MUNICIPAL ACTION GUIDE

Small Cell Wireless Technology in Cities

NLC NATIONAL LEAGUE OF CITIES

CITIES STRONG TOGETHER

Introduction

From our connected homes, where everything is controlled by the internet, to our workplaces, where reliable broadband access is paramount for almost every type of job, technology is impacting every facet of our daily lives. Cities are inextricably linked to the internet, and the integration of new technologies promises better and more innovative ways to serve our residents.

With this seismic shift toward smart cities and the internet of things (IoT), reliance on wireless and wireline broadband infrastructure is becoming greater and greater. Mobile phones, IoT devices and other small wireless gadgets are becoming ubiquitous. Wireless data consumption has reached approximately 1.8 exabytes per month in North America alone, and that number is projected to grow six-fold by 2022.[2] As various wireless providers maintain that the roll out of 5G internet service is approaching, and the IoT proliferates with the connection of millions of new smart devices to the internet, cities must face the reality that to meet the increasing demands of residents, more wireless facilities and infrastructure must be deployed. With that reality, city officials must also face a number of policy, public safety, land-use and right-of-way considerations.

As cities navigate this rapidly-changing policy issue with both wireless and infrastructure providers and community residents, a number of considerations for the different stakeholders begin to emerge. This action guide from the National League of Cities (NLC) provides an overview of small cell technology, as well as guidance on how local governments can plan for, develop policy and processes around, and manage the deployment of, small cell wireless infrastructure. It will also provide city leaders with strategies for proactively engaging with wireless providers and residents to plan for small cell networks in their communities.

The Internet of Things in Connected Cities

Every consumer product and piece of infrastructure increasingly has the ability to sense surrounding stimuli, to communicate with other devices and people, and to draw on the computing and storage power of the cloud. This phenomenon has been dubbed the internet of things (IoT). The more smart devices and sharing platforms there are, the more data is generated about consumer preferences and habits. But what does this mean for cities? Smart cities are employing the same technology to connect their disparate utility, infrastructure and public service grids, generating real-time aggregate data. This, in turn, can help cities manage their programs and services more effectively and gauge their impact for residents, businesses and visitors immediately. The city of the future is an interconnected one, where devices communicate with one another in a constant stream of data that provides real-time information to the public and to the municipality.[3]

A small cell pole in the median of the Las Vegas Strip. (Photograph by SmartWorks Partners)

What is a 'Smart City'?

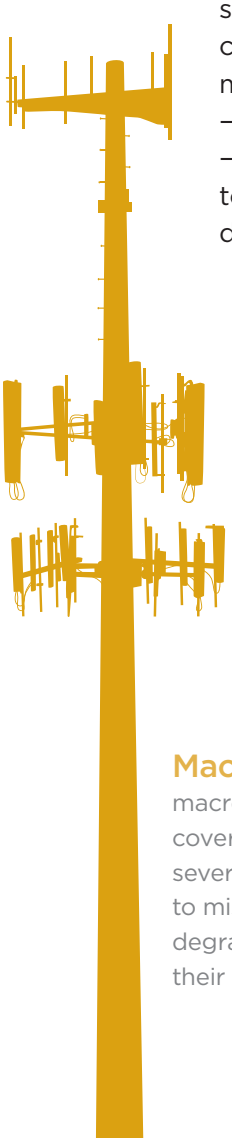
The term 'smart city' sometimes seems to mean everything and nothing all at once, and a common question about the phenomena is some variation on, "what is a smart city?". A smart city is a city that has developed technological infrastructure that enables it to collect, aggregate and analyze real-time data and has made a concerted effort to use that data to improve the lives of its residents and the economic viability of the community. Smart city initiatives often involve four components: the underlying communications infrastructure, information and communication technologies (ICTs) that generate and aggregate data; analytical tools which convert that data into usable information; and organizational structures that encourage collaboration, innovation and the application of that information to solve public problems.[1] Examples include water or utility monitoring devices that promote efficient or sustainable usage, smart streetlights that double as gunshot spotters and communicate with city administrators when they need maintenance, and traffic control and management systems that streamline traffic bottlenecks and report congestion and traffic data to city transportation planners.

Small Cell Technology

What is small cell technology?

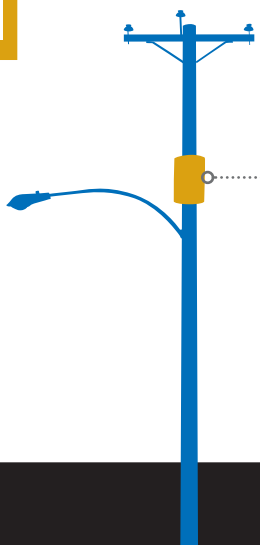
As wireless data usage continues to escalate, providers must find new and innovative ways to keep up with consumer demand for more speed and data capacity. One way to address the capacity crunch is by deploying "small cells," a type of wireless technology for broadband infrastructure. Various federal, 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.[4] 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.[5] Small cell infrastructure is typically 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.



Macrocell vs. Small Cell:
Although they serve different purposes, macrocell and small cell technologies complement each other.

Macrocell: Traditional macrocell towers have a coverage area that spans several miles. They're hard to miss, although their signal degrades towards the edge of their coverage areas.



Small Cell: Small cell technology is much more discreet, mounted on existing structures like rooftops and utility poles. Sometimes, they are accompanied by refrigerator-sized equipment. Because small cells only supply a few hundred feet of coverage, they are best suited for dense areas like downtowns.

What are some of the benefits to cities?

With the increasing usage of wireless devices and data, cities are facing increased demand for reliable wireless service. Small cell facilities can be used to increase the mobile broadband network capacity in cities. This improved service and capacity has many advantages, including economic competitiveness, a "tech friendly" reputation, and more opportunities to deploy smart city and IoT applications. Given that up to 80% of today's 911 calls are placed via wireless phones, robust wireless networks are also critical to public safety.[6]

What are some of the risks to cities?

Often, wireless providers will want small cells deployed in dense urban areas to provide adequate capacity in high demand spots, and each provider will want its own facility installed to cover the same dense area. Thus, there may be several requests to locate such facilities in the same general areas, such that four polls in a row will have small cells from four different wireless companies. This can result in clusters of small cells that are visually unappealing and detract from the aesthetic of the community. Deployment and installation of small cell facilities can potentially interfere with existing technology, such as wireless traffic signals and other municipal technology in close proximity. There is also the risk of ground mounted equipment associated with some small cell facilities obstructing a crowded city's rights-of-way. In addition, recent state and federal efforts to speed the deployment of small cell facilities have focused on preempting local authority to review and control small cell deployments, or to collect fair rents for the use of public property.

What federal and state policies apply to municipal siting processes?

The siting of wireless infrastructure is governed by local, state and federal law. Most wireless infrastructure siting is governed by the applicable government entity with control over the facility's property or location, and there may also be state and/or federal laws that apply to local determination. Local governments assess applications for permits to build new or alter existing wireless facilities for a variety of purposes, including public safety, overall management of public property or rights-of-way, accessibility requirements, environmental issues, land use and community aesthetics. Local governments may charge wireless service providers or wireless facility providers for application processing, access to the rights-of-way, and/or ongoing fees for access to public property — such as municipal street lights or traffic lights — either pursuant to local codes, as part of a large master lease or license agreements with a provider, or on an application-by-application basis.

Federal oversight of wireless siting is primarily based on three federal laws: The Communications Act of 1934, the Telecommunications Act of 1996 (Telecommunications Act) and a provision of the Middle-Class Tax Relief and Job Creation Act of 2012 (Spectrum Act).

These laws contain provisions intended to spur the development of wireless infrastructure and impose some limits on local authority over that infrastructure. The Telecommunications Act, for instance, makes it unlawful for local government to prohibit, or have the effect of prohibiting, the "provision of personal wireless service," prevents local government from "unreasonably discriminating among providers of functionally equivalent services," and requires that local government "act on any authorization to place, construct, or modify personal wireless service facilities within a reasonable period of time." It also stipulates that local governments denying siting applications do so "in writing and supported by substantial evidence contained in a written record."[7] The Federal Communications Commission (FCC) has interpreted that a "reasonable period of time" for local governments to grant or deny siting requests is 150 days for new facilities, and 90 days for collocations.[8] This presumed time limitation is commonly known as a "shot clock."

Meanwhile, the Spectrum Act also contains provisions that limit local control over collocated wireless facilities to ensure the swift deployment of wireless technologies. Section 6409(a) of the Act provided that "a State or local government may not deny, and shall approve, any eligible facilities request for a modification of an existing wireless tower or base station that does not substantially change the physical dimensions of such tower or base station."[9] The FCC created regulations in support of this law, specifying that these collocation requests must be approved within 60 days of application, and that this definition includes distributed antenna system (DAS) and small cell facilities.[10] If a city finds that it received an incomplete application, it has a limited period of time in which to pause, or "toll," the shot clock by notifying applicants in writing of the missing information and relevant local requirements.

The 1934 Communications Act has been cited in recent federal petitions and rulemaking activity[11] relating to the deployment of small cell facilities. Section 253 of the 1934 Act requires that local governments receive "fair and reasonable compensation from telecommunications providers, on a competitively neutral and nondiscriminatory basis," when determining costs to access the public rights-of-way. The FCC has solicited public comment on how and whether to clarify the meaning of this phrase in relation to small cell wireless facilities but has not yet issued a decision or guidance. Likewise, the FCC has recently issued orders prohibiting moratoria on wireless deployment applications and permitting in essentially all circumstances.[12]

State governments have also passed laws intended to speed the deployment of wireless infrastructure, particularly small cell infrastructure, in recent years. For example, Arizona's HB 2365, which was signed into law on March 31, 2017, imposes a series of new requirements on cities' regulation of wireless infrastructure. Arizona's law creates timelines for both cities and applicants to complete reviews of applications and buildout of the requested site. Additionally, it states that rates

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or fees are limited to not more than the actual and direct costs incurred by cities to review those applications or manage the ROW, and places a fixed dollar cap on those application fees, as well as a fixed cap on annual rights-of-way access and pole collocation fees.[13] [14] [15]

Other states have enacted similar limits on local review times, factors which may be considered in a site review and fees local governments may assess. State laws may limit whether local governments can enter into agreements with providers for larger-scale deployments of infrastructure within a community.

What are some of the policy challenges cities face?

Cities adapting their ordinances or processes to enable efficient small cell deployment face a number of policy challenges. First, cities must consider any recent changes to state law that impact local ordinances. Nearly half of all states had already passed small cell legislation or were considering it by their 2018 legislative sessions. Many states that passed laws exempted municipal rights of way from the legislation. These laws may impact what fees or rates cities can assess, what factors they may consider when deciding whether to approve or deny a wireless facility application, and whether the city is subject to a stricter application review timeline than federal regulations establish.

Cities must also consider their own internal capacity when determining how much time should elapse before a new ordinance focused on small cell deployment goes into effect. For example, if the new process demands the establishment of new online application systems or forms, the city should allow ample time to create those new systems before applicants will expect access to them, to avoid unnecessary delays in the application process. Particularly in the case of small cell deployments, providers may wish to file many applications at once as part of a network build-out, and cities should be prepared to determine whether they can limit the number of applications any provider can file within a given time period under state law, or whether they are capable of accepting batches of similar applications simultaneously.

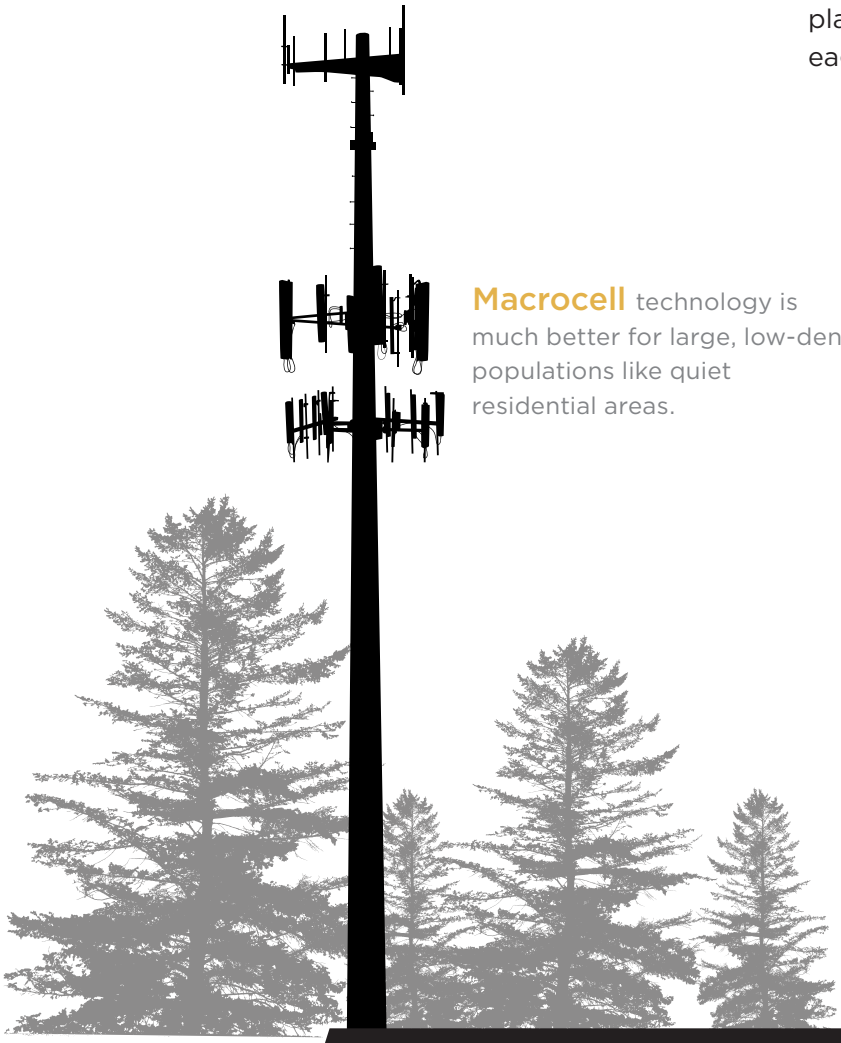
Cities should be cautious in passing moratoria on new wireless facility applications. While moratoria may provide the necessary time for policy makers to determine how best to approach this new technological and administrative challenge, they are not legal in some states, and have been prohibited by the FCC. Moratoria may invite legal challenges from wireless providers eager to start construction.

City Examples

Boston: Preserving History and Planning for a Technology-Driven Future

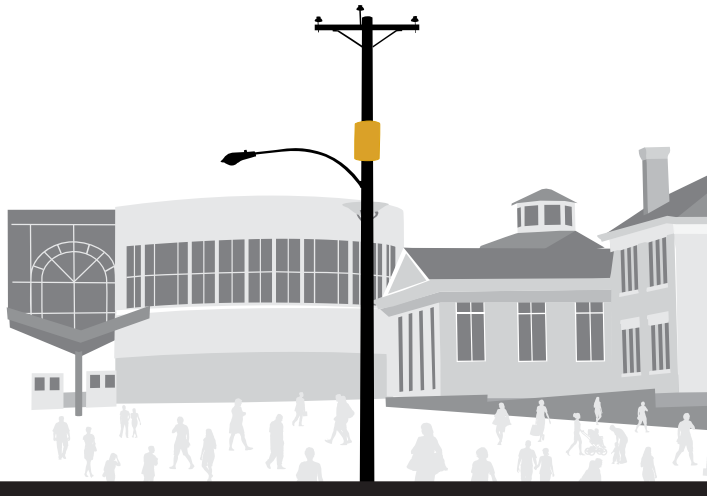
The city of Boston faced a unique challenge when it set out to upgrade the city's wireless networks: its history. The city contains narrow, twisting streets with little sidewalk space, carefully-maintained historic districts, and a wide variety of decorative poles and streetlights — including some gas lamps. This adds up to crowded rights-of-way with sensitive aesthetic needs. However, a city known for its universities and tech industries needed to be a competitive leader on broadband infrastructure to retain and attract residents and businesses.

To address the growing demand for small cell wireless infrastructure, the city used widely-available online tools to create an online application and review process that has reduced the average turnaround time for small cell site application reviews to roughly two weeks. The city has also managed to stem potential floods in applications by placing reasonable obligations on providers eager to file many applications at once.



Macrocell technology is much better for large, low-density populations like quiet residential areas.

Small cells are perfect for small, dense-population areas with high-capacity needs. Downtowns, stadiums and theme parks are ideal for this technology.



For instance, after a permit for a new wireless facility is approved, the provider must build its site within sixty days.

Because of its narrow, historic streets, Boston has had to work very closely with neighbors and wireless providers to create innovative pole designs that take up less sidewalk space, or to negotiate a different pole location on a nearby arterial street with fewer residences and more room to site equipment.

Lincoln: Creating Business Solutions to Technology Challenges

In the city of Lincoln, Nebraska, broadband infrastructure is an important development priority. As demand for service, and for permission to build infrastructure, rose in the community, the city decided to tackle business process challenges. The city began physically relocating staff and grouping them by process and function, rather than department, and created a new rights-of-way construction group of staff from multiple departments to manage broadband infrastructure, small cell wireless applications and other issues. This created a one-stop-shop for private utility construction in the public right-of-way.

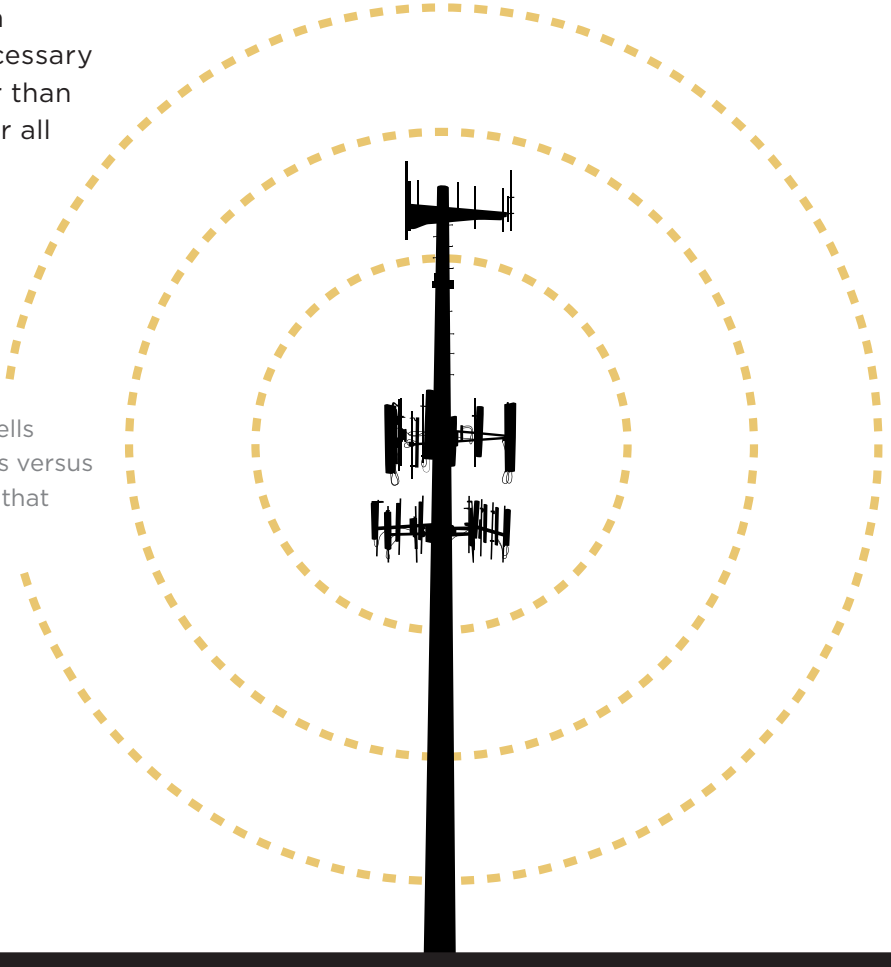
The city worked with carriers to create a standard pole design that met the needs of 95 percent of the city's pole locations and could accommodate most carriers' equipment. For the other five percent of locations, the city has worked with individual carriers to co-design poles to meet those locations' needs and added those new designs to a list of pre-approved poles. The city has also developed a database of existing right-of-way infrastructure assets, such as water, power and broadband lines in the city. This helps smooth the application process and cuts down on the time needed to communicate between city departments and with providers. Additionally, the city has created a master license agreement process based on existing public-private partnership agreements and adapted the master license agreements used for broadband to business and home to mobile infrastructure. Making the agreements consistent, and posting them publicly online, has helped reassure providers that they are getting the same deal as their competitors and smoothed the negotiating process.

Lincoln has faced some challenges in recent years with its efforts to deploy wireless infrastructure. Some providers have successfully received permits to build new poles, but have not deployed in those locations, resulting in wasted city resources and no improved service for residents. The city has also fought back against attempts by the state legislature to preempt local authority over small cells. In 2017, the city battled wireless providers who claimed that city-induced costs were inhibiting infrastructure deployment. When Lincoln offered a discount to local carriers who were willing to build out connectivity in rural parts of Nebraska, the providers backed down, and ultimately preemptive legislation did not pass that year.

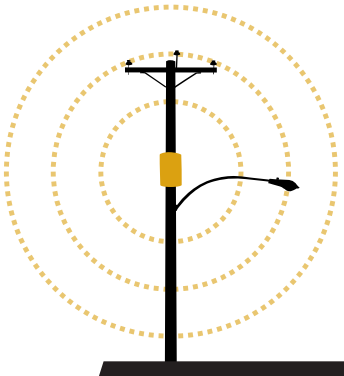
Raleigh: Finding Common Ground with Industry Through Partnerships

The city of Raleigh is focused on being the best — with hopes of being designated a 'best place' to live, work and play, as well as a forward-thinking leader in the technology space. The city recognized that in order to achieve those goals, it would need to be open to the prospect of small cell wireless infrastructure deployment. From the moment the city was approached about installing small cell infrastructure, the priority was to establish a good working relationship with wireless providers while protecting and upholding the values and interests of residents within our communities.

The city streamlined its application process by eliminating some unnecessary engineering time and costs. Rather than calling for engineering drawings for all installations, the city shifted its process to require basic geographic coordinates for proposed wireless sites, so that the city could quickly work with providers to find optimal locations. Wireless providers appreciated hearing back from city staff about site feasibility within a couple of days of submittal. The city has also taken several steps to hear the wishes of residents, most directly through its 20 Citizen Advisory Councils. City employees who manage small cell deployment have been meeting regularly with these advisory boards to gather feedback and answer questions about the process of small cell installation.



Quantity and Quality: Although macrocells cover much larger areas than small cells — miles versus feet — small cells have higher-quality coverage that works well in dense areas.



What is Broadband?

According to the Federal Communications Commission, broadband is connection speeds of at least 25 Mbps for downloads and three Mbps for uploads. About 20 percent of American households don't have access to broadband under this current definition.

One administrative challenge came about in the form of a piece of legislation passed by the state that preempts the city's ability to manage small cell applications. A 2017 law restricts local governments in the state of North Carolina from sending applications for collocated infrastructure — or infrastructure that wireless providers want to place on existing poles — to city council for review. Wireless providers that wish to collocate small cell infrastructure are allowed to seek administrative approval and place their equipment and infrastructure on those existing poles. This is intended to streamline the review process for small cell installations that do not require a new structure or pole to be constructed. While it shortens the administrative approval process, it removes the city's ability to govern on this issue.

San Jose: Welcoming New Technology While Closing the Digital Divide

Equity drives San Jose's approach to bringing new technologies to the city, and the deployment of municipal broadband and municipal fiber lines is no exception. Located in Silicon Valley, San Jose city officials are acutely aware of the technology boom happening on their doorstep and are eager to welcome these advances, provided they can do so in a way that speaks to the needs of all residents. With only three percent of the city connected to high quality fiber lines, the city needed to both improve overall access to high speed internet and address the digital divide for 95,000 residents without access. After commissioning a study of the city's broadband approach as well as conducting surveys of low-income populations, San Jose officials set about working with the private sector on an arrangement that facilitates deployment, speaks to the city's equity goals and meets provider expectations.

They settled on a tiered pricing structure where providers pay $750-$2500 depending on whether they will cover the entire city or smaller areas. Larger deployments essentially receive a bulk-discounted rate. This revenue then feeds into two important city goals: internal capacity building and digital equity. For the former, the revenue bolsters the public works department, enabling staff to streamline the permitting and governance processes. Providers are therefore amenable to the deal because it facilitates faster small cell deployment. Additionally, the remaining funds, $24 million so far, go into a "Digital Inclusion Fund" to close the digital divide for low income and vulnerable populations.

When San Jose officials stepped back to look at the whole picture, they noticed that different providers had an interest in deploying in different market segments and, therefore, different neighborhoods. By building relationships with these carriers, San Jose has been able to spread coverage across the city. Where gaps arise, the digital inclusion fund fills in. Some of the projects on deck include free device checkout at libraries and coding camps. The city will also pursue grants on top of these core funds to further build out program support in the long term.

Tempe: Bringing Transparency to the Process

The city of Tempe knows that small cell infrastructure will be integral to meeting the technological demands of the future. For city staff, determining the process for small cell infrastructure deployment and being transparent about it with wireless providers was very important. Once the city established a master license agreement with the first carrier in the market, that original agreement was used as a template to develop subsequent agreements with small cell infrastructure providers, who also wanted to deploy small cells and distributed antenna systems (DAS).

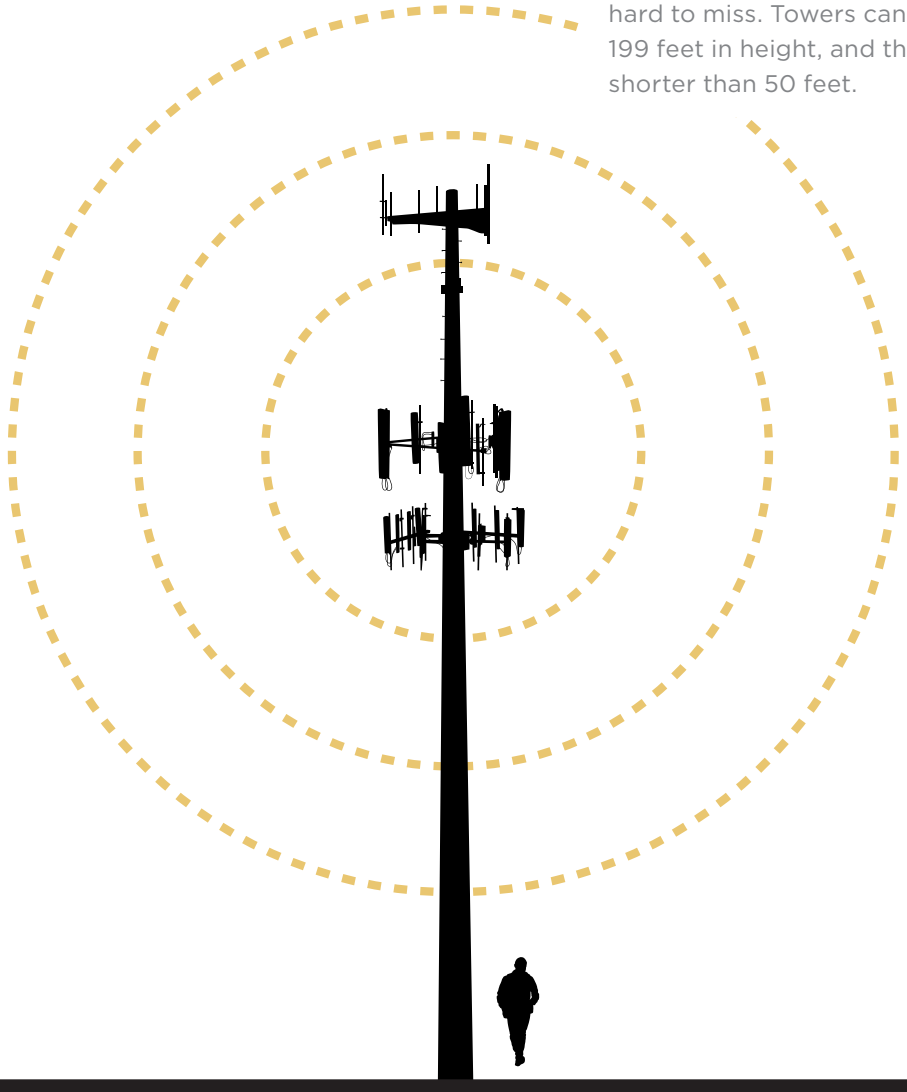
In 2017, however, preemptive legislation was passed by the Arizona state legislature that hindered the city's ability to completely control small cell infrastructure deployment. The new law imposed fee caps as well as shot clocks on the application process. It also forced cities to reduce their fees to a rate that was significantly lower than existing market rate agreements.[16] The rationalization for such legislation was that it was needed to speed up deployment in Arizona by limiting a city's capacity to interfere via local legislation and incentivize 5G by reducing the industry's costs of deployment. During the negotiation period preceding the passage of the bill, the city fought hard to maintain its ability to manage the right-of-way, mostly in order to retain control over the aesthetic elements of deployment and to minimize any visual blight caused by the size of the small cell allowed (the equivalent of 27 pizza boxes).[17]

The new law required Arizona cities to establish and make standard terms of agreements publicly available. Tempe viewed the legislation's six-month implementation period as an opportunity to foster collaboration between the public and private sectors. Before finalizing the standard terms and conditions, site license provisions, application processes for small cells and design criteria, the city sent draft copies of all proposed documents to the major carriers and infrastructure providers for feedback. Collaboration with the industry was important in avoiding conflict when documents advanced to the city council for deliberation and approval.

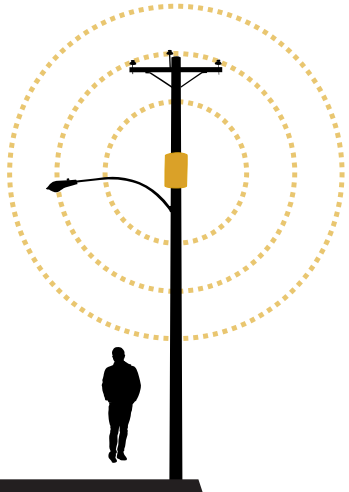
The city also carefully considered the desires and values of the public. For residents, aesthetics and the way the new

small cell infrastructure blended into the community were very important. Tempe was able to coordinate with other local cities and wireless providers to create design guidelines, ensuring that new infrastructure would mesh with the local aesthetic. The city worked to ensure that the guidelines were not too much of a hindrance to deployment. Tempe found that balancing the concerns of industry with the city's ability to manage its poles and right-of-way is critical. Local government can function as the connection between the community and industry, ensuring that both parties' interests are represented and accounted for.

Towers: Macrocell infrastructure is hard to miss. Towers can reach up to 199 feet in height, and they're rarely shorter than 50 feet.



Small cell: Small cell antennas are typically only a few feet tall, roughly the size of a pizza box. They are also often accompanied by an equipment cabinet the size of a utility box or refrigerator.



Strategies for City Leadership

1 Gain a full understanding of the technology and important safety considerations.

Local elected officials and decision-makers should ensure that they understand technical, political and legal implications of the technology, its deployment, and any existing policies related to small cell facility siting. This will ensure that the best interests of the community are upheld when new decisions around small cell siting are being made.

2 Articulate your priorities for accommodating this technology.

City officials should determine how they want to integrate this technology into their communities and be intentional about expressing those desires during the policy-making discussions and deployment process. Some questions and considerations might include:

a. **Whether the city wants to subsidize the build-out of the facilities to speed up wireless connections;**

b. **Whether the city needs extra time to conduct a thorough engineering review for public safety concerns; or**

c. W**hether the city will work to harmonize the facilities with the look and feel of different parts of town.**

3 Create clear policies for permit review that let both city staff and industry applicants know the expectations.

This includes establishing processes for how applications will be addressed or processed, timeframes, objective requirements for the decisions and possibly application checklists. Cities should communicate these policies broadly and transparently to potential applicants. They may also wish to collaborate with likely applicants to develop design standards compatible with technological needs.

4 Develop a template right-of-way access policy/agreement, as well as a city pole attachment agreement.

Cities should make sure these policies and agreements address multiple kinds of infrastructure, from macrocell towers to small-cell facilities. This might include the establishment of requirements for both types of structures — such as size, location, design, public safety, stealth, etc.

5 Think through in advance any beneficial items the city could negotiate with industry in exchange for use of the right-of-way — if allowed by state law.

Issues up for negotiation might include collocation; length of time for siting; terms of installation; terms for upgrade; free or discounted services for schools, libraries, or other public entities; or other provisions that benefit the community and its residents.

6 Give careful consideration to fee structures.

There are a variety of fees and charges that cities may want to address. Application fees to cover the cost of staff to review applications, permitting fees to cover costs of building permit reviews and inspections, regulatory access fees for use of public ROW (ongoing), rent based on market rates if using public property (ongoing), and ongoing maintenance fees. Cities should take care to ensure that costs for removal of abandoned equipment are not borne by taxpayers.

Definitions

Collocation:
When multiple wireless providers attach antennas and other equipment to a single shared support structure. This practice may lower barriers to entry for new providers and reduce pole proliferation. The federal government defines collocation as: the mounting or installation of transmission equipment on an eligible support structure for the purpose of transmitting and/or receiving radio frequency signals for communications purposes.[18]

Small cell facilities:
Small cell facilities are a type of wireless broadband infrastructure. They typically take the form of small antennas that are placed on existing infrastructure (both indoors and outdoors) and ground mounted equipment. These facilities help to compliment or stretch tower macrocell coverage and add capacity in high demand areas. In many states this term is defined by state law.

Ground mounted equipment:
This type of equipment sits at ground level, such as along sidewalks. It is distinct from equipment mounted on existing infrastructure such as telephone poles or buildings. This equipment is similar to traffic control or telephone equipment cabinets.

Macrocell:
A macrocell is a wireless facility used in cellular networks with the function of providing radio coverage to a large area of mobile network access. A macrocell differs from a microcell by offering the backbone of coverage area and high-efficiency output. It is placed on stations where the output power is higher, usually in a range of tens of watts.[19]

Smart city:
A “smart city” is one that has developed technological infrastructure that enables it to collect, aggregate and analyze real-time data to improve the lives of its residents.[20]

Internet of things (IoT):

The internet of things (IoT) is a computing concept that describes the idea of everyday physical objects being connected to the internet and able to identify themselves to other devices. The term is closely identified with RFID as the method of communication, although it also may include other sensor technologies, wireless technologies or QR codes.[21]

5G:

The term for emerging 5th generation wireless telecommunications standards usually associated with network speeds of 1 Gpbs or more.[22]

Exabytes:

An exabyte is a unit of measurement that describes 10^{18} bytes or 1 billion gigabytes. This unit refers to such a large amount of data that it is typically used to express quantities of information transmitted over the internet in absolute terms.

Internet Service Providers:

An internet service provider (ISP) is a company that provides customers with Internet access. Data may be transmitted using several technologies, including dial-up, DSL, cable modem, wireless or dedicated high-speed interconnects. Typically, ISPs also provide their customers with the ability to communicate with one another by providing Internet email accounts, usually with numerous email addresses at the customer's discretion. Other services, such as telephone and television services, may be provided as well. The services and service combinations may be unique to each ISP.[23] Throughout the paper we use this term synonymously with the term carrier.

Infrastructure Developer:

Company or entity that invests in or builds out the basic physical and virtual systems of a community, including roads, utilities, internet and wireless networks, water, sewage, etc. These systems are considered essential for enabling productivity in the economy and require significant fiscal investments. Developers and investors can be from the public or the private sector.[24]

Resources

National Association of Telecommunications Officers and Advisors: Wireless Facility Siting: Model Chapter Implementing Section 6409(a) and Wireless Facility Siting: Section 6409(a) Checklist — https://www.natoa.org/documents/6409ModelOrdinance.pdf

United States Department of Commerce Internet Policy Task Force and & Digital Economy Leadership Team: Fostering the Advancement of the Internet of Things

https://www.ntia.doc.gov/files/ntia/publications/iot_green_paper_01122017.pdf

BroadbandUSA: Broadband Glossary — https://www2.ntia.doc.gov/files/bbusa_broadband_glossary_161024.pdf

BroadbandUSA: Smart Communities Glossary — https://www2.ntia.doc.gov/files/bbusa_smartcommunitiesglossary_11212017.pdf

[1] **Trends in Smart City Development.** (2016). National League of Cities. Access at: http://www.nlc.org/sites/default/files/2017-01/Trends%20in%20Smart%20City%20Development.pdf

[2] **Ericsson, Ericsson Mobility Report at 13** (Nov. 2016), https://www.ericsson.com/assets/local/mobilityreport/documents/2016/ericsson-mobility-report-november-2016.pdf.

[3] **Trends in Smart City Development.** (2016). National League of Cities. Access at: http://www.nlc.org/sites/default/files/2017-01/Trends%20in%20Smart%20City%20Development.pdf

[4] **Federal Communications Commission.** (2016). Public Notice: Comment Sought on Streamlining Deployment of Small Cell Infrastructure by Improving Wireless Citing Policies. Access at: https://apps.fcc.gov/edocs_public/attachmatch/DA-16-1427A1.pdf

[5] **WIA** (2017). Enabling Wireless Networks Everywhere, Presentation.

[6] See https://www.nena.org/?page=911Statistics.

[7] **47 U.S.C. § 332(c)(7)(B)**

[8] **Petition to Clarify Provisions of Section 332(c)(7)(B) to Ensure Timely Siting,** WT-Docket No. 08-165 (11/18/09).

[9] 47 U.S.C. §1455(a)

[10] **Acceleration of Broadband Deployment by Improving Wireless Siting Policies,** WT Docket No. 13-238, 11-59, 13-32, (10/17/14)

[11] **Ibid.**

[12] **Federal Communications Commission. (2018):** Public Notice: FCC Speeds Access to Utility Poles to Promote Broadband, 5G Deployment. Access at https://www.fcc.gov/document/fcc-speeds-access-utility-poles-promote-broadband-5g-deployment-0

[13] $750.00 (A.R.S. § 9-593(I)) and $1000.00 (A.R.S. § 9-594(E)(3)).

[14] $50 per small cell (A.R.S. § 9-592(D)(4)

[15] $50 per pole (A.R.S. § 9-595).

[16] The average small cell fee charged by Arizona cities in 2017 was $3,530.00 per site, which included both the use of the pole and the use of the right-of-way for a small cell and associated ground equipment. (This amount was about 1/8 of the annual fees charged for macro sites). The legislation capped this fee at $100.00 per site ($50.00 for the use of the pole and $50.00 for the use of the right-of-way.)

[17] All antennas to be located inside an enclosure of up to 6 cubic feet in volume and the associated equipment to be up to 28 cubic feet in volume. A.R.S § 9-591(19).

[18] **47 C.F.R. § 1.40001(b)(2)**

[19] https://www.techopedia.com/definition/2950/macrocell

[20] **Trends in Smart City Development.** (2016). National League of Cities. Access at: http://www.nlc.org/sites/default/files/2017-01/Trends%20in%20Smart%20City%20Development.pdf

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The National League of Cities (NLC) is the nation's oldest and largest organization devoted to strengthening and promoting cities as centers of opportunity, leadership, and governance. NLC is a resource and advocate for more than 1,600 member cities and the 49 state municipal leagues, representing 19,000 cities and towns and more than 218 million Americans.

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