Contents

Summary and Recommendations: Protecting Community Aesthetics While Improving Wireless Service Under Tennessee's Small Cell Law

A cell tower the size of a lamppost could be coming to a street near you. In some communities, one might already be there. As our needs and expectations for mobile wireless service continue to evolve, so too are the networks that support them. The large, several-hundred-foot-tall cell towers that characterized the first several generations of mobile wireless networks will remain. However, the wireless industry is supplementing them with smaller facilities—typically installed on utility poles, streetlights, or standalone poles no more than 50 feet tall—many of which will be placed in public rights-of-way. Because of their relative size and range when compared with earlier wireless facilities, these smaller facilities—which are intended to increase wireless networks' speed and reliability—are often referred to as small cells.

Citing the benefits of Tennessee's "long-standing policy of encouraging investment in technologically advanced infrastructure," the General Assembly passed Public Chapter 819, Acts of 2018, creating a framework governing the regulation of small cells in public rights-of-way (see appendix A). Tennessee is among 28 states to enact laws specific to small cells, all within the last five years—though Delaware's law applies only to its state department of transportation—and the Federal Communications Commission (FCC) adopted an order governing small cells, also in 2018. Included in Tennessee's law, the General Assembly directed the Tennessee Advisory Commission on Intergovernmental Relations (TACIR) to study the effects of the Act, including

- the effect on deployment of broadband;
- the fiscal effect on local governments and the state resulting from the administrative process required by the Act;
- best practices both from the perspective of small cell applicants, local governments, and the state and from a review of other states; and
- opportunities to advance the quality of transportation in the state by utilizing technological applications, sometimes referred to as "smart transportation applications," that are supported by small cells.

The Commission was further directed to make recommendations for any changes to the Act based on the study's findings. There are several new or enhanced applications that likely could be supported by small cells. However, the rollout of small cells is currently in its early stages, with initial deployments located primarily in urban and suburban

areas in need of added wireless capacity. Because many small cells will be in public rights-of-way, local officials and private citizens have raised concerns about their effect on the communities in which they are located. For a thorough overview of Public Chapter 819's provisions as they relate to local governments, see the guide produced by the Municipal Technical Advisory Service (MTAS) and the Tennessee Municipal League (TML).[1]

Small cells are being used to improve the performance of mobile wireless networks.

The wireless industry is using small cells to enhance existing service—corresponding to services commonly referred to as 3G, 4G, or LTE—and support the latest advance in mobile wireless service—which is expected to "provide faster speeds, greater capacity, and the potential to support new features and services," according to the Congressional Research Service, and is commonly referred to as 5G. For existing service, the problem boils down to congestion. When too many people or devices try to connect through the same cell tower at once, they can overload its capacity. "When a small cell is placed," according to the CEO of a consulting firm with more than 30 years of experience in telecommunications, "the capacity formerly shared by hundreds or thousands of users over a few-square-mile area only needs to be shared by a few dozen users within a much smaller small-cell area."

For 5G, the limited distance traveled by the radio frequencies used to provide the fastest service necessitates moving cell sites closer to users. As described by the Congressional Research Service,

> 5G systems using low- to mid-band spectrum can install new 5G equipment on existing cell sites (4G cell sites). This will increase the speed and functionality of existing 4G networks but will likely not achieve the ultra-fast speeds provided by millimeter wave [high frequency] bands.
>
> For deployments that leverage higher bands . . . a much higher density of cell sites is needed as the signals cannot travel as far or through obstacles. To overcome these challenges, providers will place many smaller cell sites (also called small cells) close together to relay signals further distances and around obstacles.

[1] See: https://www.mtas.tennessee.edu/system/files/knowledgebase/original/Small%20Cells%20Deployment%20Guidelines%20%28PC%20819%29%202018.pdf.

These improvements to wireless networks have the potential to support a range of applications, including several in transportation.

Multiple applications in transportation and other sectors could potentially be supported by small cells, though questions remain.

There are many transportation applications that could be supported by small cells, though few emphasize small cells when discussing them, focusing instead on 5G. They include some—such as turn-by-turn directions, route suggestions based on real-time traffic, and supply chain management through delivery tracking—that are already supported in some capacity by wireless networks today. Among potential applications, increased automation of vehicle functions, including autonomous driving, has garnered considerable attention. This includes vehicle platooning, in which automated systems in each vehicle connect wirelessly to each other to adjust speed and distance between vehicles based on travel conditions, allowing for travel at closer distances than would otherwise be safe and leading to gains in fuel efficiency, according to the Tennessee Department of Transportation (TDOT). There are also multiple applications in other sectors, including monitoring the operation of water systems and other utilities, as well as environmental conditions, such as weather, air quality, and water pollution levels; remote patient monitoring for healthcare; and various applications in manufacturing for quality control and tasks that call for high levels of precision.

Whether small cells fulfill their potential to support these applications remains to be seen. Other wireless platforms—including one that TDOT already uses to support improvements in safety, mobility, and productivity through its intelligent transportation systems architecture—may support them as well. Some remain skeptical that small cells and 5G will yield expected benefits in the short-term, citing uncertainty about the underlying economics of 5G, including "whether and how soon it can fuel new products and services that customers are willing to pay for," according to a 2019 survey of 46 chief technology officers directly engaged in 5G development. Long-term, however, the same survey found greater optimism, with respondents painting "a picture of 5G as a powerful new technology just waiting to be tapped for innovative new uses . . . one that even, many countries believe, has the potential to create and advance entire economies." Given this potential, Tennessee has taken steps to facilitate the deployment of small cells.

Tennessee's small cell law creates a consistent statewide framework for local governments, with greater flexibility for TDOT.

Public Chapter 819 establishes the obligations of those deploying small cells in public rights-of-way and places limits on state and local authority to regulate them. Among its

provisions, the Act defines which facilities qualify as small cells, specifies information local governments can require in applications, sets time limits for local governments to act on applications, and caps fees for applications and attachments to support structures owned by local government entities other than municipal electric systems. These and other provisions create a consistent local regulatory framework for small cells in communities throughout Tennessee. As described by MTAS and TML, "any limits, requirements, policies, or processes [adopted by local governments] may not be more restrictive or in excess of what is permitted under the new law."

The Act generally includes greater flexibility for the state (see appendix D). For example, applications to local governments are automatically deemed approved if time limits for review are exceeded, but applications to TDOT are not approved until "affirmatively acted upon" by the Department. While earlier versions of the legislation would have compelled TDOT to comply with more stringent requirements, they could have placed the Department out of compliance with federal regulations, jeopardizing federal funding, according to the fiscal memorandum accompanying the bill. Based on correspondence between TDOT staff and staff of the Fiscal Review Committee, this could have resulted in the loss of 10% of the Department's federal funding annually—a loss of approximately $91 million in fiscal year 2018-19. According to interviews with TDOT staff and presentations to the Commission, the Department's regional offices are reviewing applications within the time limits set for local governments, and TDOT is satisfied with the current framework.

The Act's effect on broadband deployment in unserved areas has been minimal, though industry says it has facilitated investment in state.

Tennessee's small cell law has not accelerated the expansion of broadband to previously unserved areas. Wireless providers have said that initially small cells will be deployed to more populated areas with greater capacity needs and those areas, like interstate interchanges, where many people are passing through. Broadband is more likely to exist in these types of areas already, according to the Commission's 2017 broadband report. Although an exact count of small cells in each community could not be obtained from providers because of the business-sensitive nature of these deployments, the vast majority are in the state's four largest cities, according to interviews with local officials. Many cities report receiving only a handful of applications, while others have not yet received any. Counties contacted did not report any applications for their unincorporated areas.

While Public Chapter 819 has had minimal effect on broadband access in previously unserved areas, wireless providers report that it has facilitated investment in Tennessee, helping the state get ahead of others in the southeast with larger population centers—

such as Georgia and Florida. According to one provider, it deployed 12 times the number of small cells in Tennessee in the year following passage of the Act, compared with the year before.

Existing caps on application fees don't cover costs for some local governments.

Although the wireless industry remains generally supportive of Public Chapter 819, some local officials raised concerns about the maximum fees authorized under the Act. Citing staff time necessary to review applications and inspect projects during the construction process, officials from almost one-fourth of local governments interviewed said that the fees don't cover their costs or that they are concerned about fees. The caps in Tennessee law result in application fees lower than in most of the 21 other states that limit local application fees for small cells. The resulting fees are also generally lower than those authorized under the FCC's small cell order. However, officials from most of the 40 local governments interviewed did not raise concerns about the existing fee caps, and a few said that the cost of complying with the Act has been minimal. In the enacting clause of Public Chapter 819, the General Assembly observes that part of Tennessee's longstanding policy of encouraging investment in communications infrastructure has included keeping the industry free from local taxation and other fees that are in excess of cost recovery. Capping local fees is a practice supported by the wireless industry nationally. Despite fee caps and other limits placed on local governments, the Act "does not grant unfettered authority to deploy small cells," according to MTAS and TML, and it preserves at least some local authority—in particular, related to right-of-way management and aesthetics.

The Act generally preserves local authority to manage public rights-of-way.

Provisions in the Act protect local authority to manage rights-of-way, provided that local governments don't restrict access or effectively prohibit the deployment of small cells. Some local officials report damage caused by construction and frustration related to a lack of coordination among the different entities responsible for carrying out small cell projects, resulting in inconsistent information on applications and failure to pull appropriate permits or follow approved plans, though many noted these issues are not unique to small cells. Others—including commission members—are concerned that small cells will interfere with existing infrastructure or could block future projects, such as road-widening or sewer expansions, with a few characterizing rights-of-way in some areas as crowded or almost full, given the existing infrastructure in them.

Both the authority to require that damage be repaired and the authority to protect rights-of-way to accommodate other infrastructure are preserved under the Act (see

appendix E). Many local officials report using this authority. Several said that to ensure damage is repaired they either require or plan to require letters of credit, bonds, or other sureties for small cell projects, similar to their requirements for other infrastructure. Others have denied small cell applications for conflicts with existing infrastructure. Moreover, small cells are subject to state laws requiring that they be moved to accommodate future road projects, and it appears that—similar to other utilities in public rights-of-way—small cells would be subject to general relocation requirements to accommodate other development projects. These issues aside, the effect of small cells on community aesthetics is the most widespread cause of concern among local officials interviewed.

Local governments have authority under the Act to enforce aesthetic standards, but greater authority may be warranted to address long-term concerns.

Nearly every local official interviewed expressed concern about the ways in which small cells would affect the aesthetics of their communities. Some of these concerns stem from the investments local governments have made. Multiple officials observed that they—and in some cases the state—have spent significant resources in recent years on the appearance of their rights-of-way. Others noted the likelihood of complaints from residents, and one private individual contacted TACIR staff with concerns about small cells' effect on property values. Several officials advocated for greater local control over small cells, particularly when it comes to their location.

Local governments already have authority under Public Chapter 819 to require that small cells conform to adopted aesthetic standards provided that the standards are non-discriminatory, generally applicable to other entities deploying infrastructure in public rights-of-way, and don't preclude all deployment of small cells. Similar to right-of-way management, many local officials report they are using this authority. For example, several said their local governments require small cells to be painted the same color as existing infrastructure, while some require new poles installed for small cells to meet aesthetic standards in areas where decorative poles are used for streetlights or other utilities. The wireless industry supports adoption of objective standards that meet the Act's requirements as a best practice, and both the FCC order and 23 of the other states with small cell laws preserve at least some local authority to regulate the aesthetics of these facilities. Because aesthetic concerns are unlikely to diminish as the number of small cells increases, **the Commission encourages local governments to both**

- **update existing ordinances that set aesthetic standards for their communities to ensure their requirements apply to small cells and**
- **include small cells in any new standards they adopt.**

But adopting aesthetic standards likely won't fully address the concern of some local officials that the installation of numerous, new poles in public rights-of-way could create visual clutter, because these standards must comply with other provisions in the Act: Local governments must allow small cell applicants to seek waivers that would authorize placement of new poles for small cells in areas where electric, cable, and other communications infrastructure is otherwise required to be underground; they cannot require that small cells be placed on specific poles or categories of poles, preventing them from requiring colocation on existing poles; and they cannot require that small cells or the poles supporting them be spaced a minimum distance apart.

Local governments are currently authorized to propose design alternatives—which could include colocation on existing poles—during the application review process, offering an opportunity for applicants to collaborate on solutions acceptable to both parties. Although colocation has support among local officials, TDOT, and the wireless industry, some local officials are concerned that wireless providers won't let competitors colocate small cells on poles that those wireless providers own. One official further noted that local governments cannot require applicants to provide information needed to verify the necessity of either installing new poles or using specific locations, under Public Chapter 819. Because of the large number of small cells that the wireless industry expects to deploy and the effect on community aesthetics that could result from the installation of new poles to support those facilities, **the General Assembly could consider authorizing local governments to require colocation of small cells in areas with existing poles. Care would need to be taken to ensure this authority could not be used to block the deployment of small cells in situations where applicants can demonstrate that colocation is not feasible either for technical reasons or because of added costs, similar to limitations on colocation requirements adopted in Georgia. Regardless, some new poles will be necessary to improve wireless service given the limited distance traveled by some of the wireless signals used by providers. And because colocation will likely involve the use of electric utility poles—municipal electric systems and electric cooperatives own approximately 80% of the utility poles in Tennessee—any colocation requirements should also ensure the continued authority of local power companies to protect the safety and reliability of the electric grid.**

Small cells are unlikely to harm human health; applications cannot be denied on basis of health concerns for wireless facilities that meet federal regulations.

It is unlikely that small cells will harm human health based on existing scientific studies. According to the FCC, "at relatively low levels of exposure to [radio frequency] radiation, i.e., levels lower than those that would produce significant heating, the evidence for production of harmful biological effects is ambiguous and unproven." While the FCC acknowledges the need for further research, it notes that "standards-setting organizations and government agencies continue to monitor the latest experimental findings to confirm their validity and determine whether changes in safety limits are needed to protect human health."

Under federal law, states and local governments cannot deny applications for wireless facilities—including small cells—based on health concerns, if those facilities meet the FCC's radio frequency limits. Of the 27 states with small cell laws that apply to local governments, six specifically authorize local governments to require providers to certify that their small cells meet the FCC limits. Tennessee's law doesn't include certification of compliance among the information local governments can require of small cell applicants. Two other states define small cells subject to their expedited review processes as only those facilities that meet the FCC limits; Tennessee's law does not.

Analysis: Public Chapter 819, Acts of 2018, Small Cell Wireless Facilities, and Public Rights-of-way

The ways we use mobile wireless networks and our expectations for these networks have evolved over the last four decades. We have gone from making telephone calls on bricklike cellphones, to sending text messages on pocket-sized flip-phones, to streaming videos on smartphones that function as hand-held computers. This is to say nothing of the uses for wireless networks implemented and contemplated by businesses, industries, and governments. As our wireless needs continue to evolve, so too will the networks that support them. The large cell towers—as well as other locations often used to support wireless facilities such as water towers and rooftops—that have characterized the first several generations of wireless networks will remain. However, the wireless industry is supplementing them with smaller facilities, many of which will be placed in public rights-of-way. Because of their relative size and range when compared with earlier wireless facilities, these smaller facilities—which are intended to increase wireless networks' speed and reliability—are often referred to as small cells.

The wireless industry's shift to small cells has been a source of anticipation but also concern. It comes as excitement grows about the possible new or enhanced uses of wireless networks that could be unleashed by 5G, the next generation of mobile wireless service, which will rely in part on small cells. But the shift also entails substantial infrastructure deployments. Wireless providers and industry analysts reported in 2018 that hundreds of thousands of small cells will be deployed nationwide in the next few years, "roughly double the number of macro cells [e.g. cell towers] built over the last 30 years."[2] Because many of these small cells will be located in public rights-of-way, the shift in wireless infrastructure has raised concerns about its effect on the built environment of communities in which small cells are located and the extent to which existing regulatory frameworks developed for large towers and other traditional wireless installations are suited to small cells.

Citing the benefits of Tennessee's "long-standing policy of encouraging investment in technologically advanced infrastructure," the General Assembly passed the Competitive Wireless Broadband Investment, Deployment, and Safety Act of 2018 (Public Chapter 819, Acts of 2018), creating a framework governing the regulation of small cells in public rights-of-way (see appendix A). Tennessee is among 28 states to enact laws specific to small cells, all within the last five years—though Delaware's law applies only to its state department of transportation—and the Federal Communications Commission (FCC) adopted an order governing small cells, also in

[2] Federal Communications Commission 2018.

2018. Included in Tennessee's law, the General Assembly directed the Tennessee Advisory Commission on Intergovernmental Relations (TACIR) to study the effects of the Act, including

- the effect on deployment of broadband;
- the fiscal effect on local governments and the state resulting from the administrative process required by the Act;
- best practices both from the perspective of small cell applicants, local governments, and the state and from a review of other states; and
- opportunities to advance the quality of transportation in the state by utilizing technological applications, sometimes referred to as "smart transportation applications," that are supported by small cells.

The Commission was further directed to make recommendations for any changes to the Act based on the study's findings.

Among these findings, there are several new or enhanced services that likely could be supported by small cells. However, the rollout of small cells is currently in its early stages, with initial deployments located primarily in urban and suburban areas in need of added wireless capacity. Although a few communities report increasing volumes of applications, others have yet to receive any, and some remain unfamiliar with the new technology. So far, the wireless industry and the Tennessee Department of Transportation (TDOT) appear generally satisfied with the Act, and the framework created in the Act is generally not an outlier when compared either with other states that have adopted small cell laws or with the FCC's order. Local officials interviewed report a variety of concerns with small cells and the Act, focusing primarily on aesthetics, management of public rights-of-way, and the costs incurred by local governments relative to allowable fees. For a thorough overview of Public Chapter 819's provisions as they relate to local governments, see the guide produced by the Municipal Technical Advisory Service (MTAS) and the Tennessee Municipal League (TML).[3]

Use of wireless service continues to grow, necessitating improvements to wireless networks.

The wireless industry's embrace of small cells is occurring as users of wireless networks consume increasing amounts of data. In 2018 alone, data use increased by 82%

[3] See: https://www.mtas.tennessee.edu/system/files/knowledgebase/original/Small%20Cells%20Deployment%20Guidelines%20%28PC%20819%29%202018.pdf.

nationwide from the previous year, according to an annual industry survey by CTIA—a wireless industry trade group. The total of 28.58 trillion megabytes[4] used in 2018 was not only 73 times greater than the amount of data used in 2010 but also greater than the amount used during the entire six-and-a-half-year period from the beginning of 2010 through the middle of 2016. It is approximately equal to the amount of data that would be used by 250 million people—more than three out of every four people in the United States—playing the popular videogame Fortnite every hour of every day for more than 79 days. The amount of time spent making telephone calls over wireless networks and the number of text messages sent are also increasing.[5]

Wireless data use is likely to continue to grow both because of the use of data-heavy applications and because of the number of connected devices. Streaming video, in particular, has been and is expected to remain a primary driver of the increase in wireless internet traffic. According to one industry analyst, it accounted for more than three-quarters of the data used by smartphone owners in 2017.[6] While others in the industry don't place video's share of overall data use quite so high,[7] they forecast that video traffic on mobile networks will increase by 34% annually through 2024.[8] The number of smartphones and other connected devices contribute to increasing wireless data use as well. By the end of 2018, there were approximately 284.7 million smartphones connected in the United States. The number of data-only devices—which includes things like connected cars, smart watches, and health monitors—increased by 10% in the same year to a total of 139.4 million devices.[9]

As wireless data use increases, it is necessitating improvements in wireless networks. According to the Congressional Research Service in a 2019 report,

> first, there are more people using more data on more devices. Since 2016, more people worldwide have been using more data on mobile devices such as smartphones than on desktops. Globally, mobile data traffic is expected to increase sevenfold from 2016 to 2021, and mobile video is driving that increase. . . . Current networks (e.g., 3G, 4G) cannot always meet consumer demands for data, especially during periods of heavy use

[4] A megabyte is equal to one million bytes.

[5] CTIA 2019.

[6] NPD 2017.

[7] Grijpink et al. 2020; Ericsson 2019; and Crown Castle 2020.

[8] Ericsson 2019.

[9] CTIA 2019.

(e.g., emergencies). During periods of heavy use, consumers may experience slow speeds, unstable connections, delays, or loss of service.

Second, the total number of internet-connected devices, both consumer devices (e.g., smart watches, smart meters) and industrial devices (e.g., sensors that assist with predictive maintenance), has increased. Market research indicates that in 2018 there were 17.8 billion connected devices globally; 7 billion of which were not smartphones, tablets, or laptops, but other connected devices (e.g., sensors, smart locks) that allow users to monitor and manage activities through a mobile device, such as a smartphone, further increasing demand on networks.

Third, industries are relying on internet-connected devices in everyday business operations. Companies use devices to track assets, collect performance data, and inform business decisions. These devices, when connected, form the Internet of Things (IoT)—the collection of physical objects (e.g., health monitors, industrial sensors) that interconnect to form networks of devices and systems that can collect and compute data from many sources. More advanced IoT devices (e.g., autonomous cars, emergency medical systems) need networks that can provide persistent ("always-on") connections, low latency services (i.e., minimal lag time on commands), greater capacity (e.g., bandwidth) to access and share more data, and the ability to quickly compile and compute data. These are features that current mobile networks cannot consistently support.[10]

The Congressional Research Service observed that these "factors are driving the need for improved wireless networks."[11]

Small cells improve the capacity of wireless networks, enhancing existing service and supporting the rollout of 5G.

The wireless industry is using small cells to enhance existing mobile wireless service—corresponding to services commonly referred to as 3G, 4G, or LTE—and support the latest advance in service, commonly referred to as 5G. 5G—the fifth generation of mobile wireless service—is expected to "provide faster speeds, greater capacity, and the potential to support new features and services" when compared with existing service

[10] Gallagher and DeVine 2019.

[11] Ibid.

(see appendix B).[12] For enhancing existing service, the problem boils down to congestion. When too many people or devices try to connect through the same cell site at once, they can overload the site's capacity. Adding capacity by increasing the number of cell sites decreases the number of people and devices connecting to each one.[13] For 5G, the limited range of some radio frequencies used to provide service necessitates moving cell sites closer to users.[14] Whether to enhance existing service, support 5G, or both, the wireless industry is deploying small cells.

Small cells are generally smaller in size and have shorter ranges than traditional cell sites. They are being deployed not on tall towers but in public rights-of-way on standalone poles, utility poles, and other infrastructure, as well as on or even inside buildings (see figure 1).[15] In its 2018 municipal guide on small cells, the National League of Cities described both the need for small cells and their relationship to existing wireless infrastructure, writing that

> as wireless data usage continues to escalate, providers must find new and innovative ways to keep up with consumer demand for more speed and data capacity. One way to address the capacity crunch is by deploying "small cells," a type of wireless technology for broadband infrastructure. Various federal, state, and local laws define small cell differently. Generally, "small cell" refers to both the smaller coverage area of the wireless signal, and the smaller size of the infrastructure. Small cell installations generally cover much smaller geographic areas—measured in hundreds of feet—than the traditional macrocell towers that can cover miles in each direction. The antennas are much smaller than those deployed at macrocell sites, and are often attached to buildings, rooftops and structures in public rights-of-way (ROW), including utility and light poles and other street furniture. Pole- or ground-mounted equipment accompanying the antenna may also be needed and can be as big as a large refrigerator. This equipment may be in the ROW, or on other public or private property.
>
> These facilities help to complement or stretch macrocell coverage and add capacity in high demand areas. Small cell infrastructure is typically

[12] Ibid.

[13] Crown Castle 2020; and National League of Cities 2018.

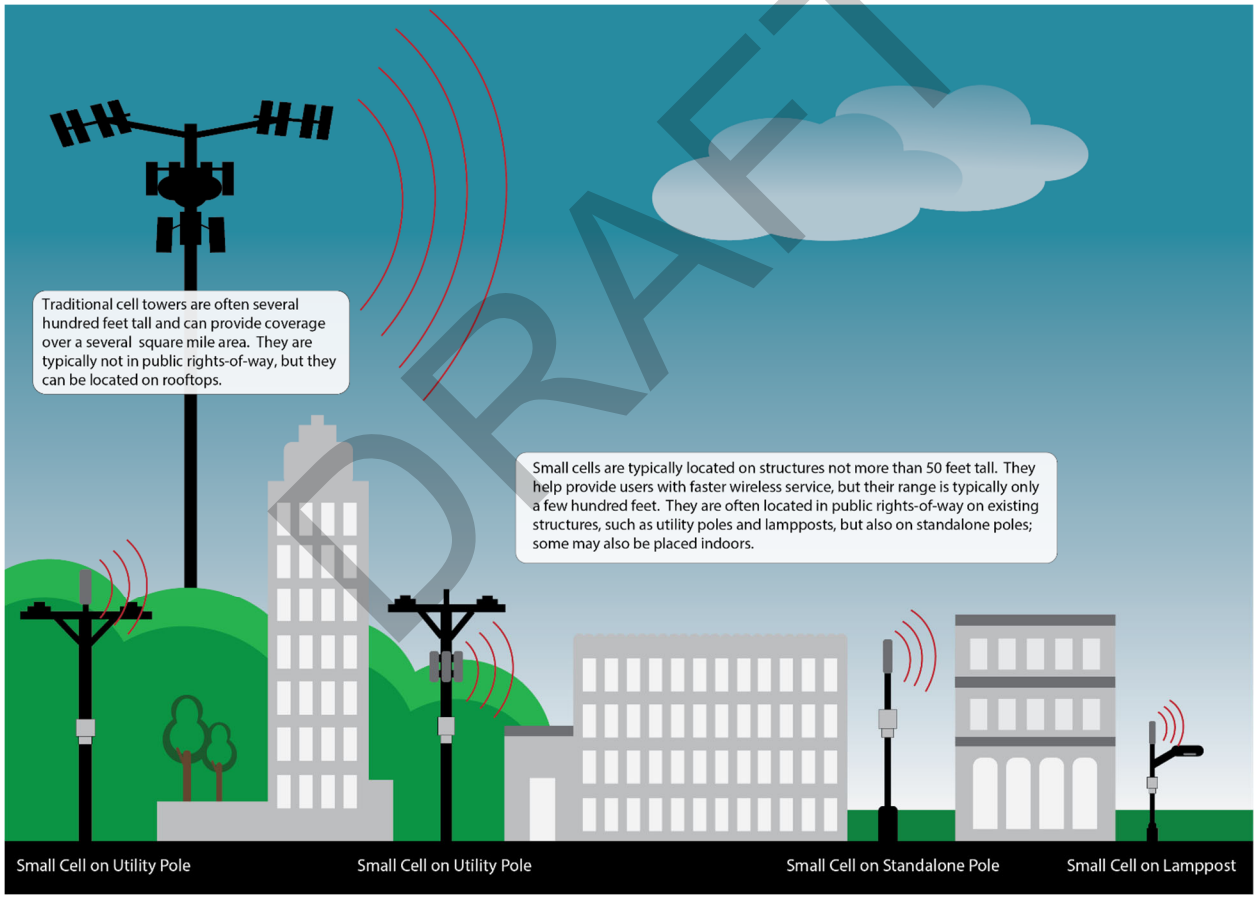
[14] Linebaugh 2019.

[15] FitzGerald 2018.

deployed to alleviate capacity constraints where crowds gather or to cover targeted areas, including public squares and spaces, downtown pedestrian areas, parks, office buildings, campuses, or stadiums and arenas.[16]

In this way, small cells help enhance existing wireless service by easing congestion on existing cell sites. "When a small cell is placed," according to the CEO of CTC Technology and Energy, a consulting firm with more than 30 years of experience in telecommunications, "the capacity formerly shared by hundreds or thousands of users over a few-square-mile area only needs to be shared by a few dozen users within a much smaller small-cell area."[17]

Figure 1: Comparing Traditional Cell Sites with Small Cells



Source: TACIR staff based on review of multiple sources.

[16] National League of Cities 2018.

[17] Afflerbach 2018.

In addition to enhancing existing service, the wireless industry is deploying small cells as part of its effort to roll out 5G, the next generation of mobile wireless service, which is expected to improve network capability (see appendix B).[18] However, both the extent to which 5G will improve existing service and the extent to which 5G will rely on the deployment of small cells depends in part on the radio frequencies used to provide it.

The radio frequencies used to provide wireless service, including 5G, can be broken down into low, middle, and high frequencies. The characteristics of each of these frequency groupings—including the speeds each can deliver and the distances each can travel—differ and are largely dependent on physics.[19] While exact performances vary and the specific set of frequencies included in each group is subject to interpretation, generalizations about each group can be made:

- Low Frequencies (generally less than 3 gigahertz): Lower frequencies have long been used for wireless service, including 3G and 4G. They provide slower speeds relative to the other groups, with reported speeds for low-frequency 5G averaging approximately 50 megabits[20] per second. But their range can be several miles, and they are less easily blocked by buildings and other obstacles, making them useful for providing coverage over wide areas.[21]
- Middle Frequencies (generally at least 3 gigahertz but no greater than 24 gigahertz): This group offers a mix of the benefits and limitations of the other two groups and is sometimes referred to as the goldilocks range. With reported speeds averaging more than 100 megabits per second, frequencies in the middle group provide faster speeds than those in the lower group but not the potential multigigabit speeds of the higher group. Their range of approximately half a mile, though longer than high frequencies, is far shorter than low frequencies.[22]
- High Frequencies (generally greater than 24 gigahertz): Also referred to as millimeter wave spectrum, high frequencies are expected to provide the fastest service for 5G. In testing, they have produced speeds faster than four gigabits per second, fast enough to download a one-hour, ultra-high-definition video in 14 seconds, though real-world speeds reported have averaged several hundreds of megabits per second. However, high frequencies have the shortest range of any of the three groups and can be more easily blocked by buildings, foliage, and

[18] Gallagher and DeVine 2019.

[19] Wheeler 2019.

[20] A megabit is 1 million bits; a gigabit is 1 billion bits or 1,000 megabits.

[21] Wheeler 2019; Sosa and Rafert 2019; Rizzato and Fogg 2020; Stern 2020; and T-Mobile "What Is 5G?"

[22] Wheeler 2019; Sosa and Rafert 2019; Rizzato and Fogg 2020; Stern 2020; and T-Mobile "What Is 5G?"

> other obstacles. Their range is estimated at 200 meters, approximately two football fields.[23]

The wireless industry is using a mix of frequencies to provide 5G. Although 5G provided over low frequencies has been referred to as "good 4G,"[24] speeds reported in reviews of 5G service provided over higher frequencies have exceeded one gigabit per second.[25] Because providing 5G at the fastest speeds relies on higher frequencies, which have limited ranges, the wireless industry is deploying small cells to bring their wireless networks closer to end-users.[26]

Without small cells, access to the fastest 5G speeds would be unlikely.[27] As described by the Congressional Research Service,

> deployment of 5G systems will rely on a range of technologies and different bands of spectrum. 5G systems using low- to mid-band spectrum can install new 5G equipment on existing cell sites (4G cell sites). This will increase the speed and functionality of existing 4G networks but will likely not achieve the ultra-fast speeds provided by millimeter wave bands.
>
> For deployments that leverage higher bands, particularly above 6 GHz, a much higher density of cell sites is needed as the signals cannot travel as far or through obstacles. To overcome these challenges, providers will place many smaller cell sites (also called small cells) close together to relay signals further distances and around obstacles.[28]

Because small cells not only facilitate the use of higher frequencies and faster speeds but also reduce congestion at existing cell sites, they are part of the wireless industry's current effort to improve its wireless networks. Moreover, these improvements have the potential to support a range of new applications for wireless users.

---

[23] Ericsson 2020; Sosa and Rafert 2019; Dano 2017; Rizzato and Fogg 2020; Stern 2020; and T-Mobile "What Is 5G?"

[24] Brodkin 2019.

[25] Welch 2019; Turley 2019; and Stern 2020.

[26] Gallagher and DeVine 2019.

[27] Sosa and Rafert 2019; Singer, Naef, and King 2017; Moritz 2019; Hart 2018; and Linebaugh 2019.

[28] Gallagher and DeVine 2019.

Whether small cells fulfill their potential to support new or enhanced wireless applications, including smart transportation applications, remains to be seen.

There are many potential wireless applications that could be supported by the deployment of small cells,[29] though few people emphasize small cells when discussing them. Instead, most focus on the benefits of 5G. 5G is still early in its commercial rollout, and some question whether or how quickly it can have a transformational effect on the things for which wireless networks are used.[30] Also, there are other wireless services and infrastructures that might be used instead of small-cell-supported 5G service to support some applications.[31] While 5G receives much of the attention, to the extent that its promise will rely on high frequency radio waves, small cells will be an infrastructure underpinning a service that could ultimately support multiple new or enhanced wireless applications, in particular when it comes to transportation.

Smart Transportation Applications

Small cells aside, wireless communications networks—including not only commercially operated cell networks but also government networks and satellites—already support numerous transportation-related uses. Most everyone with a smartphone will be familiar with the turn-by-turn directions and route suggestions provided by various mapping applications. TDOT's intelligent transportation systems architecture—which supports improvements in safety, mobility, and productivity through advanced wireless communications technologies[32]—has multiple components that rely on wireless communications.[33] Businesses and industries also rely on wireless communications to track shipments in real time.[34] And these are but a few examples. Nevertheless, improvements in wireless communications resulting from the deployment of small cells have the potential to support or enhance several transportation applications.

Transportation applications that could be supported or enhanced by improvements to wireless networks serve a variety of purposes, including but not limited to advances in efficiency and public safety. Examples include

---

[29] Grijpink et al. 2020.

[30] Grijpink et al. 2019.

[31] Nordrum 2016; Wassom 2018; 5G Americas 2018; and Bigelow 2019.

[32] Tennessee Department of Transportation "Intelligent Transportation Systems."

[33] Stantec Consulting Services 2019.

[34] Tennessee Advisory Commission on Intergovernmental Relations 2019.

- improvements to aforementioned route planning applications based on real-time traffic;
- more efficient management of traffic flow, resulting from coordinated timing of traffic lights;
- improved management of supply chains through the enhanced tracking of deliveries;
- enhanced public safety through monitoring of road conditions related to potholes, roadway debris, and weather;
- energy savings through operation of streetlights that are only lit when traffic is present;
- implementation of parking reservation systems that can help drivers find available spots; and
- increased automation of vehicle functions, including driving.[35]

In particular, the increased automation of vehicle functions has garnered considerable attention. Increased automation includes improvements that facilitate semiautonomous or fully autonomous driving, whereby the functions needed to operate a vehicle safely would be given over to automated systems relying in part on wireless communications rather than human drivers.[36] A specific example in Tennessee is the potential for wireless networks to support vehicle platooning for trucks.[37]

Vehicle platooning refers to two or more vehicles traveling in a "unified manner at electronically controlled speeds."[38] Although drivers in each vehicle still control functions like steering, automated systems in each vehicle connected wirelessly to each other can adjust speed and the distance between vehicles based on travel conditions, allowing the vehicles to travel at closer distances than would otherwise be safe and leading to gains in fuel efficiency, much like two race cars drafting off of one another. Because the automated systems in each vehicle are constantly updating each other and monitoring the road ahead, they can improve safety by reducing the amount of time needed to react to changing conditions relative to human drivers alone, according to

[35] Grijpink et al. 2020; Zantalis et al. 2019; and National League of Cities 2018.

[36] Grijpink et al. 2020.

[37] Work 2019; and Tennessee Department of Transportation "Vehicle Platooning."

[38] Tennessee Code Annotated, Section 55-8-101(55).

TDOT.[39] The General Assembly authorized vehicle platooning in Tennessee in Public Chapter 171, Acts of 2017.

Improved wireless connectivity is an important ingredient for each of the transportation applications listed above because they rely to some degree on vehicles being able to communicate with each other or with other things. According to a 2020 discussion paper by the McKinsey Global Institute, an arm of the consulting firm McKinsey & Company that focuses on developing deeper understandings of the global economy,

> this new type of "vehicle-to-everything" communication has four dimensions, with each one supporting multiple use cases and new sources of value.
>
> **Vehicle-to-network communication:** V2N provides high bandwidth, low latency, and increasingly broad coverage. This will allow cars to add new capabilities such as real-time monitoring of the driver's health condition and instant over-the-air software updates. In addition to streaming video for passengers, advanced connectivity could even deliver a full haptic/4D video or gaming experience that integrates the twists and turns of the road. We estimate that multiple types of personalized "infotainment" could create some $15 billion to $20 billion in revenue opportunities in subscription services alone. In addition, networks that support video conferencing could turn cars into "rolling offices," allowing passengers to be more productive. Advanced connectivity also makes it possible to take a more predictive and proactive approach to vehicle maintenance. Manufacturers can monitor the condition of each system in the car through signals sent by IoT sensors and notify the owner to schedule repairs before a breakdown occurs, improving the vehicle's durability and lifespan. Service offerings could even include unsupervised towing, repairs, and returns so that no time and energy is required of owners. Predictive maintenance represents a potential new revenue pool of $45 billion to $70 billion annually.
>
> **Vehicle-to-vehicle communication:** V2V technology relies on short-range connectivity. It involves cars "talking" to each other and driving cooperatively—a breakthrough that can improve the flow of traffic, avoid collisions, and pave the way for autonomous and semiautonomous driving. Vehicles can drive together more closely with shorter distances

[39] Tennessee Department of Transportation "Vehicle Platooning"; and Tennessee Department of Transportation "Vehicle Platooning: Frequently Asked Questions"; also see Work 2019.

between them at highway speeds. In addition to lessening congestion and improving fuel economy, this would increase the capacity of existing roads, lessening the need for costly new builds. Vehicles that encounter hazards such as potholes, ice patches, or debris can give others advance warning. We estimate that warning systems can lower the cost of vehicle repairs by $20 billion to $30 billion annually—not to mention the lives that can be saved and the injuries that can be prevented.

Vehicle-to-infrastructure communication: V2I, running on low- to mid-band 5G as well as short-range connectivity, enables two-way signals between vehicles and roads, traffic lights, bridges, toll collection points, and other infrastructure. This could help drivers and passengers optimize their routes, cutting down on time lost in traffic. It would also give public agencies more sophisticated tools for real-time traffic management and valuable data on road usage, public safety, and maintenance needs for future planning. Overall, we estimate that some $10 billion to $15 billion in cost savings and revenue opportunities could be realized from improved navigation systems and navigation subscription services. On top of this comes the countless hours saved and reduced city smog from better traffic planning.

Vehicle-to-pedestrian communication: Utilizing low- to mid-band 5G . . . V2P connects vehicles with smartphones and other devices held by people on the street (and with the broader environment, such as gas stations). This should improve safety by ensuring that cars react to avoid hitting pedestrians. Along with the safety element, V2P can give pedestrians an integrated view of the fastest and most comfortable way to reach their destination. We estimate that additional services such as offering parked cars to pedestrians as pick-up spots for packages, carpooling, or subscription services for automatic refueling could potentially be worth some $5 billion to $10 billion annually.[40]

While 5G and—by extension—small cells are expected to be able to support these applications, there are other wireless services that may be able to as well. Dedicated Short Range Communications (DSRC) is another wireless service platform that can support vehicle-to-vehicle and vehicle-to-infrastructure communications, operating in inclement weather, at high speeds, and with a delay of milliseconds,[41] though some in

[40] Grijpink et al. 2020.

[41] Nordrum 2016.

the wireless industry dispute whether DSRC can support the same functionality as 5G.[42] Unlike 5G—or 3G and 4G—which operates over commercial wireless networks, DSRC is operated over its own network of roadside wireless units.[43] Moreover, DSRC and 5G are not interoperable.[44] This, according to one journalist, has "created a vehicular version of the VHS-vs.-Betamax format fight of the late 1970s and early 1980s."[45] A winner has yet to be declared. Although TDOT's I-40 Smart Fiber Project—which will expand the Department's intelligent transportation systems capabilities between Memphis and Nashville—will include the deployment of DSRC units,[46] the Department in March 2020 began working with a firm that can support both DSRC and vehicle communications that use commercial wireless networks.[47]

Other Opportunities for Small Cells to Support New or Enhanced Wireless Applications

There are also multiple new or enhanced wireless applications in addition to those related to transportation that could potentially be supported by 5G and small cells. Many of these applications involve wirelessly connected devices, often referred to as the Internet of Things (IoT). By definition, the devices that make up the Internet of Things—whether for home appliances, sensors embedded in public infrastructure, or machines on a factory floor—rely on connectivity.[48] Examples of these applications include a variety of private-sector and public-sector uses, including but not limited to

- improved remote patient monitoring for healthcare through the use of wearable devices or implants that can provide information on vital functions, such as heart rate, blood oxygen levels, blood sugar levels, or temperature;
- multiple applications for manufacturing and other industries, such as
    - 3-D bin picking, whereby "robots will be able to use sophisticated vision systems to locate parts regardless of their location,"[49]

[42] 5G Americas 2018.

[43] 5G Americas 2018; and Wassom 2018.

[44] Alleven 2018.

[45] Bigelow 2019.

[46] Goldstein 2020.

[47] Integrity Security Services 2020.

[48] Zantalis et al. 2019.

[49] Grijpink et al. 2020.

    - use of augmented reality by workers via specialized eyewear that "display instructions in [the workers'] visual field to guide tasks such as quality inspections,"[50]
    - use of artificial intelligence to allow for automated quality control, and
    - other automated operations that call for high levels of precision and output;
- enhanced retail experiences for customers both in-store and through personalized promotions; and
- multiple public sector uses, such as
    - monitoring operations of public infrastructure, including water and other utility systems,
    - monitoring environmental conditions, including weather, air quality, and water pollution levels, and
    - enhancements in public safety, for example, through the use of equipment that can monitor for gun shots.[51]

Despite this potential, some remain skeptical, at least for the near-term. A 2019 survey by McKinsey & Company of 46 chief technology officers directly engaged in 5G development plans around the world found that

> the biggest uncertainties for industry professionals lie around the strength of the business cases and the underlying economics, as well as other emerging commercial considerations. Confidence in [5G] is high, but less clear is whether and how soon it can fuel new products and services that customers are willing to pay for.[52]

The same survey also found that many participants viewed improved customer experience and support for IoT as secondary concerns for 5G. Instead, these participants saw 5G "as an opportunity to cement, gain, or regain network leadership," with "around half [viewing] such competitive positioning as the number-one priority for 5G."[53]

---

[50] Ibid.

[51] Grijpink et al. 2020; Zantalis et al. 2019; and National League of Cities 2018.

[52] Grijpink et al. 2019.

[53] Ibid.

Long-term, however, there is greater optimism. More 5G smartphones are becoming available for consumers,[54] and wireless providers are announcing the availability of 5G service in more communities.[55] While 5G is not without skeptics, McKinsey & Company concluded that overall, its 2019 survey "paints a picture of 5G as a powerful new technology just waiting to be tapped for innovative new uses . . . one that even, many countries believe, has the potential to create and advance entire economies."[56] Given this potential and the role of small cells in improving existing wireless networks, policymakers at the federal level and in states, including Tennessee, have taken steps to facilitate the deployment of small cells.

Public Chapter 819 creates a consistent regulatory framework for local governments and flexibility for TDOT; inconsistencies with the Federal Communications Commission's order don't require action.

Tennessee's small cell law—the Competitive Wireless Broadband Investment, Deployment, and Safety Act of 2018 (Public Chapter 819, Acts of 2018)—establishes the obligations of those deploying small cells and places limits on state and local authority to regulate them. It applies only to small cells located in public rights-of-way. Described by the Municipal Technical Advisory Service (MTAS) and the Tennessee Municipal League (TML) as "an imperfect solution that required compromise," the Act is "the result of months-long negotiations between the wireless industry and the bill's sponsors and representatives of local government, municipal electric providers, electric cooperatives, and the cable industry."[57] Among its provisions (see appendix A), Public Chapter 819

- defines the facilities that qualify as small cells;[58]
- establishes the types of deployments or work for which applications can be required;[59]
- specifies the information that local governments can require in applications;[60]

[54] O'Donnell 2020; Fletcher 2020; and Stern 2020.

[55] T-Mobile 2020b; and Fletcher 2019.

[56] Grijpink et al. 2019.

[57] Municipal Technical Advisory Service and Tennessee Municipal League 2018.

[58] Tennessee Code Annotated, Sections 13-24-402 and 13-24-408.

[59] Tennessee Code Annotated, Sections 13-24-407 and 13-24-410.

[60] Tennessee Code Annotated, Section 13-24-409.

- sets time limits—often referred to as shot clocks—for local governments to act on applications;[61]
- sets maximum fees both for applications and for attaching to structures owned by local government entities other than municipal electric systems,[62] while applying existing cost-based fees for use of public rights-of-way to small cells;[63]
- establishes the limits of local authority to enforce requirements related to aesthetics, location, spacing, and placement underground;[64] and
- preserves state and local authority to manage public rights-of-way, including to prevent damage, protect existing utilities, and protect public safety.[65]

These provisions create a consistent local framework for regulating small cells in communities throughout the state. Tennessee is one of 28 states that, along with the Federal Communications Commission (FCC), has adopted a framework governing the regulation of small cells (see map). Although the specifics adopted in each differ to varying degrees—and Delaware's small cell law applies only to its department of transportation—the overall frameworks touch on a relatively consistent set of policy issues (see appendix C).

[61] Ibid.

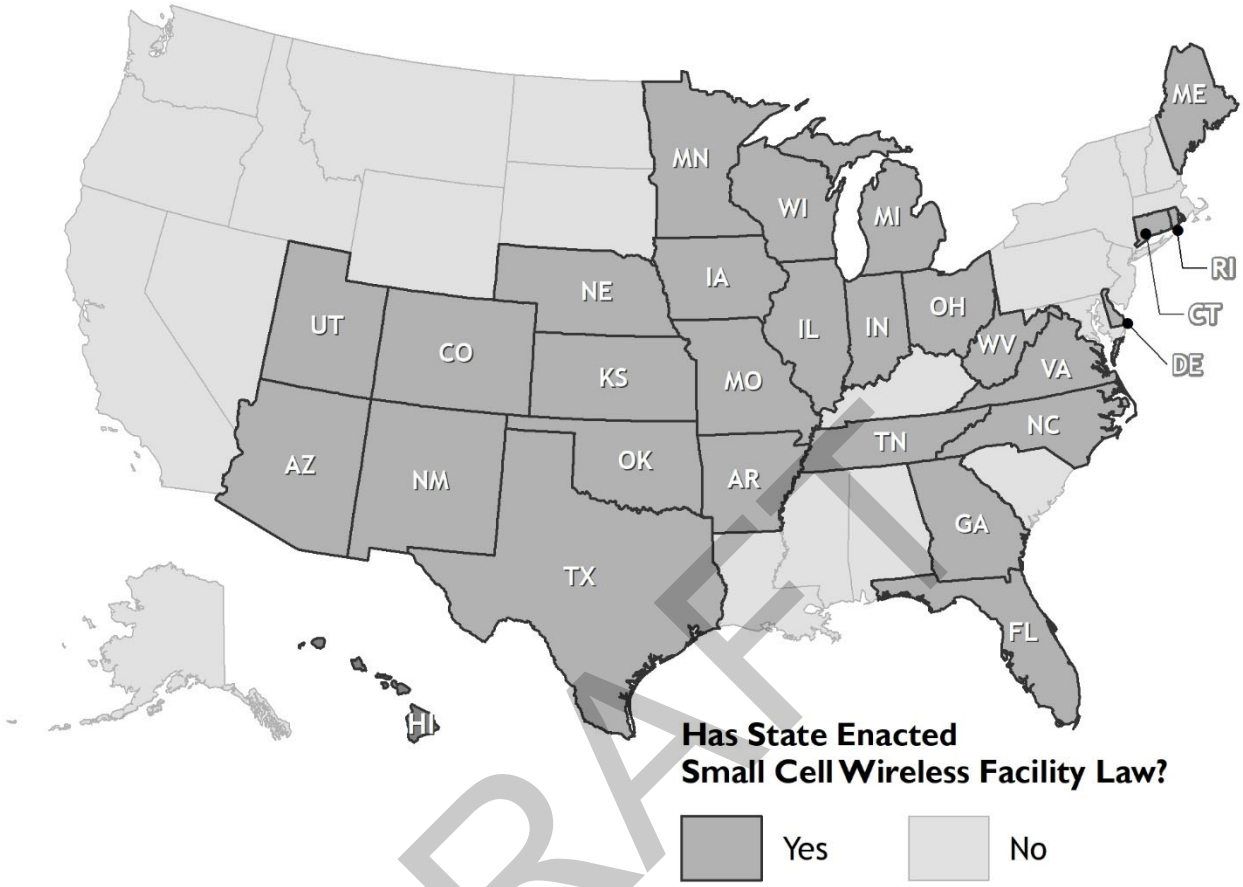
[62] Tennessee Code Annotated, Sections 13-24-408 and 13-24-410.

[63] Tennessee Code Annotated, Sections 13-24-405(3) and 65-21-103; and Bellsouth Telecommunications, Inc. v. City of Memphis, 160 S.W.3d 901 (Court of Appeals of Tennessee 2004), cert. denied 2005 Tenn. LEXIS 3.

[64] Tennessee Code Annotated, Sections 13-24-402, 13-24-408, and 13-24-411.

[65] Tennessee Code Annotated, Sections 13-24-405 and 13-24-411.

Map: States with Small Cell Laws



Source: TACIR staff review of state laws.

Although Tennessee's law places limits on local governments and the state, it "does not grant unfettered authority to deploy small cells," according to MTAS and TML.[66] Local authority to "promulgate limits, permitting requirements, zoning requirements, approval policies, or processes regulating the deployment of small cells within their jurisdictional boundaries" is preserved, provided that "any limits, requirements, policies, or processes may not be more restrictive or in excess of what is permitted under the new law."[67] State authority related to rights-of-way under TDOT's control is also preserved.[68]

[66] Municipal Technical Advisory Service and Tennessee Municipal League 2018.

[67] Ibid.

[68] Tennessee Code Annotated, Section 13-24-410.

TDOT and Tennessee's Small Cell Law: More Flexibility for State

The Act generally includes greater flexibility for the state, compared with local governments (see appendix D). For example, if local governments don't review applications within the time limits established in the Act, the applications are automatically deemed approved.[69] In contrast, the Act grants TDOT discretion to extend the time needed for review, and applications cannot be deemed approved until "affirmatively acted upon" by the Department.[70] Similarly, limitations placed on the information that can be required in applications and the grounds for denying applications apply only to local governments.[71] Prohibitions against mandating minimum spacing between small cells, passing on consultant fees to applicants, or requiring in-kind contributions from applicants also apply only to local governments.[72]

While earlier versions of the small cell bill would have compelled TDOT to comply with more stringent requirements,[73] they could have placed the Department out of compliance with federal regulations, jeopardizing federal funding, according to the fiscal memorandum accompanying the bill.[74] Specifically, the bill's prohibition against setting minimum distances between small cells and their support structures originally applied not only to local governments but also to TDOT and billboards used as support structures for small cells along highways. Based on correspondence between TDOT staff and staff of the Fiscal Review Committee, this would have taken the Department out of compliance with its obligation to maintain effective control over billboards, including spacing, along federal interstates, under 23 US Code 131. This could have resulted in the loss of 10% of the Department's federal funding annually—a loss of approximately $91 million in fiscal year 2018-19.[75] According to interviews with TDOT staff and presentations to the Commission, the Department's regional offices are

[69] Tennessee Code Annotated, Section 13-24-409.

[70] Tennessee Code Annotated, Section 13-24-410.

[71] Tennessee Code Annotated, Section 13-24-409.

[72] Tennessee Code Annotated, Sections 13-24-407 and 13-24-408.

[73] House Bill 2279 by Representative Lamberth, Senate Bill 2504 by Senator Ketron, version filed for introduction January 31, 2018, in the House of Representatives and February 1, 2018, in the Senate.

[74] Fiscal memorandum for House Bill 2279 and Senate Bill 2504, Fiscal Review Committee, February 13, 2018.

[75] Email correspondence between Jennifer Herstek, director of finance, Tennessee Department of Transportation, and Jessica Himes, local government fiscal analyst, Fiscal Review Committee, Tennessee General Assembly, February 13, 2018; and fiscal memorandum for House Bill 2279 and Senate Bill 2504, Fiscal Review Committee, February 13, 2018.

reviewing applications within the time limits set for local governments, and TDOT is satisfied with the current framework.[76]

Comparing Tennessee's Small Cell Law with the FCC's Small Cell Order: Inconsistencies Exist, Action Not Currently Required

Similar to Tennessee's law, the FCC's small cell order, which applies to all states regardless of whether they have adopted small cell laws, establishes limits on state and local authority to regulate small cells.[77] Except for two provisions regarding the enforcement of aesthetic requirements—which were vacated and remanded to the FCC for further action—the order was upheld by the US Court of Appeals for the Ninth Circuit in City of Portland v. United States, 2020 U.S. App. LEXIS 25553 (August 12, 2020). The ruling has not been appealed, at this time. Overall, the FCC order addresses many of the same issues as Tennessee's law (see appendix C). The specific policies adopted in the FCC order are generally similar to those in Tennessee, as well, but inconsistencies exist (see appendix E).

Some of the inconsistencies between Tennessee's small cell law and the FCC order are related to the basic application of each framework: While Public Chapter 819 excludes municipal utilities from its provisions, the FCC order does not.[78] Even the definition of what qualifies as a small cell and the maximum height of support structures differ between the state's law and the FCC order. The maximum size for small cells is larger under the Act than the FCC order, and the state sets separate maximum heights for support structures in residential and non-residential areas, but the FCC order does not. See appendix E.

Other inconsistencies affect various operational aspects of each framework, including but not necessarily limited to application review, fees, and authority related to aesthetics:

- Application Review: State law and the FCC order differ regarding the time limits for application review and whether applications are deemed approved if time limits are exceeded. Under state law, applications must be reviewed within 60 days, 75 days, 90 days, or 120 days depending on the number of small cells applied for within a 30-day period. The 60-day time limit can be extended to 75

[76] Interviews with Tennessee Department of Transportation staff; and Panel discussion of Public Chapter 819, Acts of 2018, TACIR Meeting, January 17, 2020.

[77] Federal Communications Commission 2018.

[78] Tennessee Code Annotated, Sections 13-24-402 and 13-24-403; Federal Communications Commission 2018; and City of Portland v. United States, 2020 U.S. App. LEXIS 25553 (9th Cir. 2020).

days if requested by a local government within 30 days of receiving an application, and applicants can pay $100 per small cell to have applications subject to the 120-day time limit reviewed on a shorter timeline. Under the FCC order, applications must be reviewed within either 60 days for those involving colocation on existing support structures or 90 days for those involving installation of new support structures. While applications are automatically deemed approved when the state time limits are exceeded, they are not when the FCC time limits are exceeded.[79] See appendix E.

- Fees: State law and the FCC order differ regarding the maximum fees that can be charged for applications, right-of-way access, and pole attachments, as well as whether consultant fees can be passed on to applicants. Under state law, beginning on January 1, 2020, application fees are capped at $110 per small cell for the first five small cells in a single application and $55 per small cell remaining in the same application—the maximums increase by 10% every five years. In contrast, the FCC caps application fees at cost, though it adopted thresholds below which fees are presumed acceptable of (A) $500 total for the first five small cells in a single application involving colocation and $100 per small cell remaining in the same application and (B) $1,000 per small cell for applications requiring installation of new support structures. Although the state caps recurring fees for right-of-way access at cost and caps fees for attaching to poles owned by local governments excluding those owned by municipal utilities at $100 per small cell annually, the FCC caps both at cost and adopted a threshold below which fees are presumed acceptable of $270 per small cell, per year, combined for right-of-way fees and pole attachments. Moreover, the state prohibits local governments from passing on fees from consultants to applicants, but the FCC does not.[80] See appendix E.
- Aesthetics: State law and the FCC order are similar regarding enforcement of aesthetic requirements. Both authorize local governments to enforce aesthetic standards—though the FCC's requirements that these standards be objective and no more burdensome than those applied to other infrastructure were vacated and remanded for further consideration in *City of Portland*. Both also authorize

[79] Tennessee Code Annotated, Section 13-24-409; Federal Communications Commission 2018; and 47 Code of Federal Regulations 1.6003(c).

[80] Tennessee Code Annotated, Sections 13-24-402, 13-24-405, 13-24-407, 13-24-410, and 65-21-103; Bellsouth Telecommunications., Inc. v. City of Memphis, 160 S.W.3d 901 (Court of Appeals of Tennessee 2004), cert. denied 2005 Tenn. LEXIS 3; and Federal Communications Commission 2018. Note: Under state law, local governments are also authorized to charge a one-time fee of $200 for the first application filed by each applicant.

local governments to apply requirements that utilities be placed underground to small cells under certain conditions. However, the state prohibits local governments from requiring minimum spacing between small cells, while the FCC does not. The state further prohibits local governments from requiring that small cells be placed on specific support structures or categories of support structures—effectively prohibiting requirements to colocate on existing support structures—but authorizes enforcement of requirements that small cells be placed near property boundaries in residential areas, neither of which is addressed in the FCC order.[81] See appendix E.

The inconsistencies between Tennessee's small cell law and the FCC order don't appear to be sources of widespread concern, so far, based on interviews with local officials and those in the wireless industry. Officials from one city reported concerns about differences in the maximum allowable height for support structures, particularly for residential areas, because there are circumstances under which state law authorizes taller support structures compared with the FCC order. Officials from this city also reported that differences in the state and federal time limits for application review can cause confusion, and they noted inconsistencies related to the maximum size allowable for small cells and the number of small cells allowed in a single application.[82] No other specific concerns related to the differences between state law and the FCC order were raised in interviews. So far, these differences don't appear to have altered the effect of Tennessee's small cell law on broadband deployment.

The Act has had minimal effect on broadband expansion in unserved areas.

Tennessee's small cell law has not accelerated the expansion of broadband to previously unserved areas. In a presentation to the Commission and in interviews with staff, wireless providers said that initially small cells will be deployed to serve more populated areas with greater capacity needs and those areas, like interstate interchanges, where many people are passing through.[83] Although an exact count of current and planned small cell deployments statewide could not be obtained from providers because of the business-sensitive nature of these deployments,[84] the general trend providers described has been borne out in interviews with local officials. The vast

[81] Tennessee Code Annotated, Sections 13-24-402, 13-24-408, and 13-24-411; Federal Communications Commission 2018; and City of Portland v. United States, 2020 U.S. App. LEXIS 25553 (9th Cir. 2020).

[82] Interviews and correspondence with local officials.

[83] Panel discussion of Public Chapter 819, Acts of 2018, TACIR Meeting, January 17, 2020; and interviews with wireless providers.

[84] Interviews with wireless providers.

majority of small cells in Tennessee are located in the state's four largest cities. In particular, the Metropolitan Government of Nashville and Davidson County reported that it approved and permitted 838 small cells from November 2017 to April 2020. It expects to receive almost that many new applications from one provider alone through the end of 2020. Other cities throughout the state reported at most several dozen applications for small cells, with many receiving only a handful. Several officials said their cities had not yet received any small cell applications, with two reporting that their only applications predated enactment of the state law. Counties contacted did not report any small cell applications for their unincorporated areas.[85]

Given small cells' limited range and the need to deploy many of them to serve a community, it can be too expensive to deploy them in rural areas.[86] According to *The Wall Street Journal*, "population density, household income, and five-year population growth are among the factors tower companies and wireless carriers typically consider in deciding where to install new equipment."[87]

Broadband access is more likely to exist already in the communities where small cells are primarily being deployed in Tennessee. In its 2017 report on broadband deployment, availability, and adoption, the Commission found that a greater percentage of residents in urban areas live in census blocks where providers report offering broadband, compared with rural areas, as broadband access tends to be greater in areas with greater population density. But there are densely populated areas where no provider reports offering broadband, and improvements to wireless networks resulting from the deployment of small cells could bring better service to these communities.[88]

However, mobile wireless service isn't necessarily a comparable substitute for wireline service for home and business users at this time. Mobile wireless service plans restrict the amount of data subscribers can use relative to wireline providers. Even mobile wireless providers offering unlimited data plans say users' internet speeds may be reduced during months when they have used a specified amount of data, in most cases less than 100 gigabytes.[89] In contrast, some wireline providers offer plans without data

[85] Interviews and correspondence with local officials.

[86] Hart 2018.

[87] Krouse and Pacheco 2019.

[88] Tennessee Advisory Commission on Intergovernmental Relations 2017.

[89] Verizon 2020; T-Mobile 2020a; and AT&T 2020.

caps or with data caps up to 1,200 gigabytes.[90] The median amount of data used by one wireline providers' residential subscribers for the six months ending in June 2020 was more than 300 gigabytes per month.[91] While the Act might not be a solution for communities that currently lack broadband, it has helped support the rollout of small cells, according to the wireless industry.

Wireless providers say the Act helped accelerate deployment of small cells in Tennessee, but time limits for review could burden some communities.

Although Public Chapter 819's effect on broadband deployment in unserved areas has been minimal, wireless providers report that it facilitated investment in Tennessee. This is in contrast to the FCC order at the national level, which at least one provider said has not affected their investment decisions.[92] But in Tennessee, one provider interviewed said that it deployed 12 times the number of small cells in the year following passage of the state's small cell law, compared with the year before.[93] In presentations to the Commission and in hearings before the General Assembly, providers also said that the state's law helped them steer resources from offices in other states to invest in projects in Tennessee. They said this helped Tennessee initially get ahead of other states in the southeast, such as Georgia and Florida, that have larger population centers.[94]

Overall, representatives for wireless providers remain supportive of the framework established in the current law.[95] Several aspects of the law appear to be examples of best practices from the industry's perspective, based on interviews with staff. In particular, one provider said the law demystifies the process of deploying small cells by laying out the information that needs to be provided in applications. This provider also said the time limits for application review—see appendix E—have created an incentive for local governments to work with industry.[96]

---

[90] Google Fiber 2020; and Comcast 2020a.

[91] Comcast 2020b.

[92] Verizon 2018.

[93] Interview with wireless provider.

[94] Panel discussion of Public Chapter 819, Acts of 2018, TACIR Meeting, January 17, 2020; and hearing on House Bill 2150 by Representative Zachary in the House Utilities Subcommittee, March 4, 2020.

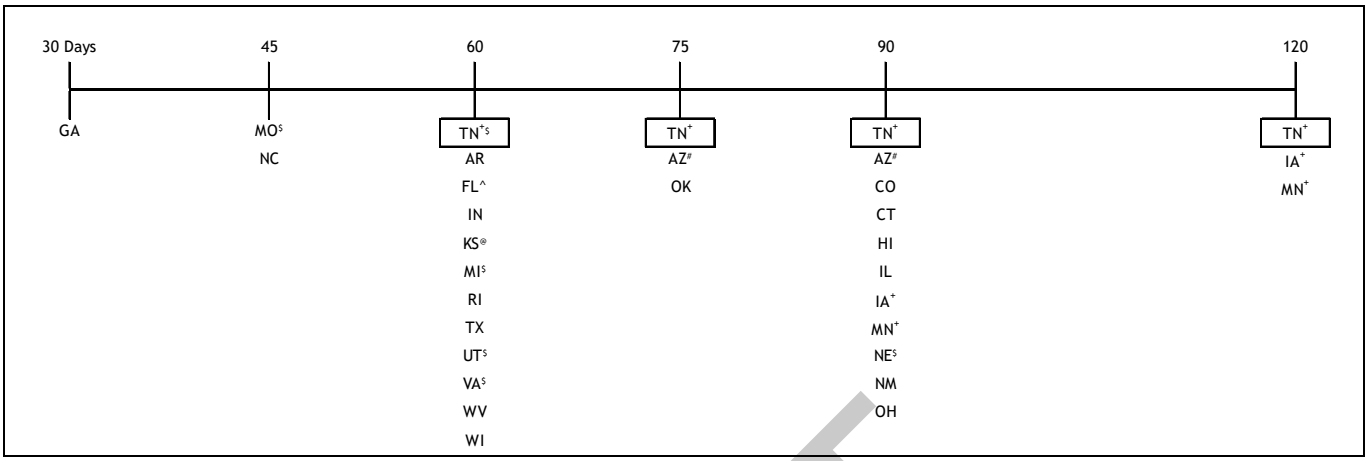
[95] Interviews with wireless providers; panel discussion of Public Chapter 819, Acts of 2018, TACIR Meeting, January 17, 2020; and hearing on House Bill 2150 by Representative Zachary in the House Utilities Subcommittee, March 4, 2020.

[96] Interviews with wireless providers.

But the time limits are a source of concern for some local governments. Of the local officials from the 40 local governments interviewed for this study, one dismissed the time limits outright as too short, a few said the time limits would be too short were they to receive many applications at once, and two said the limits don't leave enough time to work with applicants to resolve disputes related to issues such as small cell design or location. Officials from most of the local governments interviewed did not mention concerns regarding the time limits in state law,[97] and Tennessee's limits fall within the range adopted by other states (see figures 2 and 3). Tennessee is one of three states—Iowa and Minnesota are the others—where time limits automatically increase based on the number of small cells applied for in a time period set in state law. Of the 26 states that set time limits in state law for local governments to act on small cell applications, Tennessee is one of 24 in which applications are deemed approved if time limits are exceeded (see table 1). Other concerns with Tennessee's small cell law raised by the wireless industry or state or local officials were related to the aesthetics of small cells, local authority to manage public rights-of-way, and the maximum application fees local governments are authorized to impose.

[97] Interviews with local officials.

Figure 2: State Limits on the Amount of Time for Local Governments to Process Complete Applications to Colocate Small Cells on Existing Structures*



* The Federal Communications Commission adopted a time limit of 60 days for local governments reviewing applications for small cell colocated on existing support structures.

\+ Time limit varies based on the number of small cells applied for in time period specified in state law in Tennessee (60, 75, 90, or 120 days), Iowa (90 or 120 days), and Minnesota (90 or 120 days).

^ Under Florida law, time limit is extended to 90 days if applicant rejects request by local government to use an alternate location.

@ Under Kansas law, time limit applies only to applications containing no more than 25 small wireless facilities.

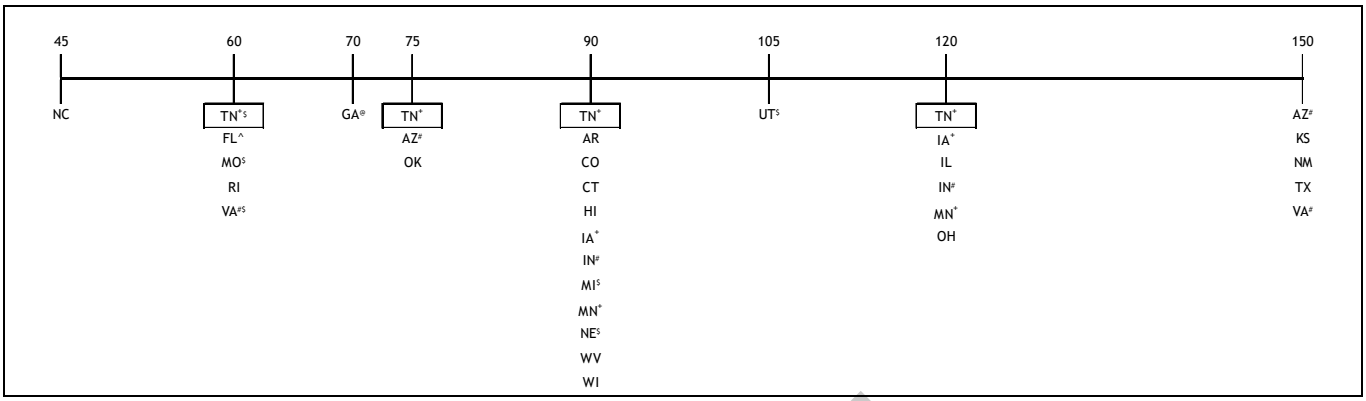
$ Under certain circumstances specified in law, time limit can be extended at request of local government in Michigan, Missouri, Nebraska, Utah, Virginia, and Tennessee. Note that in Tennessee only the 60-day time limit can be extended.

Under Arizona law, time limit varies depending on whether project is subject to zoning review (90 days) or not (75 days).

Additional notes:
— In 11 states, the time limit for processing applications doesn't begin until an application is deemed complete; in the remaining 17 states with small cell laws, the time limit can be halted if an application is deemed incomplete.
— Delaware not shown because its law, which sets a time limit of 60 days, applies only to its state department of transportation; Maine not shown because its law does not set a time limit for reviewing applications; other 22 states not shown have not enacted small cell laws.
— In 14 states, separate time limits (not shown here) apply to small cell applications involving requests to construct new or replace or modify existing utility poles or support structures.

Source: TACIR staff review of state laws; Federal Communications Commission 2018; and 47 Code of Federal Regulations 1.6003(c).

Figure 3: State Limits on the Amount of Time for Local Governments to Process Complete Applications for Small Cells Requiring New Poles*



* The Federal Communications Commission adopted a time limit of 90 days for local governments reviewing applications for small cells requiring new support structures.

\+ Time limit varies based on the number of small cells applied for in time period specified in state law in Tennessee (60, 75, 90, or 120 days), Iowa (90 or 120 days), and Minnesota (90 or 120 days).

^ Under Florida law, time limit is extended to 90 days if applicant rejects request by local government to use an alternate location.

@ Under Georgia law, joint applications that include both colocations on existing structures and placements on new poles must be reviewed within 60 days.

$ Under certain circumstances specified in law, time limit can be extended at request of local government in Michigan, Missouri, Nebraska, Utah, Virginia, and Tennessee. Note that in both Tennessee and Virginia only the 60-day time limit can be extended.

\# Time limit varies depending on whether project is subject to zoning review (150 days in Arizona, 120 days in Indiana, and 150 days in Virginia) or not (75 days in Arizona, 90 days in Indiana, and 60 days in Virginia).

Additional notes:
— In 11 states, the time limit for processing applications doesn't begin until an application is deemed complete; in the remaining 17 states with small cell laws, the time limit can be halted if an application is deemed incomplete.
— Delaware not shown because its law, which sets a time limit of 60 days, applies only to its state department of transportation; Maine not shown because its law does not set a time limit for reviewing applications; other 22 states not shown have not enacted small cell laws.
— In 14 states, separate time limits (not shown here) apply to small cell applications involving requests to colocate on existing structures.

Source: TACIR staff review of state laws; Federal Communications Commission 2018; and 47 Code of Federal Regulations 1.6003(c).

Table 1: Are Small Cell Applications Deemed Approved if Local Governments Exceed State Time Limit for Review?*

Yes	No
TN, AR+, AZ^, FL, GA@, HI, IA, IL$, IN, KS, MI#, MN, MO, NC, NE, NM, OH, OK, RI, TX, UT, VA, WI, WV (24)	CO, CT (2)

* Under the Federal Communications Commission's 2018 small cell order, applications are not deemed approved if federal time limits for review are exceeded by state or local governments.

+ Under Arkansas law, applications are deemed approved 10 days after applicant provides written notice to local government that time limit has been exceeded.

^ Under Arizona law, only applications to cities are deemed approved if time limits are exceeded. Applications to counties are not.

@ Under Georgia law, applications are deemed approved 20 days after applicant provides written notice to local government that time limit has been exceeded.

$ Under Illinois law, applications are deemed approved for exceeding time limit only if applicant has notified local government at least 15 days prior to time limit expiring that it will seek to enforce deemed-approved remedy.

Under Michigan law, applicants must give local governments 7-days notice before beginning work once application has been deemed approved for missing time limit.

Note: Delaware not shown because its small cell law applies only to its state department of transportation; Maine not shown because it doesn't set time limits in its small cell law; other 22 states not shown have not enacted small cell laws.

Source: TACIR staff review of state laws; and Federal Communications Commission 2018.

The effect of small cells on local aesthetics is a source of widespread concern.

Aesthetics are among the most widespread concerns related to small cells and the framework established in Public Chapter 819, Acts of 2018. Nearly every local official interviewed whose community had received small cell applications expressed either general or specific concerns about the ways in which small cells would affect the aesthetics of their communities, including but not limited to the color of small cells, the design of the poles on which they are located, and the additional equipment that is sometimes hung on the side of these poles. Some of these concerns stem from the

investments local governments have made. Multiple officials observed that they—and in some cases the state—have spent significant resources in recent years on the appearance of their rights-of-way to improve the aesthetics of their communities, for example by installing decorative light fixtures or by requiring existing utilities to be moved underground. Others noted the likelihood of complaints from residents, and one private individual contacted TACIR staff with concerns about small cells' effect on property values. Several officials advocated for greater local control over small cells, particularly when it comes to their location.[98]

Aesthetic Plans: Existing Authority

Protecting aesthetics was among the motivating factors for local officials during the legislative process that resulted in Public Chapter 819. According to MTAS and TML, officials were "concerned that the unencumbered deployment of small cells would harm the character and aesthetic appeal of their communities that they and residents had invested resources and energy in establishing, protecting, and promoting."[99] The Act includes provisions that preserve at least some local authority related to aesthetics.

Local governments have authority under the Act to require that small cells conform to adopted aesthetic plans.[100] These plans need not be "singular, overarching" documents, according to MTAS and TML.[101] Rather they include "any written resolution, regulation, policy, site plan, or approved plat that imposes any aesthetic restrictions or requirements."[102] And while aesthetic plans can apply throughout out a community, they don't have to. As described by MTAS and TML, through these plans "the Act affords [local governments] the ability to adopt and enforce limits or requirements throughout . . . or within a portion of [their jurisdiction], for the purposes of preserving and promoting the desired aesthetics."[103]

However, the law includes restrictions on local aesthetic plans. To be enforceable, local aesthetic plans

- must be non-discriminatory and generally applicable to other entities deploying infrastructure in public rights-of-way and

[98] Interviews and correspondence with local officials; and correspondence with private citizens.

[99] Municipal Technical Advisory Service and Tennessee Municipal League 2018.

[100] Tennessee Code Annotated, Sections 13-24-402 and 13-24-411.

[101] Municipal Technical Advisory Service and Tennessee Municipal League 2018.

[102] Ibid.

[103] Ibid.

- cannot preclude all deployment of small cells.[104]

In other words, according to MTAS and TML,

> a written regulation would not qualify as an aesthetic plan if it only applied to small cell providers but not utility operators. Similarly, a policy would not qualify as an aesthetic plan if it applied to one small cell provider but not others. Moreover, an aesthetic plan is not valid if the requirements have the effect of precluding the deployment of any small cells.[105]

The FCC order and federal law also apply to aesthetic plans. As noted above, the FCC's requirements that aesthetic standards be reasonable and published in advance were upheld by the Ninth Circuit Court of Appeals in *City of Portland*. But requirements that aesthetic standards be objective and no more burdensome than those applied to other infrastructure were vacated and remanded to the FCC for further consideration.[106] Under federal law, states and local governments cannot enforce requirements that either "unreasonably discriminate among providers of functionally equivalent services" or "prohibit or have the effect of prohibiting the provision of personal wireless services."[107]

Of the 27 states with small cell laws that apply to local governments,[108] 24—including Tennessee—preserve at least some local authority related to aesthetics, subject to limitations. These limitations vary from state to state, but they include requirements that aesthetic standards be reasonable (14 states), objective (11 states), published in advance (11 states, including Tennessee), non-discriminatory or generally applicable (13 states, including Tennessee), and not have the effect of prohibiting small cells (11 states, including Tennessee). See table 2 and appendix F.

[104] Tennessee Code Annotated, Sections 13-24-402 and 13-24-411.

[105] Municipal Technical Advisory Service and Tennessee Municipal League 2018.

[106] City of Portland v. United States, 2020 U.S. App. LEXIS 25553 (9th Cir. 2020).

[107] 47 US Code 332(c)(7)(B)(i).

[108] Delaware's law applies only to its department of transportation.

Table 2: Does State Small Cell Law Address Local Authority to Enforce Aesthetic Standards?*

Addressed		Not Addressed
No Limitations	Subject to Limitations	
(0)	**TN**, AR, AZ, FL, GA, HI, IA, IL, IN, KS, MI, MN, MO, NC, NE, NM, OH, OK, RI, TX, UT, VA, WI, WV (24)	CO, CT, ME (3)

* The FCC preserved local authority to enforce aesthetic standards that are published in advance, no more burdensome than standards applied to other infrastructure, objective, and reasonable, in its 2018 small cell order. However, requirements that aesthetic standards applied to small cells by states and local governments be 1) no more burdensome than those for other infrastructure and 2) objective were vacated and remanded to the FCC for further action by the US Court of Appeals for the Ninth Circuit in City of Portland v. United States, 2020 U.S. App. LEXIS 25553 (August 12, 2020). The Court upheld the remainder of the Order. At this time, the ruling has not been appealed, and the FCC has not taken action on the portions of the Order that were vacated and remanded.

Note: Delaware not shown because its law, which includes authority to enforce aesthetic standards, applies only to the state's department of transportation. Other 22 states not shown here have not enacted small cell laws.

Source: TACIR staff review of state laws; and Federal Communications Commission 2018.

Many of the 40 local governments interviewed are making use of their authority related to aesthetic plans. Several local officials said they enforce specific requirements that small cells and their equipment be painted the same color as other infrastructure in public rights-of-way. Others said they require any new poles installed for small cells to be similar to existing poles in areas where decorative poles are required and to be made of the same material as other poles, preventing small cell applicants from installing wood poles in areas where existing utility poles are required to be metal. While most of the local officials interviewed said their communities have either adopted ordinances that apply to small cells or are in the process of adopting them, several have not and are applying existing standards to small cells.[109]

The wireless industry supports the adoption of objective aesthetic standards that meet Public Chapter 819's requirements as a best practice. At least one company in the

[109] Interviews with local officials.

wireless industry further stressed the importance that standards be adopted and communicated to applicants in advance because they improve transparency, citing friction with one community that waited until construction of a small cell was almost complete to object to the project's aesthetics.[110] Several local officials and a consultant who works with local governments also recommended holding pre-meetings with applicants before they submit applications to review aesthetic standards.[111]

A Picket Fence of Small Cells: New Poles vs. Colocation on Existing Poles

Although the authority granted to local governments under the Act preserves at least some local control over community aesthetics, long-term concerns remain about the potential number of new poles that could be installed in public rights-of-way. Some new poles will be necessary given the limited range of small cells and the lack of existing poles or other above-ground support structures in communities with underground utilities.[112] However, officials from nearly one-third of the 40 local governments interviewed said that they are concerned about the effect new poles could have on community aesthetics, particularly as more applicants begin deploying small cells. Their concerns are less about the appearance of individual poles than about the potential that several sets of poles would be installed along stretches of right-of-way by multiple different applicants, creating what some characterized as a picket fence of small cells.[113]

Unilateral local authority to address long-term concerns about the number of new poles in public rights-of-way through Public Chapter 819 appears to be limited. It may be possible to use existing authority to limit the number of new poles in a given area under aesthetic plans. According to MTAS and TML,

> if the site plan for a development limited the height or number of vertical structures permitted within the area or required all utilities to be buried underground, then these elements of the site plan would . . . constitute an aesthetic plan.[114]

---

[110] Interviews with wireless providers.

[111] Interviews with local officials and consultants.

[112] Interviews with wireless providers; also see discussion above on the limited range of small cells when using high frequencies.

[113] Interviews with local officials.

[114] Municipal Technical Advisory Service and Tennessee Municipal League 2018.

But under other provisions of Public Chapter 819, local governments must allow small cell applicants to seek waivers that would authorize placement of new poles for small cells in areas where electric, cable, and other communications infrastructure is otherwise required to be underground. The Act also prohibits local governments from requiring that small cells be placed on specific poles or categories of poles, preventing them from requiring colocation on existing poles. It further prohibits them from requiring that small cells or the poles supporting them be spaced a minimum distance apart—though local governments can require that small cells be located close to property boundaries in residential neighborhoods.[115]

Local authority over the placement of new poles varies across states. Among the 27 states with small cell laws that apply to local governments, eight authorize local governments to require alternate locations for small cells. In each state, however, this authority is subject to limitations. Some states require an alternate location to be within a certain distance of the original proposed site, while requirements that alternate locations not impose technical limitations or significant added costs are also common. North Carolina authorizes local governments to require applicants seeking to install new poles to evaluate the feasibility of using existing locations and authorizes local governments to require this information to be included in applications but does not specifically authorize local governments to require the use of alternate locations. See table 3 and appendixes G and H.

[115] Tennessee Code Annotated, Sections 13-24-408 and 13-24-411.

Table 3: Does State Small Cell Law Allow Local Governments to Require Alternate Locations?*

Yes		Can Require Information on Feasibility	No	Not Addressed
Subject to Limitations	Without Limitations			
AR, GA, IL, IN, MI, OH, VA, WI (8)	(0)	NC (1)	**TN**, AZ, FL, HI, KS, MN, MO, NE, OK, UT (10)	CO, CT, IA, ME, NM, RI, TX, WV (8)

* The Federal Communications Commission's 2018 small cell order doesn't specifically address state or local requirements for alternate locations.

Additional Notes:
— North Carolina authorizes local governments to require that applicants seeking to install new poles evaluate the reasonable feasibility of colocating their small cells on existing structures within their search area and, as part of application, can require information necessary to determine whether colocation is feasible.
— Delaware not shown because its small cell law applies only to its department of transportation; other 22 states not shown have not enacted small cell laws.

Source: TACIR staff review of state laws; and Federal Communications Commission 2018.

In 12 of the 27 states with small cell laws that apply to local governments, and under the FCC order, local governments are authorized to require minimum spacing between small cells, subject to limitations (see table 4 and appendixes E, G, and I). Similarly, among the provisions in an ordinance adopted prior to enactment of Public Chapter 819, the Metropolitan Government of Nashville and Davidson County prohibited installation of new support structures in public rights-of-way within 500 feet of existing support structures.[116] One of the purposes of the ordinance was to prioritize colocation of small cells on existing structures to prevent the proliferation of poles that could create visual clutter or obstruct pedestrians.[117] Commenting on the ordinance prior to its adoption, wireless providers said that the distance "does not take into account the use of the current and potential future technologies which require small cell wireless

[116] Metropolitan Government of Nashville and Davidson County Ordinance No. BL2016-415.

[117] Joint meeting on telecommunication discussion items of the Budget and Finance Committee and the Public Works, Planning, Zoning, and Historical Committee, Metropolitan Government of Nashville and Davidson County, October 17, 2016.

antenna to be closer to each other in an urban environment."[118] In interviews with TACIR staff, one company in the wireless industry said that spacing requirements can make deploying small cells difficult because of the limited range of the high-frequency signals used for some 5G service.[119] In other states, limitations on local authority to set minimum spacing include conditions that requirements must be reasonable, generally applicable, or non-discriminatory and that they cannot prohibit service. (see appendix I).

Table 4: Does State Small Cell Law Allow Local Governments to Set Minimum Spacing Requirements?*

Yes		No	Not Addressed
Subject to Limitations	Without Limitations		
AR, AZ, HI, IL, MI, MN, MO, NC, NE, NM, OH, OK (12)	(0)	**TN**, FL, IN, UT (4)	CO, CT, GA, IA, KS, ME, RI, TX, VA, WI, WV (11)

* Under the Federal Communications Commission's 2018 small cell order, minimum spacing requirements, just like aesthetic standards, are enforceable only if they are published in advance, reasonable, no more burdensome than standards applied to other infrastructure, and objective. However, requirements that aesthetic standards applied to small cells by states and local governments be 1) no more burdensome than those for other infrastructure and 2) objective were vacated and remanded to the FCC for further action by the US Court of Appeals for the Ninth Circuit in City of Portland v. United States, 2020 U.S. App. LEXIS 25553 (August 12, 2020). The Court upheld the remainder of the Order. At this time, the ruling has not been appealed, and the FCC has not taken action on the portions of the Order that were vacated and remanded.

Note: Delaware not shown because its small cell law applies only to its department of transportation; other 22 states not shown have not enacted small cell laws.

Source: TACIR staff review of state laws; and Federal Communications Commission 2018.

[118] Memorandum from Joel K. Hargis, attorney, Baker, Donelson, Bearman, Caldwell & Berkowitz, on behalf of Verizon Wireless to Greg Adkins, chairman, and members of the Metropolitan Planning Commission, October 13, 2016. See also, memorandum from Kathy Sager, regional director of external and legislative affairs, AT&T to Greg Adkins, chairman, Metropolitan Planning Commission, October 13, 2016; memorandum of James L. Murphy, attorney, Bradley, on behalf of Access Fiber Group to Greg Adkins, chairman, and members of the Metropolitan Planning Commission, October 13, 2016; and memorandum Erica Garrison, attorney, Waller, Lansden, Dortch & Davis, on behalf of T-Mobile to members of the Metropolitan Planning Commission, October 27, 2016.

[119] Interview with wireless provider.

Only one state with a small cell law—Georgia—has a requirement for colocating on existing poles (see table 5 and appendix G). Similar to states that authorize local governments to require alternate locations or set minimum spacing for small cells, Georgia's requirement is subject to limitations. Under Georgia law, the installation of new poles for small cells is prohibited if the applicant can colocate on an existing pole under reasonable terms and conditions and colocation would not impose technical limitations or add significant costs based on the assessment of a licensed engineer.[120] As noted above, North Carolina authorizes local governments to require applicants seeking to install new poles to evaluate the feasibility of using existing locations and authorizes local governments to require this information to be included in applications but does not authorize local governments to require the use of alternate locations, which could include colocation.

Table 5: States That Address Colocation Requirements in Their Small Cell Laws*

Colocation Required		Local Gov't Can Require Information on Feasibility	Local Gov't Cannot Require Colocation	Not Addressed
Subject to Limitations	Without Limitations			
GA (1)	(0)	NC (1)	**TN**, AR, AZ, FL, HI, IL, IN, MO, NE, NM, OH, OK, UT (13)	CO, CT, IA, KS, ME, MI, MN, RI, TX, VA, WI, WV (12)

* The Federal Communications Commission's 2018 small cell order doesn't specifically address state or local requirements for colocation.

Additional Notes:
— Under Georgia law, colocation is required unless A) applicant cannot obtain reasonable terms and conditions for attaching to existing pole or B) colocation would impose technical limits or substantial added costs based on assessment of licensed engineer.
— North Carolina authorizes local governments to require that applicants seeking to install new poles evaluate the reasonable feasibility of colocating their small cells on existing structures within their search area and, as part of application, can require information necessary to determine whether colocation is feasible.
— Delaware not shown because its small cell law applies only to its department of transportation; other 22 states not shown have not enacted small cell laws.

Source: TACIR staff review of state laws; and Federal Communications Commission 2018.

[120] Official Code of Georgia Annotated, Section 36-66C-6.

Colocation of small cells on existing poles has support among local officials, TDOT, and the wireless industry. Officials for approximately one-quarter of the 40 local governments interviewed said that they favored colocation over the installation of new poles. Officials for the remaining local governments expressed no preference in their interviews. No local officials opposed colocation, and one city included a requirement for colocation in a small cell ordinance it passed prior to the enactment of Public Chapter 819.[121] The Tennessee Department of Transportation also prefers that small cells be colocated on existing structures.[122] At least one wireless provider said that colocation is less expensive for them, while another said that it expects colocation will become more common as time goes on.[123] Several companies act as third-party infrastructure providers for others in the wireless industry, and they benefit financially from colocating multiple small cells at one site.[124] But some local officials remain concerned that wireless providers won't let competitors colocate small cells on poles that those wireless providers own. One official further noted that local governments cannot require information needed to verify the necessity of either installing new poles or using specific locations, under Public Chapter 819.[125]

Collaboration on Alternate Locations—Including Colocation—and Public Chapter 819, Acts of 2018

Collaboration among local governments, small cell applicants, and pole owners is needed to address local concerns about the number of new poles in public rights-of-way, under the state's existing framework. Local governments are currently authorized to propose design alternatives—which could include colocation on existing poles—during the application review process, offering an opportunity for applicants to find solutions acceptable to both parties.[126] The extent to which local governments have found this collaborative model to be effective varies. While several reported that small cell applicants have accommodated local requests, a few expressed frustration at having alternate locations rejected. Requests to move a new pole more than 50 feet have been rejected, according to local officials, because applicants have stated that particular sites are necessary to support the operation of their networks. This is to be expected in some

[121] Interviews with local officials.

[122] Panel discussion of Public Chapter 819, Acts of 2018, TACIR Meeting, January 17, 2020.

[123] Interviews with wireless providers; and panel discussion of Public Chapter 819, Acts of 2018, TACIR Meeting, January 17, 2020.

[124] Elliott Management Corporation 2020.

[125] Interviews with local officials.

[126] Tennessee Code Annotated, Section 13-24-408.

cases given the limited range of small cells. But under the current framework, local governments cannot require analysis documenting the necessity of individual sites, according to local officials, leading some to question the validity of applicants' claims. Multiple local officials said they would like more authority to require alternate locations or colocation on existing support structures for small cells.[127]

Representatives for wireless companies expressed few concerns regarding the collaborative model, with one company characterizing most disputes as a byproduct of the learning curve when it comes to dealing with new infrastructure like small cells.[128] However, wireless companies did note that Tennessee's small cell law does not apply to municipal electric systems or electric cooperatives, which they characterized as a weakness of the current framework relative to other states.[129] Tennessee is one of nine states with small cell laws that exempt municipal electric systems or electric cooperatives from at least part of their framework (see appendix C).

Colocating small cells on existing support structures will rely in part on access to the poles of municipal electric systems and electric cooperatives. This will be the case regardless of whether colocation is encouraged as part of the existing collaborative process or required pursuant to a grant of greater authority to local governments. Municipal electric systems and electric cooperatives own approximately 80% of the utility poles in Tennessee.[130] Attachments to these poles are partially regulated by the Tennessee Valley Authority (TVA), while attachments to poles owned by municipal utilities are also subject to the FCC small cell order.

TVA requires the municipal electric systems and electric cooperatives it serves to recover their costs from any pole attachments, under the terms of its wholesale power contracts. This requirement includes small cells attached to poles owned by utilities or cooperatives, and it is intended to prevent electric ratepayers from subsidizing the infrastructure costs of other entities. Although TVA has adopted a formula for calculating the pole attachment fees charged by its utilities and cooperatives for wireline attachments, this formula does not apply to small cells. Instead, TVA staff interviewed said that TVA monitors compliance with the provisions of its wholesale

[127] Interviews with local officials.

[128] Interviews with wireless providers.

[129] Panel discussion of Public Chapter 819, Acts of 2018, TACIR Meeting, January 17, 2020; and interviews with wireless providers.

[130] Tennessee Advisory Commission on Intergovernmental Relations 2017.

power contracts through its audit process.[131] TVA requires the municipal electric systems and electric cooperatives it serves to submit annual audits performed by independent certified public accountants. TVA reviews these audits every year. In addition to its annual audit review, TVA performs compliance assessments on each utility and cooperative every few years. According to TVA, these assessments include a review of the utility's or cooperative's accounts.[132] TVA may consider adopting a pole attachment formula for small cells in the future, according to TVA staff.[133]

Attachments to poles owned by municipal utilities are further subject to the FCC small cell order.[134] Representatives for municipal electric systems in Tennessee said that the pole attachment fees charged by their utilities are currently less than the FCC's safe harbor of $270 per small cell per year, below which the FCC presumes fees are acceptable. Two reported that their utilities previously charged pole attachment fees that were based on market rates for wireless attachments and were greater than the FCC's safe harbor. One noted that it has been able to move forward with more colocations now that it has reduced its fee and adopted a cost-based approach.[135]

In addition to pole attachment fees, municipal electric systems are subject to the FCC's limits on fees for processing applications and time limits for application review. Several said that to cover the full cost of engineering review and inspections, their fees for processing applications are greater than the FCC's safe harbor, which is permissible under the FCC order. They are also endeavoring to meet the FCC's time limits for application review, though the capacity of utilities to review applications varies.[136]

Municipal electric systems and electric cooperatives raised several concerns regarding small cells and attachments to utility poles. Worker safety was a common concern among those interviewed, given the proximity of small cells to live electric lines. Similarly, the potential for unqualified workers or falling small cells to damage the electric grid was mentioned. Several reported that they currently do not allow or do not want small cells to be located above their high-voltage power lines, given concerns

---

[131] Interview with Tennessee Valley Authority staff. For more on TVA's pole attachment fee formula for wireline attachments, see Tennessee Advisory Commission on Intergovernmental Relations 2017.

[132] Tennessee Advisory Commission on Intergovernmental Relations 2017.

[133] Interview with Tennessee Valley Authority staff.

[134] Federal Communications Commission 2018; and City of Portland v. United States, 2020 U.S. App. LEXIS 25553 (9th Cir. 2020).

[135] Interview with municipal electric systems and Tennessee Municipal Electric Power Association.

[136] Interview with municipal electric systems and Tennessee Municipal Electric Power Association; and Federal Communications Commission 2018.

about worker safety and grid reliability. This has caused friction with small cell applicants in at least two communities, while one wireless provider also reported that delays in agreeing to the terms and conditions of attachments has limited its ability to colocate on existing poles. The utilities and cooperatives interviewed said they have either adopted or are in the process of developing the terms and conditions that will apply to small cell attachments on their poles. Although some are using agreements reached by other utilities as templates, differences among individual electric systems related to the engineering of their grids, staffing capacity, and policy preferences would make developing a uniform framework for attaching small cells to utility poles in Tennessee difficult, based on interviews with utilities and cooperatives.[137]

The effect of small cells on local aesthetics will likely remain a concern for communities. Whether all aesthetic concerns can be addressed effectively through the current framework in state law—in particular, long-term concerns about the installation of new poles—will depend in part on collaboration between local governments and applicants. Efforts to encourage or—if greater authority is granted to local governments—require colocation will also necessarily affect pole owners, including municipal utilities and electric cooperatives. Other concerns raised by local officials include their authority to manage rights-of-way and the limits on application fees.

Local authority to manage public rights-of-way is preserved in Tennessee's small cell law.

Similar to aesthetics, local officials interviewed described issues they had experienced during the construction of small cells and raised concerns about local authority to manage public rights-of-way, under Public Chapter 819. In particular, local officials reported damage caused by construction and frustration related to a lack of coordination among the different entities responsible for carrying out small cell projects. Examples include damage to existing underground utilities, such as water-main breaks, and failure to repair damage or return rights-of-way to their prior condition in a timely manner. Coordination issues reported by local officials included the submission of inconsistent information on applications, failure to pull appropriate permits, failure to follow approved plans, and failure to coordinate different elements of projects such as the connection of electric service.[138]

---

[137] Interview with municipal electric systems and Tennessee Municipal Electric Power Association; interview with electric cooperatives and Tennessee Electric Cooperative Association; and interviews with wireless providers.

[138] Interviews with local officials; and panel discussion of Public Chapter 819, Acts of 2018, TACIR Meeting, January 17, 2020.

Some local officials, including commission members, also questioned whether local governments retain enough authority under the Act to protect and accommodate other right-of-way infrastructure and right-of-way users in addition to small cells. A few of these officials characterized rights-of-way in some areas as crowded or almost full, given the existing infrastructure in them. They said they were concerned that small cells would interfere with existing infrastructure or could block future projects—such as road-widening or sewer expansions.[139]

But right-of-way management was a focus for local governments during the legislative process for Public Chapter 819. As described by MTAS and TML, a local government's

> ability to maintain control of its rights-of-way, protect facilities within its right-of-way, to ensure the public's interest, and to promote the safety of pedestrians and the motoring public was a significant concern to [local] officials.[140]

Provisions ultimately included in the Act protect local authority, provided that local governments don't restrict small cells' access to rights-of-way or effectively prohibit the deployment of small cells. The authority to have damage repaired and protect rights-of-way to accommodate other infrastructure and users are both among these provisions (see table 6 and appendix E).[141] The following description of cities' authority under the Act from the guide created by MTAS and TML applies generally to cities and counties in Tennessee:

> Under the Act, a city may not use its policies and requirements to restrict small cell providers' access to the rights-of-way or to effectively prohibit the deployment of small cells in the right-of-way. . . .
>
> However, the Act establishes parameters concerning local governance of providers' use of rights-of-way. Cities are permitted to require providers to obtain the same work and traffic permits required of other entities performing construction in the right-of-way and to charge the same fees for such permits.
>
> A city may ensure that any small cell is constructed and maintained in a manner that does not impair the free flow of pedestrian or automobile

[139] Interviews with local officials; and Public Chapter 819, Acts of 2018 (Small Cell)—Update, TACIR meeting, September 7, 2018.

[140] Municipal Technical Advisory Service and Tennessee Municipal League 2018.

[141] Tennessee Code Annotated, Sections 13-24-405 and 13-24-411.

traffic, including but not limited to the enforcement of any policies or requirements relating to the Americans with Disabilities Act.

In addition, cities may require providers to construct or place facilities in such a way as to not preclude the use of the right-of-way by other operators and to abide by the same vegetation control requirements as required of other entities maintaining facilities in the right-of-way.

Moreover, a city may enforce any requirement or safety regulations concerning breakaway sign supports, provided those requirements and regulations are applied to others operating in its rights-of-way.

Furthermore, a city may require a provider to maintain any small cell in proper working order or to remove the small cell when it is creating a hazard or is no longer in operation. Similarly, a city may require a provider to repair any small cell that is damaged or to relocate a small cell in the event of construction or an emergency.

In the event that the provider causes damage to city streets or to facilities owned by the city or another entity operating in the right-of-way, then the provider may be required to repair the damage. Moreover, a city may require a provider to secure insurance or a surety bond or to provide indemnification for any claims arising from the provider's negligence so long as such requirements are required of others operating in the right-of-way.[142]

[142] Municipal Technical Advisory Service and Tennessee Municipal League 2018.

Table 6: Authority of Local Governments to Manage Public Rights-of-Way Related to Small Cells, Under Tennessee Law and the FCC Order

	Tennessee Law	FCC Order
Can local governments require relocation of small cells to accommodate road projects?	Yes Small cells are subject to title 54, chapter 5, part 8, as well as similar generally applicable requirements on entities with infrastructure in right-of-way.	Yes Must be competitively neutral and non-discriminatory.
Can local governments require relocation of small cells to accommodate development projects or other improvements to rights-of-way?	Yes It appears small cells, similar to other utility infrastructure located in public rights-of-way, would likely be subject to general relocation requirements to accommodate other development projects.	Yes Must be competitively neutral and non-discriminatory.
Can local governments prohibit small cells from obstructing other utilities?	Yes Can enforce generally applicable, non-discriminatory requirements prohibiting obstruction of legal use of right-of-way by other utilities.	Yes Must be competitively neutral and non-discriminatory.
Can local governments require damage to rights-of-way resulting from installation of small cells be repaired?	Yes Can enforce generally applicable, non-discriminatory requirements, including but not limited to those for insurance, surety bonds, or indemnification.	Yes Must be competitively neutral and non-discriminatory.

Source: Tennessee Code Annotated, Sections 13-24-405 and 13-24-411; Metropolitan Government of Nashville v. BellSouth Telecommunications, Inc., 502 F. Supp. 2d 747 (US District Court for the Middle District of Tennessee 2007); Federal Communications Commission 2018; and 47 US Code 253(b) and (c).

Many local officials interviewed report using their authority under the Act to address right-of-way management issues. Several said that to ensure damage to rights-of-way and other utilities is repaired they either require or plan to require letters of credit, bonds, or other sureties for small cell projects, similar to their requirements for other infrastructure projects.[143] To improve coordination, one local official recommended that the state grant local authority to require applicants to have a single point of contact for each small cell project who would be responsible for requesting inspections and resolving problems for all components of the project. One wireless provider said in response that it would be receptive to a uniform policy for coordinating work on small cell projects, similar to platforms that exist in some cities for utilities to communicate with each other.[144] But other local governments are using their existing authority to require that inconsistencies on applications be fixed, while issuing stop-work orders for projects where necessary permits haven't been applied for or where work does not follow approved plans. Moreover, several local officials said that the issues they have

[143] Interviews with local officials.

[144] Panel discussion of Public Chapter 819, Acts of 2018, TACIR Meeting, January 17, 2020.

encountered with small cell projects, including damage and lack of coordination, are not unique; rather, they are typical of issues that local governments deal with on other infrastructure projects.

Other local officials report that they are using their authority to enforce generally applicable, non-discriminatory requirements that prohibit small cells from obstructing the legal use of the right-of-way by other utilities. Some have denied small cell applications for conflicts with existing infrastructure. Small cells are also subject to state laws requiring they be moved to accommodate future road projects,[145] and it appears that—similar to other utilities in public rights-of-way—small cells would be subject to general relocation requirements to accommodate other development projects.[146]

When relocation of small cells is required, the entity responsible for paying the relocation costs varies under state law. For other utilities, Tennessee courts have ruled that

> in the absence of a valid reimbursement statute (or contract), [a local government] has the police power to require [a utility] to relocate its lines from public rights-of-way, at [the utility's] expense, to accommodate public works reasonably necessary to benefit the public welfare, regardless of whether they benefit the so-called "traveling public," whether pedestrian or vehicular.[147]

It appears likely that entities owning small cells would similarly be required to pay for relocation unless a project is subject to a reimbursement statute under state law. Several such statutes exist. For example, the state is required to pay for relocation when it relies on the presumptive right-of-way to construct improvements to any section of an existing two-lane, undivided public road.[148] For other road projects, the state is

---

[145] Tennessee Code Annotated, Section 13-24-405.

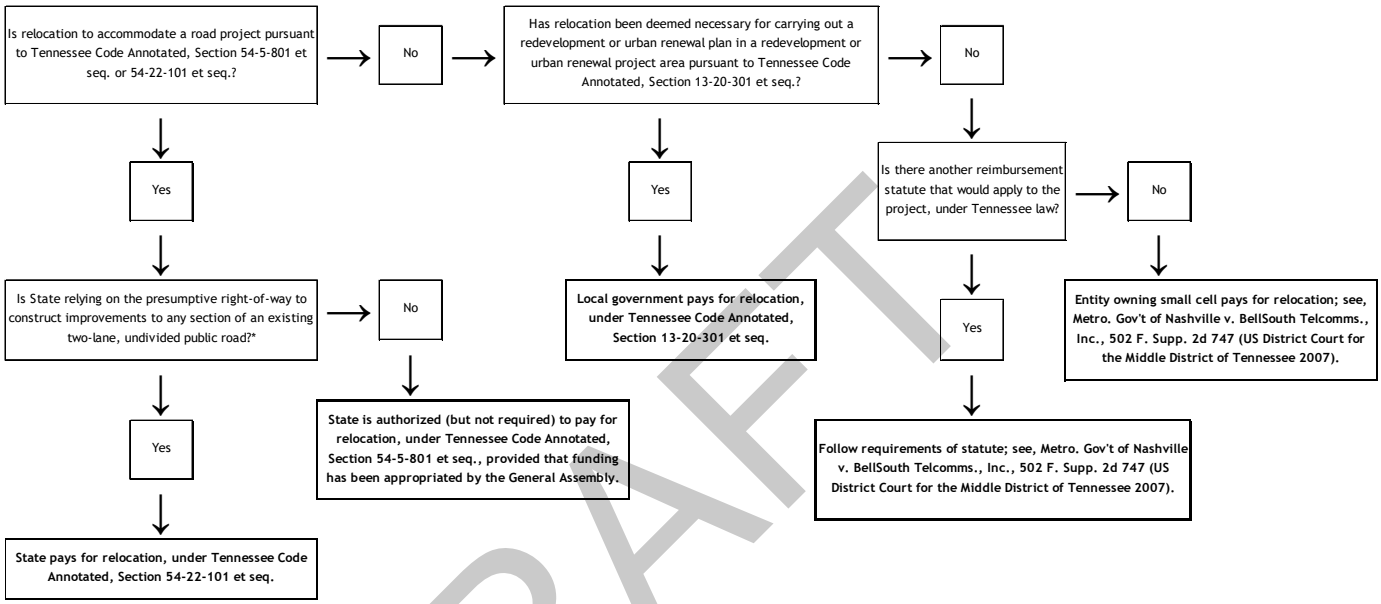
[146] Metropolitan Government of Nashville v. BellSouth Telecommunications, Inc., 502 F. Supp. 2d 747 (US District Court for the Middle District of Tennessee 2007); and Pack v. Southern Bell Telephone & Telegraph Company, 215 Tenn. 503 (Supreme Court of Tennessee 1965).

[147] Metropolitan Government of Nashville v. BellSouth Telecommunications, Inc., 502 F. Supp. 2d 747 (US District Court for the Middle District of Tennessee 2007).

[148] Tennessee Code Annotated, Section 54-22-101 et seq.; and Municipal Technical Advisory Service 2020. Note: The presumptive right-of-way for an existing, two-lane, undivided public road that cannot be ascertained totally or partially by instruments of conveyance, court orders, or otherwise, is 25 feet on either side of the centerline of the traveled portion of the road. The term "public road" as used in Tennessee Code Annotated, Section 54-22-101 et seq., probably excludes municipal streets, according to the Municipal Technical Advisory Service.

authorized but not required to pay relocation costs, provided that funding has been appropriated by the General Assembly.[149] Local governments are required to pay for relocations deemed necessary for carrying out a redevelopment or urban renewal plan in a redevelopment or urban renewal project area.[150] See figure 4.

Figure 4: Who Would Pay for the Relocation of Small Cells Located in Public Rights-of-Way, Under Tennessee Law?



* The presumptive right-of-way for an existing, two-lane, undivided public road that cannot be ascertained totally or partially by instruments of conveyance, court orders, or otherwise, is 25 feet on either side of the centerline of the traveled portion of the road. The term "public road" as used in Tennessee Code Annotated, Section 54-22-101 et seq., probably excludes municipal streets, according to the Municipal Technical Advisory Service.

Source: Tennessee Code Annotated, Sections 13-24-405, 13-24-410(7), 13-24-411, 54-5-801 et seq., 54-22-101 et seq., and 13-20-301 et seq.; Metropolitan Government of Nashville v. BellSouth Telecommunications, Inc., 502 F. Supp. 2d 747 (US District Court for the Middle District of Tennessee 2007); Pack v. Southern Bell Telephone & Telegraph Company, 215 Tenn. 503 (Supreme Court of Tennessee 1965); and Municipal Technical Advisory Service 2020.

[149] Tennessee Code Annotated, Sections 13-24-405, 13-24-410, and 54-5-801 et seq.; and Municipal Technical Advisory Service 2020.

[150] Tennessee Code Annotated, Section 13-20-301 et seq.; and Metropolitan Government of Nashville v. BellSouth Telecommunications, Inc., 502 F. Supp. 2d 747 (US District Court for the Middle District of Tennessee 2007).

Maximum application fees allowed under state law don't always cover costs related to small cells, according to some local officials.

In the enacting clause for Public Chapter 819, the General Assembly observes that Tennessee has a longstanding policy of encouraging investment in communications infrastructure and that part of this policy has included keeping the industry free from local taxation and other fees that are in excess of cost recovery (see appendix A). The existing maximum application fees authorized under the Act generally appear to be no more than the cost of application review, and capping fees local governments can impose on small cells is another practice supported by the wireless industry nationally.[151] In many cases, the fees authorized under Tennessee's law are below cost, according to local officials interviewed.

Officials from almost one-fourth of local governments interviewed said that the fees allowed under state law don't cover their costs or that they are concerned about fees. While a few reported that complying with the Act resulted in either no or minimal costs beyond those recovered through fees, most local officials did not express an opinion on the existing fee caps. Those who said that fees did not cover their costs cited the amount of staff time necessary to review applications and inspect projects during the construction process.[152]

Of the 27 states with small cell laws that apply to local governments, Tennessee is one of 22 that caps fees local governments can impose for application review. Delaware also caps fees for application review, but its law applies only to its department of transportation. While some states set their maximum fees on a per-application basis regardless of the number of small cells included in each application, others—including Tennessee—set their maximum fees on a per-small-cell basis. For these states, some set a flat rate per small cell, but others—including Tennessee—vary their rate depending on the number of small cells in each application. Fifteen states allow greater maximum fees for small cells that involve the installation of new poles rather than colocation on existing poles; Tennessee does not.[153] See table 7 and appendix J.

[151] Wireless Infrastructure Association and CTIA 2018; and Federal Communications Commission 2018.

[152] Interviews with local officials. TACIR staff did not attempt to quantify the cost difference for local governments given the limited number that had received more than a dozen small cell applications at the time of their interviews.

[153] TACIR staff review of state laws.

Table 7: Does State Small Cell Law Allow Greater Maximum Local Fee for Reviewing Applications If New Support Structures Are Required?*

Yes	No	Maximum Fees Not Set in State Law
AR, AZ^, GA, IL, KS, MI, MO, NE#, NM, OK, RI$, TX, UT, WI, WV (15)	**TN**, FL, IA, IN, NC, OH, VA (7)	CO, CT, HI, ME, MN (5)

* The Federal Communications Commission capped state and local fees at the actual, reasonable costs of application review in its 2018 small cell order; however, it also set a presumptive safe harbor for acceptable fees, which is larger for applications requiring new support structures.

^ Under Arizona law, maximum fee is greater for new support structures only for those located in cities or towns or for structures subject to zoning review.

Under Nebraska law, applications for small cells requiring new poles that include fewer than three facilities would not result in greater fees than applications for colocation, based on how maximum fees are calculated.

$ Under Rhode Island law fees are capped at the lesser of the actual cost of processing the application or the fees charged for processing permits for new utility poles.

Note: Delaware not shown because its small cell law applies only to its department of transportation; other 22 states not shown have not enacted small cell laws.

Source: TACIR staff review of state laws; and Federal Communications Commission 2018.

Compared with other states that set fee caps for small cells, Tennessee's caps generate fees that are lower than most other states. For every 100 small cells applied for, Tennessee's cap generates fees of $6,875, regardless of whether applications involve colocation or the installation of new poles. The median for states that set fee caps is $10,000 per 100 small cells for colocations and $25,000 per 100 small cells for new poles.[154] See tables 8 and 9.

[154] TACIR staff calculations based on a review of state laws.

Table 8: Maximum Total Application Fees Local Governments Authorized to Charge for 100 Small Cells Colocated on Existing Support Structures, by State*

State	Maximum Amount per 100 Small Cells
Florida	$ 400
Kansas	$ 2,000
Virginia	$ 5,750
Iowa	$ 6,000
North Carolina	$ 6,000
Arizona (cities)	$ 6,000
New Mexico	$ 6,000
Tennessee	**$ 6,875**
Arizona (counties)	$ 7,025
Indiana	$ 10,000
Arkansas	$ 10,000
Nebraska	$ 10,000
Utah	$ 10,000
Missouri	$ 10,000
Georgia	$ 10,000
Wisconsin	$ 10,000
West Virginia	$ 10,500
Oklahoma	$ 12,000
Michigan	$ 20,000
Ohio	$ 25,000
Texas	$ 30,000
Illinois	$ 35,000

* The Federal Communications Commission capped state and local fees at the actual, reasonable costs of application review in its 2018 small cell order; however, it also set a presumptive safe harbor for acceptable fees that would result in a maximum amount of $10,000 (total) for 100 small cells colocated on existing support structures. Colorado, Connecticut, Delaware, Hawaii, Maine, and Minnesota don't set maximum fees for local governments in their small cell laws; Rhode Island's fees are capped at the lesser of the actual cost of processing the application or the fees charged for permits for new utility poles; other 22 states not shown haven't enacted small cell laws.

Note: Calculations assume that applicants submit maximum number of small cells allowable in each application, under state law.

Source: TACIR staff calculations based on review of state laws; and Federal Communications Commission 2018.

Table 9: Maximum Total Application Fees Local Governments Authorized to Charge for 100 Small Cells Requiring New Support Structures, by State*

State	Maximum Amount per 100 Small Cells
Florida	$ 400
Virginia	$ 5,750
Iowa	$ 6,000
North Carolina	$ 6,000
Tennessee	**$ 6,875**
Arizona (counties)	$ 7,025
Indiana	$ 10,000
Arkansas	$ 25,000
Nebraska	$ 25,000
Ohio	$ 25,000
Utah	$ 25,000
West Virginia	$ 25,000
Michigan	$ 30,000
Oklahoma	$ 35,000
Missouri	$ 50,000
Arizona (cities)	$ 75,000
New Mexico	$ 75,000
Georgia	$ 100,000
Texas	$ 100,000
Illinois	$ 100,000
Wisconsin	$ 100,000
Kansas	$ 200,000

* The Federal Communications Commission capped state and local fees at the actual, reasonable costs of application review in its 2018 small cell order; however, it also set a presumptive safe harbor for acceptable fees that would result in a maximum amount of $100,000 (total) for 100 small cells requiring new support structures. Colorado, Connecticut, Delaware, Hawaii, Maine, and Minnesota don't set maximum fees for local governments in their small cell laws; Rhode Island's fees are capped at the lesser of the actual cost of processing the application or the fees charged for permits for new utility poles; other 22 states not shown haven't enacted small cell laws.

Note: Calculations assume that applicants submit maximum number of small cells allowable in each application, under state law.

Source: TACIR staff calculations based on review of state laws; and Federal Communications Commission 2018.

States and local governments cannot deny small cell applications on basis of health concerns for facilities that meet regulations, under federal law.

Concerns that small cells and 5G wireless service might negatively affect human health have been reported by numerous media outlets. In the US and in other countries, there have been instances where wireless facilities have been vandalized by those who think the facilities are harmful.[155] A number of local officials interviewed said that they have received complaints from residents worried about the health effects of small cells; one individual contacted TACIR staff directly with their concerns.[156] Although it is unlikely that small cells will harm human health based on existing scientific studies, states and local governments have only limited authority to regulate wireless facilities related to health concerns, under federal law.

The radio frequencies used for wireless communications have not been found to have negative effects on human health when transmitted at power levels below the limits adopted by the FCC and international bodies. According to the FCC,

> biological effects can result from exposure to RF [radio frequency] energy. Biological effects that result from heating of tissue by RF energy are often referred to as "thermal" effects. It has been known for many years that exposure to very high levels of RF radiation can be harmful due to the ability of RF energy to heat biological tissue rapidly. This is the principle by which microwave ovens cook food. Exposure to very high RF intensities can result in heating of biological tissue and an increase in body temperature. Tissue damage in humans could occur during exposure to high RF levels because of the body's inability to cope with or dissipate the excessive heat that could be generated. . . .
>
> At relatively low levels of exposure to RF radiation, i.e., levels lower than those that would produce significant heating, the evidence for production of harmful biological effects is ambiguous and unproven. Such effects, if they exist, have been referred to as "non-thermal" effects. A number of reports have appeared in the scientific literature describing the observation of a range of biological effects resulting from exposure to low levels of RF energy. However, in most cases, further experimental research has been unable to reproduce these effects. Furthermore, since much of the research is not done on whole bodies (in vivo), there has been

[155] Hamilton 2020; Stern 2020; and Margolin 2020.

[156] Interviews with local officials.

> no determination that such effects constitute a human health hazard. It is generally agreed that further research is needed to determine the generality of such effects and their possible relevance, if any, to human health. In the meantime, standards-setting organizations and government agencies continue to monitor the latest experimental findings to confirm their validity and determine whether changes in safety limits are needed to protect human health.[157]

A 2020 review of scientific studies that was undertaken by the International Commission on Non-Ionizing Radiation Protection (ICNIRP)—a non-profit created in the 1970s that provides science-based advice on the effects of radiation—found that

> the only substantiated adverse health effects caused by exposure to radiofrequency EMFs [electromagnetic fields] are nerve stimulation, changes in the permeability of cell membranes, and effects due to temperature elevation. There is no evidence of adverse health effects at exposure levels below the restriction levels in the ICNIRP (1998) guidelines and no evidence of an interaction mechanism that would predict that adverse health effects could occur due to radiofrequency EMF exposure below those restriction levels.[158]

The likelihood that individuals would be exposed to levels of radio frequencies in excess of the limits set by the FCC is also relatively small, unless someone were to climb a pole on which a small cell is mounted. The FCC notes that

> when . . . antennas are mounted at rooftop locations it is possible that a person could encounter [radio frequency] levels greater than those typically encountered on the ground. However, once again, exposures approaching or exceeding the safety guidelines are only likely to be encountered very close to and directly in front of the antennas.[159]

Representatives for electric utilities interviewed said they are working with wireless providers to ensure that small cells can be shut off when electric utility workers need to work on electric lines in close proximity to small cells.[160]

---

[157] Federal Communications Commission "RF Safety FAQ."

[158] International Commission on Non-Ionizing Radiation Protection 2020.

[159] Federal Communications Commission "RF Safety FAQ."

[160] Interview with municipal electric systems and the Tennessee Municipal Electric Power Association.

States and local governments cannot deny applications for wireless facilities, such as small cells, based on health concerns, as long as those facilities do not exceed the FCC's radio frequency limits. Under 47 US Code 332(c)(7)(B)(iv),

> no state or local government or instrumentality thereof may regulate the placement, construction, and modification of personal wireless service facilities on the basis of the environmental effects of radio frequency emissions to the extent that such facilities comply with the Commission's regulations concerning such emissions.

Of the 27 states with small cell laws that apply to local governments, six explicitly authorize local governments to require providers to certify that their small cells meet the FCC's radio frequency limits. Tennessee's law doesn't include certification of compliance with these limits among the information that local governments can require of small cell applicants. Two other states explicitly define small cells subject to their expedited review processes as only those facilities that meet the FCC limits; Tennessee's law does not. See table 10.

Table 10: Does State Small Cell Law Explicitly Address Federal Standards for Radio Frequency Emissions and Public Health?*

Yes			No
Local Governments Authorized to Require Applicants to Certify that Small Cells Meet Federal Standards	To Meet Definition of a Small Cell in State Law, Wireless Facility Must Meet Federal Standards	Prohibited from Denying Applications Based on Health Concerns or Imposing Regulations Exceeding Federal Standards*	
AZ^, MI, MN, NM, WV, WI (6)	AR, NE (2)	IA, KS, OH (3)	**TN**, CO, CT, FL, GA, HI, IL, IN, ME, MO, NC, OK, RI, TX, UT, VA (16)

* Federal law prohibits states and local governments from denying applications based on health concerns for wireless facilities that meet federal standards and prohibits states and local governments from imposing regulations exceeding federal standards; see, 47 US Code 332(c)(7)(B)(iv).

^ Arizona's authorization applies only to cities and towns not counties.

Note: Delaware not shown because its law, which also does not address federal radio frequency standards, applies only to its state department of transportation; other 22 states not shown because they have not enacted small cell laws.

Source: TACIR staff review of state laws; and Federal Communications Commission 2018.

References

Afflerbach, Andrew. 2018. "Exhibit A." In *Smart Communities and Special Districts Coalition—Ex Parte Submission: Accelerating Wireless Broadband Deployment by Removing Barriers to Infrastructure Investment, WT Docket No. 17-79; Accelerating Wireline Broadband Deployment by Removing Barriers to Infrastructure Investment, WC Docket No. 17-84*, submitted by Joseph Van Eaton, Gerard Lavery Lederer, Gail A. Karish, John Gasparini, Tyler Brown, and Michael Watza, September 19. https://ecfsapi.fcc.gov/file/10920230003833/Ex%20Parte-Smart%20Communities%20and%20Special%20Districst%2009-19-18.pdf.

Alleven, Monica. 2018. "Editor's Corner—DSRC vs C-V2X: It's One Fine Mess." *Fierce Wireless*, March 19. https://www.fiercewireless.com/wireless/editor-s-corner-dsrc-vs-c-v2x-it-s-one-fine-mess.

AT&T. 2020. "Upgrade to Unlimited Today." Accessed September 3, 2020. https://www.att.com/plans/wireless/.

Bigelow, Pete. 2019. "A New Connected-Car Battle: Cellular Vs. DSRC." *Automotive News*, February 3. https://www.autonews.com/mobility-report/new-connected-car-battle-cellular-vs-dsrc.

Brodkin, Jon. 2019. "T-Mobile Touts "Nationwide 5G" That Fails to Cover 130 Million Americans." *Ars Technica*, December 2. https://arstechnica.com/information-technology/2019/12/t-mobile-touts-nationwide-5g-that-fails-to-cover-130-million-americans/.

Comcast. 2020a. "All Internet Plans Are Powered by Data. Xfinity Delivers Data Built for You." Accessed September 3, 2020. https://www.xfinity.com/learn/internet-service/data.

———. 2020b. "What Is the Median Usage of People on Your Network Today?" Accessed September 3, 2020. https://www.xfinity.com/support/articles/data-usage-average-network-usage.

Crown Castle. 2020. "Company Overview." Presentation to investors, May. Accessed June 9, 2020 (link discontinued).

CTIA. 2019. *Annual Survey Highlights*. https://api.ctia.org/wp-content/uploads/2019/06/2019-Annual-Survey-Highlights-FINAL.pdf.

Dano, Mike. 2017. "Editor's Corner—The economics of Fixed Wireless, from LTE to 5G, and What It Means for Verizon." *Fierce Wireless*, July 27. http://www.fiercewireless.com/5g/economics-fixed-wireless-from-lte-to-5g-and-what-it-means-for-verizon.

Elliott Management Corporation. 2020. "Reclaiming the Crown: Elliott's Perspectives on Crown Castle." Presentation to investors, July 6. https://www.reclaimingthecrown.com/wp-content/uploads/2020/07/Reclaiming-the-Crown-Presentation_07062020.pdf.

Ericsson. 2019. *Ericsson Mobility Report*. June. https://www.ericsson.com/assets/local/mobility-report/documents/2019/ericsson-mobility-report-june-2019.pdf.

———. 2020. "Ericsson Researchers Top 4.3Gbps Downlink on 5G Millimeter Wave." News release, February 12. https://www.ericsson.com/en/news/2020/2/ericsson-achieves-record-5g-mmwave-speed.

Federal Communications Commission. 2018. *In the Matter of Accelerating Wireless Broadband Deployment by Removing Barriers to Infrastructure Investment Accelerating Wireline Broadband Deployment by Removing Barriers to Infrastructure Investment: Declaratory Ruling and Third Report and Order*. https://docs.fcc.gov/public/attachments/FCC-18-133A1.pdf.

———. "RF Safety FAQ." Accessed September 9, 2020. https://www.fcc.gov/engineering-technology/electromagnetic-compatibility-division/radio-frequency-safety/faq/rf-safety.

FitzGerald, Drew. 2018. "Across the US, 5G Runs Into Local Resistance." *The Wall Street Journal*, September 13. https://www.wsj.com/articles/across-the-u-s-5g-network-builders-run-into-local-resistance-1536692258.

Fletcher, Bevin. 2019. "The Lowdown on 5G in Mid-2019: Where It's At with AT&T, Sprint, Verizon and T-Mobile." *Fierce Wireless*, July 12. https://www.fiercewireless.com/5g/5g-deployments-where-it-s-at-at-t-sprint-verizon-and-t-mobile.

———. 2020. "New Samsung 5G Phones Can Tap Both Sub-6 GHz and Millimeter Wave Spectrum." *Fierce Wireless*, February 12. https://www.fiercewireless.com/devices/new-samsung-5g-phones-can-tap-both-sub-6-ghz-and-millimeter-wave-spectrum.

Gallagher, Jill C. and Michael E. DeVine. 2019. *Fifth-Generation (5G) Telecommunications Technologies: Issues for Congress*. Congressional Research Service, January 30. https://fas.org/sgp/crs/misc/R45485.pdf.

Goldstein, Phil. 2020. "Tennessee to Deploy New Smart Highway System." *State Tech*, July 27. https://statetechmagazine.com/article/2020/07/tennessee-deploy-new-smart-highway-system.

Google Fiber. 2020. "Your Internet. Our Gigabit Speeds." Accessed September 3, 2020. https://fiber.google.com/internet/.

Grijpink, Ferry, Eric Kutcher, Alexandre Ménard, Sree Ramaswamy, Davide Schiavotto, James Manyika, Michael Chui, Rob Hamill, and Emir Okan. 2020. *Connected World: An Evolution in Connectivity Beyond the 5G Revolution*. McKinsey Global Institute. Discussion paper, February. https://www.mckinsey.com/~/media/mckinsey/industries/technology%20media%20and%20telecommunications/telecommunications/our%20insights/connected%20world%20an%20evolution%20in%20connectivity%20beyond%20the%205g%20revolution/mgi_connected-world_discussion-paper_february-2020.ashx.

Grijpink, Ferry, Tobias Harlin, Harrison Lung, and Alexandre Menard. 2019. *Cutting Through the 5G Hype: Survey Shows Telcos' Nuanced Views*. McKinsey & Company, February 13. https://www.mckinsey.com/industries/telecommunications/our-insights/cutting-through-the-5g-hype-survey-shows-telcos-nuanced-views.

Hamilton, Isobel Asher. 2020. "77 Cell Phone Towers Have Been Set on Fire So Far Due To a Weird Coronavirus 5G Conspiracy Theory." *Business Insider*, May 6. https://www.businessinsider.com/77-phone-masts-fire-coronavirus-5g-conspiracy-theory-2020-5.

Hart, Kim. 2018. "How 5G May Widen the Rural-Urban Digital Divide." *Axios*, September 22. https://www.axios.com/5g-digital-divide-19b70d34-4978-44df-a1cb-ae9222d113ef.html.

International Commission on Non-Ionizing Radiation Protection. 2020. "Appendix B: Health Risk Assessment Literature." *ICNIRP Guidelines for Limiting Exposure to Electromagnetic Fields (100 kHz to 300 GHz)*. https://www.icnirp.org/cms/upload/publications/ICNIRPrfgdl2020.pdf.

Integrity Security Services. 2020. "Integrity Security Services (ISS) Delivers Tennessee Department of Transportation (TDOT) V2X Certificates for the State of Tennessee via the ISS Certificate Management Service (CMS)." News release, March 16. https://www.prnewswire.com/news-releases/integrity-security-services-iss-delivers-tennessee-department-of-transportation-tdot-v2x-certificates-for-the-state-of-tennessee-via-the-iss-certificate-management-service-cms-301023385.html.

Krouse, Sarah and Inti Pacheco. 2019. "New York City Tries to Even Out Access to Wireless Networks." *The Wall Street Journal*, February 26. https://www.wsj.com/articles/new-york-city-tries-to-even-out-access-to-wireless-networks-11551219168.

Linebaugh, Chris D. 2019. *Overview of Legal Challenges to the FCC's 5G Order on Small Cell Siting*. Congressional Research Service (legal sidebar), February 25. https://fas.org/sgp/crs/misc/LSB10265.pdf.

Margolin, Josh. 2020. "Feds Warn of Attacks Related to Bogus COVID-19 Conspiracy Theory." *ABC News*, May 16. https://abcnews.go.com/US/feds-warn-attacks-related-bogus-covid-19-conspiracy/story?id=70721145.

Moritz, Scott. 2019. "Verizon Drops $10 Fee for 5G Amid Complaints of Spotty Service." *Bloomberg*, April 25. https://www.bloomberg.com/news/articles/2019-04-25/verizon-drops-10-fee-for-5g-amid-complaints-of-spotty-service.

Municipal Technical Advisory Service. 2020. "Utility Relocation." Reference Number MTAS-1474. Last modified April 16, 2020. http://www.mtas.tennessee.edu/reference/utility-relocation.

Municipal Technical Advisory Service and Tennessee Municipal League. 2018. *Small Cells: Competitive Wireless Broadband Investment, Deployment, and Safety Act of 2018—Public Chapter 819, Acts of 2018*. https://www.mtas.tennessee.edu/system/files/knowledgebase/original/Small%20Cells%20Deployment%20Guidelines%20%28PC%20819%29%202018.pdf.

National League of Cities. 2018. *Municipal Action Guide: Small Cell Wireless Technology in Cities*. https://www.nlc.org/sites/default/files/2018-08/CS_SmallCell_MAG_FINAL.pdf.

Nordrum, Amy. 2016. "Autonomous Driving Experts Weigh 5G Cellular Network Against Dedicated Short Range Communications." *IEEE Spectrum*, May 3. https://spectrum.ieee.org/cars-that-think/transportation/self-driving/autonomous-driving-experts-weigh-5g-cellular-network-against-shortrange-communications-to-connect-cars.

NPD. 2017. "Unlimited Data Plan Users Consume 67 Percent More Cellular Data Than Users on Limited Plans Consume." News release, December 27. https://www.npd.com/wps/portal/npd/us/news/press-releases/2017/unlimited-data-plan-users-consume-67-percent-more-cellular-data-than-users-on-limited-plans-consume/.

O'Donnell, Bob. 2020. "After Years of Hype, 5G Making Progress in the USA." *USA Today*, August 4. https://www.usatoday.com/story/tech/columnist/2020/07/31/5-g-after-years-hype-technology-making-progress-us/5555022002/.

Rizzato, Francesco and Ian Fogg. 2020. "How AT&T, Sprint, T-Mobile and Verizon Differ in Their Early 5G approach." *OpenSignal*, February 20. https://www.opensignal.com/2020/02/20/how-att-sprint-t-mobile-and-verizon-differ-in-their-early-5g-approach.

Singer, Hal, Ed Naef, and Alex King. 2017. "Attachment A: Assessing the Impact of Removing Regulatory Barriers on Next Generation Wireless and Wireline Broadband Infrastructure Investment." In *Comments of Corning Incorporated in the Matter of Accelerating Wireline Broadband Deployment by Removing Barriers to Infrastructure Investment, WC Docket No. 17-84*, submitted by Timothy J. Regan, Thomas J. Navin, and Umair Javed, June 15. https://ecfsapi.fcc.gov/file/106151419705353/Corning%20Wireline%20Infrastructure%20Comments%206-15-2017.pdf.

Sosa, David W. and Greg Rafert. 2019. *The Economic Impacts of Reallocating Mid-Band Spectrum to 5G in the United States*. Analysis Group, February. https://api.ctia.org/wp-content/uploads/2019/02/The-Economic-Impacts-of-Reallocating-Mid-Band-Spectrum-to-5G-1.pdf.

Stantec Consulting Services. 2019. *Tennessee Statewide Intelligent Transportation Systems Architecture*. Prepared for Tennessee Department of Transportation, January 30. https://www.tn.gov/content/dam/tn/tdot/intelligent-transportation-systems/rpt_tn_statewide_its_final.pdf.

Stern, Joanna. 2020. "5G Smartphones Could Crush Your Home Wi-Fi. So Where's the 5G?" *The Wall Street Journal*, August 17. https://www.wsj.com/articles/5g-smartphones-could-crush-your-home-wi-fi-so-wheres-the-5g-11597670710.

Tennessee Advisory Commission on Intergovernmental Relations. 2017. *Broadband Internet Deployment, Availability, and Adoption in Tennessee*. https://www.tn.gov/content/dam/tn/tacir/documents/2017_Broadband.pdf.

———. 2019. *Public Chapter 952, Acts of 2018: Proposed Shippers' Franchise and Excise Tax Liability Credit Does Not Appear to be Necessary*. https://www.tn.gov/content/dam/tn/tacir/2019publications/2019ShippersCredit.pdf.

Tennessee Department of Transportation. "Intelligent Transportation Systems." Accessed August 30, 2020. https://www.tn.gov/tdot/intelligent-transportation-systems.html.

———. "Vehicle Platooning." Accessed August 30, 2020. https://www.tn.gov/tdot/transportation-freight-and-logistics-home/vehicle-platooning.html.

———. "Vehicle Platooning: Frequently Asked Questions." Accessed August 30, 2020. https://www.tn.gov/tdot/transportation-freight-and-logistics-home/vehicle-platooning/platooning-frequently-asked-questions.html.

T-Mobile. 2020a. "There's a Cell Phone Plan for Everyone." Accessed September 3, 2020. https://www.t-mobile.com/cell-phone-plans.

———. 2020b. "T-Mobile Launches World's First Nationwide Standalone 5G Network." News release, August 4. https://www.t-mobile.com/news/network/standalone-5g-launch.

———. "What Is 5G?" Accessed August 30, 2020. https://www.t-mobile.com/5g.

Turley, Brian. 2019. "Qualcomm's Snapdragon X50 in the Wild: Analyzing 5G Mobile Performance in U.S. Cities." *Speedtest* (blog), August 14. https://www.speedtest.net/insights/blog/qualcomm-snapdragon-x50-mobile-performance-us-cities/.

Verizon. 2018. "Q3 2018 Verizon Communications Inc. Earnings Call." *Thomson Reuters*, October 23.

———. 2020. "It's Unlimited Built Right." Accessed September 3, 2020. https://www.verizon.com/plans/unlimited/.

Wassom, Brian. 2018. "DSRC vs. 5GLTE: Which Will It Be for Connected Vehicles?" *Wards Auto* (blog), July 23. https://www.wardsauto.com/industry-voices/dsrc-vs-5glte-which-will-it-be-connected-vehicles.

Welch, Chris. 2019. "Verizon's 5G network Is Now Hitting Gigabit Download Speeds." *The Verge*, May 16. https://www.theverge.com/2019/5/16/18628080/verizon-5g-network-gigabit-1gbps-download-speeds.

Wheeler, Tom. 2019. *5G in Five (Not So) Easy Pieces*. The Brookings Institution, July 9. https://www.brookings.edu/research/5g-in-five-not-so-easy-pieces/.

Wireless Infrastructure Association and CTIA. 2018. *Ex Parte Presentation, Accelerating Wireless Broadband Deployment by Removing Barriers to Infrastructure Investment, WT Docket No. 17-79; Accelerating Wireline Broadband Deployment by Removing Barriers to Infrastructure Investment, WC Docket No. 17-84; Streamlining Deployment of Small Cell Infrastructure, WT Docket No. 16-421*, submitted by Kara R. Graves and D. Zachary Champ, August 10. https://ecfsapi.fcc.gov/file/10810298508690/180810%20CTIA-WIA%20Ex%20Parte.pdf.

Work, Daniel. 2019. Presentation at Meeting of Tennessee Advisory Commission on Intergovernmental Relations, September 6.

Zantalis, Fotios, Grigorios Koulouras, Sotiris Karabetsos, and Dionisis Kandris. 2019. "A Review of Machine Learning and IoT in Smart Transportation." *Future Internet* 11, no. 94 (April 10). https://www.mdpi.com/1999-5903/11/4/94/htm.

5G Americas. 2018. *Cellular V2X Communications Towards 5G*. Whitepaper, March. https://www.5gamericas.org/wp-content/uploads/2019/07/2018_5G_Americas_White_Paper_Cellular_V2X_Communications_Towards_5G__Final_for_Distribution.pdf.

Persons Interviewed

Andrew Afflerbach
CEO and CTO
CTC Technology and Energy

Donald Anthony
Town Planner
Nolensville

Ted Baecher
Vice President
State Government Affairs
Charter

Jerry Bailey
CEO
Union City Energy Authority

David Ball
Planning Director
Gatlinburg

Zachary Bates
Senior Manager
State Government Affairs
Charter

Les Beaver
Engineer
Knoxville Utilities Board

Kirk Bednar
City Manager
Brentwood

Shanna Boyette
City Manager
Shelbyville

Daniel Brady
Road Inspector
Street Department
City of Franklin

Tom Brechko
Principal Planner
Knoxville-Knox County Planning

Jim Brown
Director
Code Enforcement Department
Bartlett

Phillip Brown
Government Affairs Manager
Crown Castle

Rodney Carmical
Executive Director
Tennessee County Highway Officials Association

Brian Coleman
Area Manager, Small Cell Buildout
AT&T Tennessee

David Connor
Executive Director
Tennessee County Services Association

Robert Cook
Attorney
Buerger, Moseley, and Carson
County Attorney
Williamson County

Theresa Costonis
Attorney
Metropolitan Government of Nashville and Davidson County

Justin Crosby
Building Official
Building and Codes Department
Clarksville

Sherri Darnell
Site Acquisition Project Manager
AT&T Tennessee

Terry Davis
Project Manager
Crown Castle

Kathy Dillon
City Manager
Union City

Chris Dorsey
City Manager
East Ridge

Catherine Durant
Town Administrator
Arlington

Jeremy Elrod
Director
Government Relations
Tennessee Municipal Electric Power Association

Keith Free
Planning Director
Hendersonville

Brad Freeze
Director
Traffic Operations Division
Tennessee Department of Transportation

Vernon Gerth
Assistant City Administrator
City of Franklin

Nicole Goodman
Network Real Estate Specialist
Crown Castle

Jaime Groce
Town Planner
Collierville

Cameron Heck
Senior Manager
Regulatory Policy and Compliance
Tennessee Valley Authority

Jeremy Hitchcock
Supervisor
Customer Engineering Attachments
Nashville Electric Service

Trevor Hobbs
Assistant to the Town Administrator
Farragut

Elisha Hodge
Legal Consultant
Municipal Technical Advisory Service

Jeff Hoge
Director
Right-of-Way Division
Tennessee Department of Transportation

John Holden
Mayor
Dyersburg

Gina Holt
City Manager
Springfield

Liang Hong
Professor
Department of Electrical and Computer Engineering
Tennessee State University

Michael Horlacher
State Utility Coordinator
Right-of-Way Division
Tennessee Department of Transportation

Joe Horne
Director
Community Development
Williamson County

David Ives
Assistant City Attorney
Murfreesboro

Chad Jenkins
Deputy Director
Tennessee Municipal League

John Johnson
City Manager
Jefferson City

Mark Johnson
City Manager
Alcoa

Marva Johnson
Vice President
State Government Affairs, South Region
Charter

Jason Keller
Senior Director
Government Affairs
Charter

Paul Keltner
Director
Development Services
Columbia

Mike Knotts
Vice President
Government Affairs
Tennessee Electric Cooperative Association

Patrick Lawton
City Administrator
Germantown

Victor Lay
City Administrator
Spring Hill

Chevelle Lewis
Street Light Systems Manager
Department of Engineering
Knoxville

Stephanie Logan
IT Project Manager
Germantown

Amy Martin
President
Tennessee Cable and Broadband Association

Chris McCartt
City Manager
Kingsport

Greg McClain
City Manager
Maryville

Rick McClanahan
Director
Engineering Department
Bartlett

A. Keith McDonald
Mayor
Bartlett

Katie Merce
Senior Government Relations Counsel
Crown Castle

Ashley Miller
Assistant City Planner
Alcoa

Preston Mitchell
Director
Development Services
Johnson City

Jennifer Morris
Planning and Codes Director
Paris

Steve Neilson
Director
Economic and Community
Development
Morristown

Phil Noblett
City Attorney
Chattanooga

Darrel Pae
Attorney Advisory
Competition and Infrastructure Policy
Division, Wireless Telecommunications
Bureau
Federal Communications Commission

Nick Pavlis
Director
State Government Affairs
Charter

Jeremy Pearson
City Planner
Alcoa

Joelle Phillips
President
AT&T Tennessee

Stan Pilant
Planning Director
City of Jackson

Jason Pilkinton
Director of Planning and Zoning
City of Dickson

Randy Porter
Mayor
Putnam County

Louise Povlin
Vice Mayor
Farragut

Rebecca Ray
Assistant to the Mayor
Covington

Rory Rowan
Public Works
Metropolitan Government of Nashville and Davidson County

Jamie Sain
Codes Director
Manchester

Lily Seabolt
Right-of-Way Specialist
Electric Department
Oak Ridge

Brian Skelton
President
Tullahoma Utilities Authority

Mark Smith
Attorney
Miller and Martin

Todd Smith
City Administrator
Greeneville

Tom Smith
City Manager
Savannah

David Smoak
Town Administrator
Farragut

Tish Spalding
CEO, SESite
Project Manager, Information Technology Services
Metropolitan Government of Nashville and Davidson County

Laura Squires
Private Citizen

Tom Suggs
Chief Operating Officer
Middle Tennessee Electric Membership Corporation

Kim Taylor
Planning Director
Bartlett

Brad Thompson
Director
Economic and Community Development
Martin

Tim Thornbury
Public Works Director
Red Bank

Thomas Trotter
Traffic Signal System Engineer
Transportation Department
Chattanooga

Dennis Wagner
Director
External and Legislative Affairs
AT&T Tennessee

Jeremy Walden
Director
Electric and Engineering Operations
Lenoir City Utility Board

Mark Watson
City Manager
Oak Ridge

Tom Wheeler
Visiting Fellow – Governance Studies
Center for Technology Innovation
The Brookings Institution
Former Chairman
Federal Communications Commission

Bob Wilson
Assistant City Manager
Johnson City

Velma Witte
Executive Secretary
City Manager's Office
Bristol

Daniel Work
Associate Professor
Department of Civil and Environmental
Engineering
Vanderbilt University

Mandy Young
Attorney
Butler Snow
On behalf of Verizon