over FCC's Small Cell Ruling*, National League of Cities, September 2018.

²⁷ Federal Communications Commission, *FCC Concludes First High-Band 5G Airwaves Auctions*, Federal Communications Commission, May 2019.

²⁸ L. Ropek, *Over a Month On, Baltimore Still Grappling with Hack Fallout*, Government Technology, June 2019.

²⁹ M. Anderson, *About a quarter of rural Americans say access to high-speed internet is a major problem*, Pew Research Center, September 2018.

Lawmakers have highlighted this problem; however, little concrete action has been enacted to ameliorate the issue.³⁰

5G technology, which relies on small cells utilizing a higher frequency spectrum with very limited ranges, will only further incentivize mobile infrastructure development in densely populated areas. Mobile network inequality between densely and non-densely populated areas are likely to be exacerbated without intentional policy intervention. A robust policy framework committed to ensuring distributional fairness and aimed at ending the “digital divide” will be imperative.

Current Legislative Landscape

Although the thrust of mobile technology development has occurred through private sector investment, the FCC, federal, and state governments have sought to facilitate the proliferation of this important technology. Regulatory streamlining from the FCC and efforts in many state legislatures to facilitate small cell proliferation has created a deployment-friendly environment for mobile telecommunication companies. In addition to federal action regarding 5G technology and national security concerns, legislation has been introduced to encourage the deployment of 5G physical infrastructure. Changes in federal and state-level policies are likely to increase as 5G technology continues to develop.

State and Local Legislative and Regulatory Environment

Over the past few years, many states have enacted legislation to facilitate the development and deployment of 5G technology. By the end of 2018, 21 states enacted small cell legislation.³¹ While each state’s legislation varied, the laws broadly sought to streamline applications to access public rights-of-way, set ceilings on costs and fees, and reduce consideration timelines for cell-site applications. Additionally, 23 states have introduced small cell legislation this year.³² These states, whose legislation complements the FCC’s regulatory changes, have further exacerbated municipal governments’ concerns with small cell deployment.

While many states have sought to facilitate the proliferation of 5G infrastructure, an equal number have pushed back against the FCC’s new regulations. 25 states, including Oregon and Washington, have refused to adopt the FCC’s Declaratory Ruling and Third Report and Order.³³ These states’ refusal to adopt the FCC’s new regulatory framework illustrates that many stakeholders in the legislative process sympathize with those who oppose local preemption on small cell deployment.

Federal Legislation

In response to state and local governments’ refusal to adopt the FCC’s small cell deployment regulatory changes, Senators John Thune (R-SD) and Brian Schatz (D-HI) introduced [S. 1699: Streamlining The Rapid Evolution And Modernization of Leading-edge Infrastructure Necessary to Enhance \(STREAMLINE\) Small](#)

³⁰ M. Collins, *Congress prepares to knock down barriers to broadband expansion in rural America*, USA Today, January 2018.

³¹ H. Morton, *Mobile 5G and Small Cell 2018 Legislation*, National Conference of State Legislatures, December 2018.

³² H. Morton, *Mobile 5G and Small Cell 2019 Legislation*, National Conference of State Legislatures, July 2019.

³³ L. Hardesty, *States contest FCC’s small cell rule, prompting Senate bill*, Fierce Wireless, June 2019.

[Cell Deployment Act](#) on June 3, 2019.³⁴ The STREAMLINE Small Cell Development Act amends the Communications Act to federalize small cell deployment regulations. This legislation would codify the FCC's ability to preempt local governments' zoning policy for small cell deployment. The bill was referred to the Senate Committee on Commerce, Science, and Transportation. Bipartisan introduction of the STREAMLINE Small Cell Development Act reveals widespread federal support for encouraging 5G deployment through local preemption.

The STREAMLINE Small Cell Development Act updates the Communications Act to facilitate more rapid small cell deployment. The new legislation creates small cell placement and approval guidelines as well as new timelines for state and local governments to respond to wireless equipment installment requests. Additionally, it outlines fee processing requirements for local governments as they charge for 5G infrastructure deployment and would require applications to be processed within 60 days for requests to collocate equipment and 90 days for other requests. However, there is some flexibility for municipalities with less than 50,000 residents. The pro-development orientation of the STREAMLINE Small Cell Development Act illustrates tensions between federal authorities who aim to proliferate 5G technology as quickly as possible and local stakeholders who seek to retain zoning authority over their jurisdictions.

Conclusion

Increased federal action on and scrutiny of 5G technology are likely moving forward. Meaningful developments in the regulatory space have altered the way cities and municipal governments address mobile technology deployment, primarily reducing their ability to regulate small cell deployment. As 5G technology further develops and is more widely implemented, local governments' concerns over federal preemption and an increasingly lax regulatory framework will grow in prominence. As the discussion around 5G technology materializes, securing a seat at the table and advocating for your community is vital.

³⁴ S.1699 - STREAMLINE Small Cell Deployment Act, Congress.Gov.