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How Localities Can Improve Wireless Service for the Public While Addressing Citizen Concerns

A Primer for Localities Managing the Emerging Wave of Wireless Deployment

As demand for wireless data continues to grow, a diverse group of tower companies, wireless carriers, fiber companies, and neutral-host infrastructure providers such as Mobilitie and ExteNet are requesting attachment permits from city and county officials nationwide. The flood of requests and actual deployments is creating uncertainty and stress for local officials as the new technologies are proposed on poles, streetlights, and new structures in neighborhoods. Community members, too, are increasingly asking their local officials whether the new equipment is necessary—and whether there are alternative approaches that would reduce the impact on their neighborhoods.

The wireless industry is investing billions of dollars to enhance their networks by adding antennas and interconnecting them with fiber. Through a process they refer to as "network densification," the carriers will use a mix of traditional macro cell towers, distributed antenna system (DAS) networks, and small cells to reach individual customers—both on the move and in their businesses and homes.

Indeed, Federal Communications Commission Chairman Tom Wheeler, speaking at a recent CTIA conference, noted, "There are just over 200,000 cell towers in the U.S., but there may be millions of small cell sites in the 5G future."[1]

Local communities will feel the impact of these new cellular installations, particularly because the antennas will need to be even closer to where people live and work. Local government decision-makers need to be aware of the rapid emergence of large-scale DAS and small cell wireless deployment in residential neighborhoods—and the potential opposition to those deployments from residents.

[1] "Remarks of FCC Chairman Tom Wheeler," CTIA Super Mobility Show 2016, Las Vegas, September 7, 2016, http://transition.fcc.gov/Daily_Releases/Daily_Business/2016/db0907/DOC-341138A1.pdf

Understanding the Augmentation of Towers with Small Cells and DAS

Traditional Approach to Wireless Service

Cellular network designers have a goal of providing customers with coverage and high-speed access—in the areas where customers expect to use the service. Challenges to network designers include the range of performance of phones and wireless devices, the limited availability of radio frequency spectrum, the placement of the wireless transmission facilities with respect to the user, rapid growth in demand, and obstructions such as building walls and trees.

Historically, to support only voice and text, wireless providers installed 150- to 200-foot towers to serve users in a five-mile radius (for a total service area of 50 to 75 square miles). The industry regarded the tall tower approach to wireless deployment as a reliable and cost-effective way to address narrow-bandwidth cell phone voice applications.

The most common forms of cell tower deployment have been self-supporting towers and monopoles. Typically, three or more wireless carriers share a common structure, with each carrier installing separate multi-antenna arrays (or rings) at designated heights. A common area beneath the tower is used to house the electronic equipment and backup power for each carrier, often with each carrier having a separate building.

Figure 1 is a typical self-supporting tower with three service provider antennas. Figure 2 is an example of a monopole cell tower. In addition to the antennas used to provide wireless service to customers, both towers also have microwave antennas to link the sites to neighboring sites and connect with the backbone telephone network and Internet. This connection can be provided either by a microwave or a cabled connection. However, to support expanding future needs for broadband Internet, typically a fiber optic connection is needed.


Figure 1: Self-Supporting Tower


Figure 2: Monopole Tower

Evolution of Wireless Technology

Modern broadband 4G and future 5G technologies require substantially greater bandwidth and signal strength than voice and text.

Over the past decade, service providers have begun to augment tall tower deployment with neighborhood wireless transmission facilities—such as DAS and small cells—that have smaller coverage footprints. In the new distributed wireless architecture, broadband users communicate with localized access points, typically mounted at elevations of 20 to 30 feet above ground level.

These neighborhood access sites target service areas with a radius of 250 to 300 feet from the access site.

The rapid increase in wireless data usage requires an increase in the overall capacity and functionality of local wireless networks. Initially, nationwide wireless carriers focused on the 700 MHz band. Commercial wireless carriers then began to address the growth by acquiring and activating spectrum in higher-frequency radio bands (1.9 GHz to 2.5 GHz and higher), and segmenting the coverage area of their access points to serve smaller areas, so that fewer users share the same spectrum. While the higher-frequency bands increase the capacity, they are also more susceptible to blockage from buildings, foliage and terrain and often have more limited range.

Wireless providers additionally propose to expand their transmission capacity by adding hundreds of megahertz in unlicensed spectrum (in the 2.4 and 5.8 GHz bands used by Wi-Fi) to augment the licensed spectrum that they hold. The FCC is currently evaluating alternatives for providing additional spectrum to further enhance the resources of the wireless industry, focusing its efforts across the 2.4 to 6.0 GHz spectrum, as well as submillimeter spectrum up to 80 GHz.

A wide range of innovations currently is included under the evolving category of "5G,"[2] offering the promise of improved transmission speeds and accompanying throughput by enhancing coding techniques; "beam forming;" spectrum band aggregation; and other technological advancements. But even with these technological enhancements, user demand for high-speed network access will potentially continue to exceed technology updates.

The industry sees smaller network segments and large numbers of DAS and small cell network access points situated close to the user as a pragmatic and cost-effective approach to enhancing the delivery of broadband services.

Deployment Options for Achieving Targeted Neighborhood-Area Coverage

Currently, the industry is focused on enhancing broadband delivery, particularly in urban and suburban markets with high concentrations of users in relatively small areas. DAS networks and small cell antennas are two of the most common technologies for filling in capacity and coverage gaps within carriers' existing footprints. (That is, the DAS networks and small cells are typically not being used to expand the area covered; they add capacity in existing coverage areas, or fill in spotty coverage gaps in very targeted areas within a carrier's current coverage area.)

Both DAS networks and small cells are pole-mounted installations smaller than the rings of traditional cellular antennas at large macro sites. DAS network installations are typically the larger of the two types of installations, supporting multiple spectrum bands and multiple wireless

[2] Technologies in the "5G" category include upcoming releases of 4G LTE technology known as "LTE-Advanced" as well as submillimeter high-frequency technologies providing line-of-sight communications, typically over very short ranges.

carriers within the same structure. Small cells typically support only one wireless carrier and have a smaller physical size than a DAS installation.

Similar in appearance to telephone, cable-TV, or electrical devices mounted on utility poles, the DAS or small cell installations are installed 20 to 30 feet above ground on structures in the public right-of-way (ROW) such as utility poles, traffic lights, and streetlights—providing a reliable communications range of 200 to 300 feet from the mounting structure.

Figure 3 illustrates a typical neighborhood DAS deployment, with access points connected via fiber optics. (From the perspective of visual impact, a small cell antenna will look similar.) Access point locations are selected based on the availability of suitable mounting structures with the goal of delivering a uniform signal level to users throughout the service area.

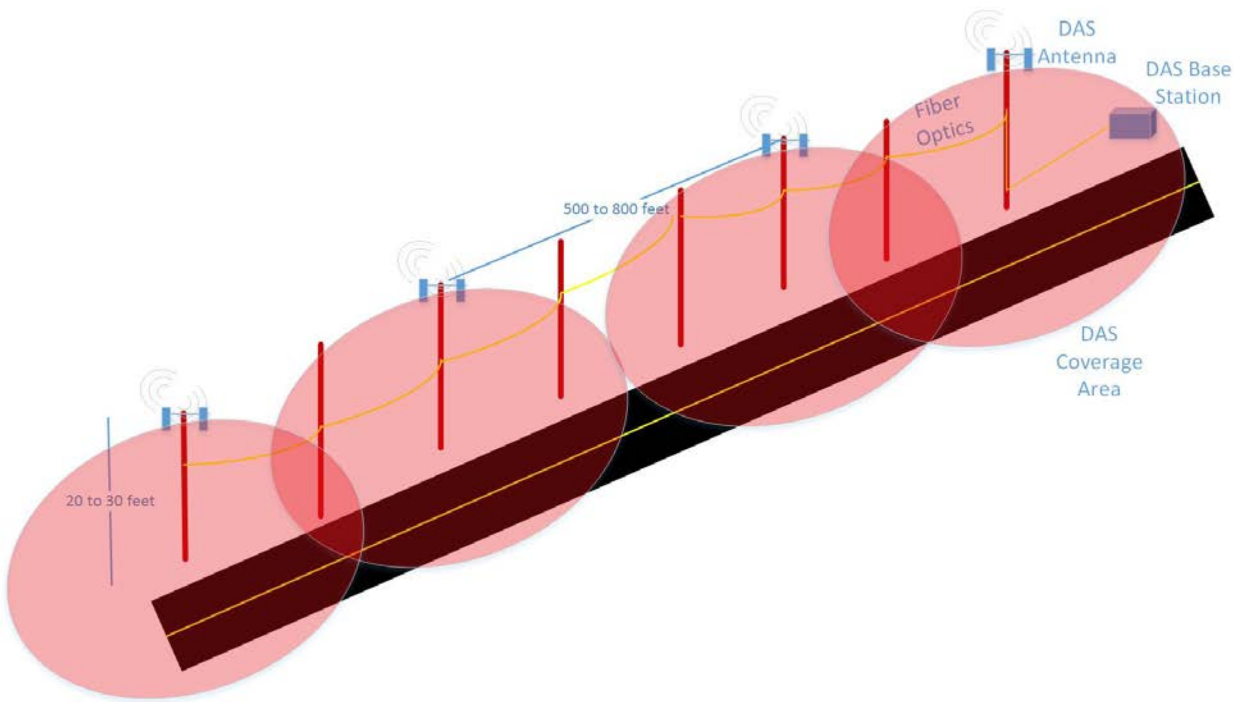

Figure 3: DAS With Fiber Optic Cable Backhaul

An alternative approach to linking DAS and small cell access points is to connect them wirelessly (Figure 4). Wireless interconnection (or "backhaul") uses a separate wireless network to interconnect individual local access points to the service provider. This approach eliminates the cost and time required to bring fiber optics to the access point. At the top of each pole, another independent antenna connects the access point to a core aggregation site.

With a wireless backhaul approach, poles or other structures must support a wireless backhaul antenna that is higher on the pole than the DAS access point.

Additionally, in the wireless backhaul approach, the core aggregation site that communicates with each of the access points must be 100 to 120 feet above ground, substantially taller than the other access points.

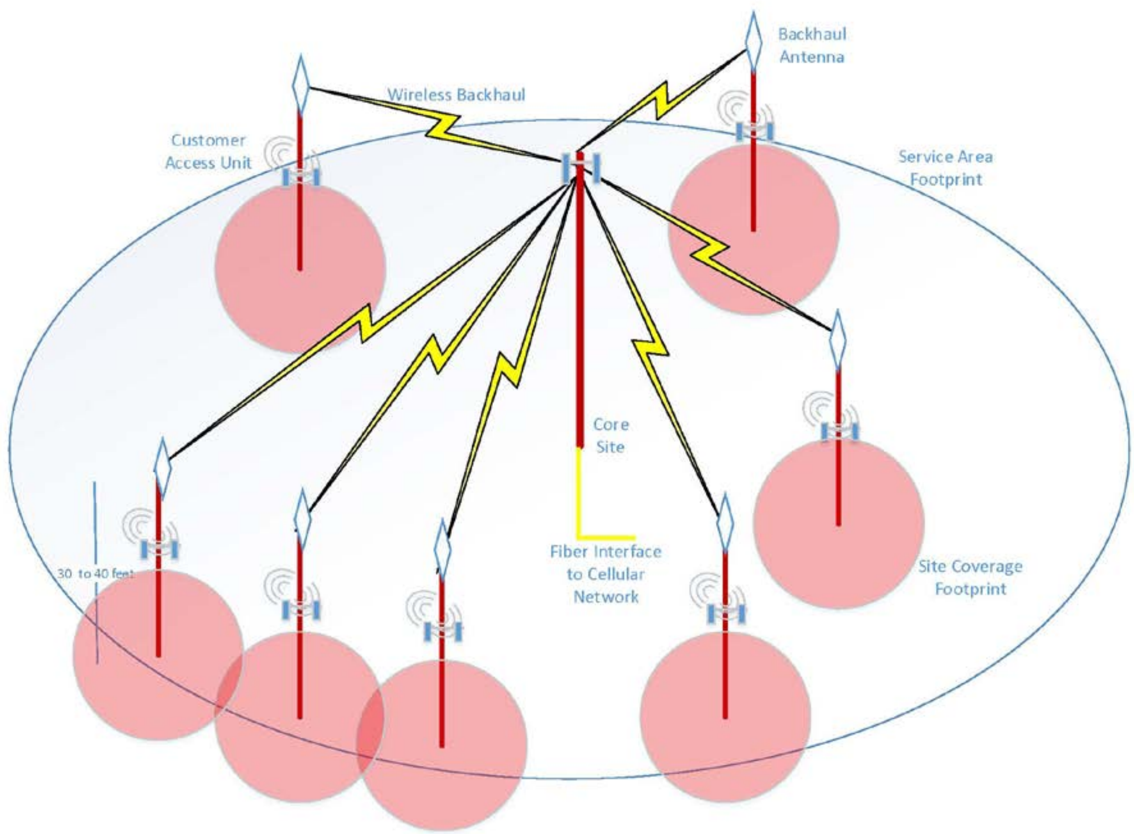

Figure 4: DAS with Wireless Backhaul

Key Technical Facts for Local Government Decision-makers

Our review of small cell and DAS technologies indicates that overall they share most of the following attributes:

- Deployment is focused on existing structures in the public right-of-way such as utility poles, traffic lights and streetlights. Where necessary, the wireless provider replaces the existing light pole with a stronger light pole to accommodate the wireless access equipment, or otherwise reinforces the structure.
- Systems utilize low power and high-frequency spectrum (1.9 GHz or higher) providing near-line-of-sight communications. Design coverage from an individual access site is

typically 400 feet or less from the antenna and is consistent with the placement of future 5G equipment.

- In many cases, the systems are installed to accommodate multiple wireless carriers utilizing common equipment.
- The systems are typically not being deployed with the 800 MHz antennas and equipment wireless companies typically used for voice service
- In a typical multi-dwelling, high-density, suburban environment, the density of systems can be as high as 25 to 30 access points per square mile.
- Typically, the antennas are installed 20 to 30 feet above ground level.
- Wireless access points are interconnected to the wireless provider's network through a fiber-optic or wireless backhaul network. Systems that use wireless backhaul typically require core consolidation antenna sites exceeding 100 feet in height, and wireless providers are frequently seeking to place these larger poles in the public right-of-way.

Understanding Wireless Carrier Business Planning and Strategies

It is important to understand that wireless carriers face significant challenges in the large-scale deployment of outdoor small cell antennas and DAS networks, and that these motivate the strategies and choices of wireless deployers:

- Site acquisition,
- Variation from locality to locality of planning and zoning laws, including those governing placement of antennas and enclosures on poles and in the ROW,
- Provisioning fiber to and increasing power to poles and traffic lights, and
- Fiber backhaul availability, including access to fiber in less competitive and rural markets.

One strategy that large Mobile Network Operators (MNO) like AT&T, Sprint, T-Mobile, and Verizon Wireless are using to address these challenges is to outsource their deployments to third parties.

This approach insulates the MNOs from some of the cost and risk associated with antenna deployment. For example, when MNOs do not apply directly to the local jurisdictions for the new infrastructure, they avoid municipal and public scrutiny over the applications and leave it to the third parties.

The outsourced companies include tower companies such as Crown Castle and American Tower; fiber operators such as Zayo, Lightower, Lumos, FiberLight, and Uniti Fiber; and "neutral host" infrastructure companies like Mobilitie and ExteNet.

The companies building small cells and DAS know that there are often limited sites that are best suited for small cell attachment. As soon as they receive award for a small cell deployment from an MNO, some may "over permit" to lock up the attachable real estate. As the first to the site in many markets, an early over-permitter may create de facto monopolies and restrict future deployment and competition, leaving future MNOs to then find other means of deployment, or turn to an infrastructure operator already attached to the poles.

Infrastructure deployers are also pursuing policies and business arrangements that will streamline their buildout efforts, including:

- Seeking blanket agreements for utilization of public-owned structures to reduce administrative hurdles and speed implementation,
- Exploring partnerships with cities and/or technology companies on Smart City Internet of Things deployments, potentially providing wireless providers more access to structures such as light poles and street furniture, and
- Asking federal and state governments to restrict and standardize local authority on use of ROW, and enact expedited timelines.

Impact on Local Governments and Their Citizens

MNOs and their infrastructure partners are calling for local governments to expedite approvals for new wireless facility siting—but the large-scale deployment of small cells and DAS is also causing concerns about aesthetics, safety, potential frequency interference, and how future modifications to those structures may potentially amplify those problems. Expedited approval timelines can limit a locality's ability to properly review an application, or to consider the potential future impact of a siting.

We anticipate that the wireless industry's large scale deployment of small cells and DAS will have a significant impact on local governments in the following areas:

- Administrative burden – Municipalities generally are prepared to deal with a small number of tower requests each year, but many localities may potentially receive hundreds of new applications, all at once, as deployments begin. Additionally, under the FCC's rules, all applications must be reviewed and acted on within 90 days (for modifications to existing sites) or 180 days (for new towers).
- Aesthetics – The increase in applications for small cells, DAS networks, and other antennas means that neighborhoods could have a high density of antennas and cabinets. In neighborhoods without utility poles, antennas will need to be placed on streetlights or on new poles. If a deployer is using wireless backhaul technology, it may seek to place a 100 to 120-foot tall tower in a residential neighborhood.

- Support for internal communications – With the industry's aggressive deployment, some municipalities may face future challenges in finding places to mount radios for their own public safety needs or Smart City deployments. As new fiber is placed to support fiber-to-the-tower deployments, there will be less space on utility poles for other communications uses, including municipal Smart City infrastructure.

If a locality is educated and prepared to respond, it can negotiate from a position of strength. There are opportunities for local governments to actively shape the future visual appeal of their neighborhoods while still ensuring that the community is equipped with the technology needed to enable Smart City planning and meet the wireless needs of residents and businesses.

Locality strategies for managing small cell and DAS buildout might include:

- Limiting in advance how many poles a single deployer can use (perhaps one out of four),
- Requiring the use of existing poles or the replacement of those poles with poles that visually resemble the existing poles, or
- Sharply restricting or banning exceptionally tall poles in residential rights-of-way.

Wireless deployments may create opportunities for public–private partnerships. These include:

- A locality working with a deployer to build a Wi-Fi network in public gathering places such as parks, shopping districts and downtown business centers in return for the use of City fixtures and assets;[3]
- A wireless deployer and a locality to reducing costs by jointly building fiber;
- A wireless deployer buying or leasing existing locality fiber instead of building new fiber; and
- A locality and a wireless deployer working together on wireless deployment for Smart City applications.

What Localities Can Do to Facilitate and Manage Small Cell, DAS, and 5G Deployment

Local governments have a dual role in the expansion of wireless facilities and services in their communities. They want to actively support the expansion of high-quality wireless services for their residents and local businesses, but they also must address citizen concerns related to deployment of new wireless facilities.

[3] One example is Sprint's collaboration with the City of Kansas City and Cisco Systems, placing free Wi-Fi for the public in downtown areas and parks, http://investors.sprint.com/news-and-events/press-releases/press-release-details/2016/Sprint-Launches-Free-Wi-Fi-Service-as-Part-of-Kansas-Citys-Smart-City-Initiative/default.aspx.

In addition, localities must perform these roles under tight time constraints imposed by the FCC's "shot clock" for reviewing and approving the industry's applications for co-locations and new facilities.

In our experience as wireless facility advisers to local governments, we have found that localities can take steps to facilitate and enable the process so that the needs of the carriers and the needs of the community are addressed. If local governments perform their roles in a structured and organized fashion, the process is predictable for both the carriers and the community—and the process is more likely to fit within the timeframe established by the FCC.

Among the steps that localities can take to enable due consideration of community concerns while providing a predictable filing experience for carriers are:

1) Ensuring that a carrier or third-party entity that seeks to install wireless infrastructure has the proper authority to operate the equipment. That authority might be granted by a Public Service Commission, another applicable state authority, or the Federal Communications Commission (which licenses the use of some radio frequencies).

2) Enacting zoning requirements to regulate wireless facilities in residential areas. Zoning might consider whether a facility is speculative (and could deny an application that does not identify a cellular carrier for which the antennas will be installed), whether an antenna is proposed for attachment to an existing structure or if a new structure will be constructed, and whether the proposed facility meets established height limits and setback requirements. Zoning might also distinguish between DAS and small cell antennas.

3) Managing the public rights-of-way by reviewing applications for licensing/permitting, structural issues, placement of facilities to minimize community impact, acceptable results of RF emission studies, and compliance with national codes (NEC, NESC) and pole owners' attachment requirements.

4) Evaluating the community impact of proposed small cell and DAS installations with the same focus as traditional towers and antenna siting. Once approved, structures are subject to federal law for co-location—which could permit a co-locator to increase a facility's height by up to 10 percent or 20 feet, whichever is greater, without local approval.

5) Establishing a community notification process to require carriers to notify residents of upcoming applications in their neighborhoods.

These recommendations may form pillars of a locality process. In order to manage these challenges and opportunities, we recommend that localities continue to become educated, share knowledge and experiences, and stay informed and active as discussions occur at the state and federal level.