2018

Connecticut State-Wide Telecommunications Coverage Plan

Introduction

The role of the Connecticut Siting Council (Council) in the deployment of wireless telecommunications facilities is specifically defined by federal and state laws. The Connecticut General Statutes (CGS) require the Council to develop a plan for state-wide telecommunications coverage (plan) and to revise such plan as necessary.[1] According to statute, the plan must be consistent with the federal Telecommunications Act of 1996, state telecommunications goals under CGS §16-247a, *et seq*. and the state tower sharing policy under CGS §16-50aa. The Council first prepared a plan in 2006 and revised such plan in 2013. According to its enabling laws, the Council does not choose or develop the sites for these facilities. Such sites are generally proposed by commercial wireless telecommunications providers or private companies that own and lease towers. For its part, the Council is responsible for ensuring that the facilities proposed by these private companies are properly planned and controlled in ways that will not adversely affect the environmental quality of the state and its ecological, scenic, historic and recreational values. The Council also promotes the sharing of towers wherever technically, legally, environmentally and economically feasible in order to avoid the unnecessary proliferation of towers in the state.

The Federal Telecommunications Act of 1996

In 1996, the United States Congress recognized the public need for high quality wireless communications service throughout the United States and adopted the Telecommunications Act (Telecom Act), which is implemented by the Federal Communications Commission (FCC). The purpose of the Telecom Act is to "provide for a competitive, deregulatory national policy framework designed to accelerate rapidly private sector deployment of advanced telecommunications and information technologies and services to all Americans." The Telecom Act struck a balance between legitimate areas of state and/or local regulatory control over wireless infrastructure. It preempts state and/or local regulation over the public need for telecommunications facilities and preempts state and/or local regulation over radio frequency emissions from telecommunications facilities.

In 2012, Congress passed the "Middle Class Tax Relief and Job Creation Act of 2012" (Spectrum Act). Section 6409 of the Spectrum Act amended the Telcom Act. Section 6409 mandates state and local government approval of an "eligible facilities request" for the modification of an existing telecommunications tower that does not substantially change the physical dimensions of the tower. An "eligible facilities request" is defined as any request for modification of an existing tower that involves collocation of new transmission equipment, removal of transmission equipment or replacement of transmission equipment. A "substantial change" is defined as the mounting of a proposed antenna on a tower that would increase the existing height of a tower by more than 10%, or by the height of one

[1] Connecticut General Statutes §16-50ee (2018).

additional antenna array with separation from the nearest existing antenna not to exceed twenty feet, whichever is greater or the mounting of a proposed antenna that would involve adding an appurtenance to the body of the tower that would protrude from the edge of the tower more than twenty feet, or more than the width of the tower structure at the level of the appurtenance, whichever is greater.

In 2014, the FCC issued a Wireless Infrastructure Report and Order (2014 Wireless Order) to promote the deployment of wireless infrastructure as the ability to meet demand for wireless capacity depends on the infrastructure that supports the services. In the 2014 Wireless Order, the FCC finds that collocations of smaller facilities, such as distributed antenna systems (DAS) and small cells[2], on existing towers and other structures, such as utility poles in public rights-of-way (ROW), are environmentally desirable because they obviate the need for construction of new towers. However, local and state review processes can slow deployment of wireless infrastructure substantially, and the Wireless Order took action in four areas to reduce regulatory obstacles and bring efficiency to wireless facility siting and construction. Those four areas are as follows:

1. Categorical exclusions in environmental and historic preservation review processes;
2. Exemption from notification requirements for temporary towers meeting certain criteria;
3. Adoption of rules to implement and enforce the Spectrum Act; and
4. Clarification of reasonable timeframes for local and state review of siting applications.[3]

In 2018, the FCC issued a Wireless Infrastructure Report and Order (2018 Wireless Order) to remove regulatory barriers that inhibit the deployment of infrastructure necessary for 5G and other advanced wireless service. In the 2018 Wireless Order, the FCC explains when a state or local regulation of wireless infrastructure deployment constitutes an effective prohibition of service, establishes two new "shot clocks" for small wireless facilities (60 days for attachment to existing structures and 90 days for attachment to new structures), and adopts a new remedy for missed "shot clocks" by finding a failure to act within the small wireless facility "shot clock" constitutes a presumptive prohibition on the provision of services.

State Telecommunications Goals

Pursuant to CGS §16-247a, *et seq.*, it is the goal of the state to "(1) ensure the universal availability and accessibility of high quality, affordable telecommunications services to all residents and businesses in the state, (2) promote the development of effective competition as a means of providing customers with the widest possible choice of services, (3) utilize forms of regulation commensurate with the level of competition in the relevant telecommunications service market, (4) facilitate the efficient development and deployment of an advanced telecommunications infrastructure, including open

[2] The FCC has jurisdiction and authority rather than the state when defining technical terms such as "DAS," and "small cell." 28 FCC Rcd 3700 (2013) ("DAS are comprised of a relatively dense network of small cells that are connected by fiber optic cable and can be placed on such locations as utility poles, buildings, or traffic signal poles.") and ("A small cell is a small low-power wireless base station that functions like a cell in a mobile wireless network.")

[3] FCC, Wireless Infrastructure Report and Order, FCC 14-153, October 21, 2014, available at http://www.fcc.gov/document/wireless-infrastructure-report-and-order

networks with maximum interoperability and interconnectivity, (5) encourage shared use of existing facilities and cooperative development of new facilities where legally possible, and technically and economically feasible, and (6) ensure that providers of telecommunications services in the state provide high quality customer service and high quality technical service."

State Tower Sharing Policy

Pursuant to CGS §16-50aa, it is the policy of the state to promote tower sharing for fair consideration whenever technically, legally, environmentally and economically feasible, and whenever such sharing meets public safety concerns, will avoid the unnecessary proliferation of towers, and is in the public interest.

Administrative Procedures

The Council does not select or develop sites for telecommunications facilities. In accordance with the Public Utility Environmental Standards Act (PUESA), the Council is responsible for balancing the need for adequate and reliable telecommunications services at the lowest reasonable cost to consumers with the need to protect the environment and ecology of the state.

Consistent with the provisions of the PUESA, the Council employs several administrative procedures to fulfill its telecommunications responsibilities under federal and state laws.

Application for a Certificate of Environmental Compatibility and Public Need

Any person seeking to construct, operate and maintain a new tower must submit to the Council an application for a Certificate of Environmental Compatibility and Public Need (Certificate).[4] A formal public hearing process that includes a site review[5], evidentiary hearing session(s) and a public comment session is required for a Certificate application. The Council must render a final decision on a Certificate application within 180 days of receipt of the application. The 180-day decision deadline may be extended by up to 180 days with the consent of the applicant.

Petition for a Declaratory Ruling

Any person seeking to modify an existing telecommunications facility or to install equipment on a non-tower structure must submit to the Council a Petition for a Declaratory Ruling (Petition) that such installation would not have a substantial adverse environmental effect).[6] This includes, but is not limited to, a request to increase the height of an existing tower or to install telecommunications equipment on an electric transmission line structure. Requests for installation of DAS and small cells on new or existing tower structures that are not principally used for another purpose, such as electric distribution structures under the jurisdiction of the Public Utilities Regulatory Authority or light poles under the jurisdiction of the host municipality, must also submit a Petition. The Council must give 30-day notice of

[4] Connecticut General Statutes §16-50k (2018).
[5] Site reviews are not requisite for a Certificate proceeding.
[6] Connecticut General Statutes §4-176 (2018).

receipt of a Petition and must take some action on a Petition within 60 days of receipt of the Petition[7]. A site review and/or a public hearing may be held, but is not required. The Council must render a final decision on a Petition within 180 days of receipt of the Petition. The 180-day decision deadline may be extended by up to 180 days with the consent of the petitioner and all of the parties and intervenors, if applicable.

Tower Share Request

Any person seeking to install equipment on an existing telecommunications facility must file a Tower Share Request to the Council per CGS § 16-50aa and RCSA §16-50j-88. In the Tower Share Request, the requesting entity must demonstrate that the shared use of an existing tower is technically, legally, environmentally and economically feasible, meets public safety concerns, avoids the unnecessary proliferation of towers and is in the public interest. The Council may arbitrate any issue between the owner of the existing facility, and the requesting entity concerning the establishment of or compliance with any reasonable conditions established by the owner concerning the use of the facility. The Council may also hold a feasibility proceeding if the owner of a facility refuses permission for the proposed shared use.

Request for Exempt Modification

Any person seeking to modify an existing telecommunications facility, including, but not limited to, modifications to swap out antennas or install a generator, must file a Notice of Request for Exempt Modification to the Council per RCSA 16-50j-72. In the request, the requesting entity must demonstrate that the modification will not increase the tower height, extend the boundaries of the site by any dimension, increase noise levels at the site boundary to levels that exceed state and local criteria, increase radio frequency emissions to above the FCC standards, cause a significant adverse change in the physical or environmental characteristics of the site and impair the structural integrity of the facility. Due to the FCC regulations promulgated under the Telecom Act, the Council must render a decision on a request for an exempt modification within 60 days of receipt of the request.

Eligible Facilities Request

Any person seeking to modify an existing telecommunications facility that qualifies as an "eligible facilities request" under Section 6409 of the Spectrum Act must file a sub-petition for a declaratory ruling that demonstrates the modification does not substantially change the physical dimensions of the

[7] In accordance with CGS §4-176, within 60 days after receipt of a Petition, the Council, in writing shall:

1. issue a ruling declaring the validity of a regulation or the applicability of the provision of the general statutes, the regulation, or the final decision in question to the specified proceedings;
2. order the matter set for specified proceedings;
3. agree to issue a declaratory ruling by a specified date;
4. decide not to issue a declaratory ruling and initiate regulation-making proceedings under CGS §4-168 on the subject; or
5. decide not to issue a declaratory ruling, stating the reasons for its action.

tower[8]. Due to the FCC regulations promulgated under the Telecom Act, the Council must render a decision on an eligible facilities request within 60 days of receipt of the request.

Where We Are

Over the past few years there has been a significant shift in how wireless telecommunication is performed. In addition to cell phones, there is now widespread communication through smart watches, tablets, wireless-enabled computers, and other wireless devices. Even within the cell phone market, consumers continue to migrate from first/second generation voice and text touch-key style phones to touch-screen style "smart phones" which are, for all intents and purposes, pocket-sized computers complete with robust operating systems.

Wireless subscriber connections have continued to grow steadily in the United States. From 2012 through 2018, wireless subscriber connections grew from 326.5 million to 400 million, which is the equivalent of approximately 1.2 devices for each person in the country. Most connected devices are data-intensive smartphones with each generating more than 5 gigabytes (GB) of data each month on average during 2017. This is a more than 2,844% increase in data usage since 2010.[9]

The near universal use of wireless devices has created the need for near universal coverage. Connecticut is fortunate in being a small, compact state; its wireless infrastructure is built out to the extent that most of the state has wireless coverage except the northwest area of the state. (see Figure 1 –2018 Statewide Coverage Map).

According to Council records, there are 2,128 wireless telecommunication sites used by the commercial carriers in our state, 238 of which have been added since the 2013 Plan was written. Of the 2,128 total sites, 798 are stand-alone towers used by the commercial carriers; 824 sites are located on rooftops, water tanks, billboards, or other non-tower structures; 167 sites are located on electric distribution structures and 93 sites are located on electric transmission structures. In addition, there are approximately 246 towers and non-tower sites that are used by the state police, municipalities, utility companies, ham radio operators, television companies, or small private companies.

During the fiscal years of 2013/2014 to 2017/2018, the Council approved a total of 23 new telecommunications sites for the state - a rate of approximately 5 new towers per year (see Table 1). The number of new towers during this five year period is substantially less than 13 new towers per year that were approved for the state in the 2013 Plan. However, during this time period carriers have trended toward installation of smaller facilities and changes to existing equipment to provide additional user capacity and reliable wireless services. Over the last five years approvals of eligible facility requests, small cell facilities, and tower shares escalated from about two structures per year per the 2013 report

[8] The Council rendered a declaratory ruling pursuant to Conn. Gen. Stat. §4-176 that Conn. Gen. Stat. §16-50k does not apply to Eligible Facilities Requests for existing telecommunications facilities submitted under the Federal Communications Commission (FCC) rules adopted pursuant to the October 21, 2014 FCC Wireless Infrastructure Report and Order. The following link provides guidance to wireless communications providers on process. https://www.ct.gov/csc/lib/csc/guides/2016guides/pe1133-20150306-dcltr.pdf

[9] CTIA-The Wireless Association, The State of Wireless 2018, https://api.ctia.org/wp-content/uploads/2018/07/CTIA_State-of-Wireless-2018_0710.pdf

to 50 structures per year. This is attributable to the use of existing structures for rapid deployment associated with 4G growth.

Table 1: CSC Approval of New Wireless Telecommunications Facilities
Fiscal Years 2013-14/2017-18 (Source: Siting Council Records)

Fiscal Year	New Stand-Alone Towers Approved	New Use of Existing Structures* Approved
2013-14	9	61
2014-15	6	39
2015-16	4	57
2016-17	2	47
2017-18	2	49
Total	**23**	**253**

* eligible facilities requests, small cells, tower shares

Connecticut's Coverage

Current

For the purposes of describing the extent of the state's existing wireless coverage, all the municipalities in the state were grouped into quintiles according to their respective population densities, based on their 2010 census populations (See Figure 2 – State of Connecticut Population Density, 2010)[10]. As one might expect, the area of the state with the least coverage encompasses many of the towns in the quintile with the lowest population density (fewer than 160 persons per square mile). These towns are located in two general areas: the state's northwest and northeast corners. The towns in the northwest corner with minimal coverage include Barkhamsted, Canaan, Colebrook, Cornwall, Goshen, Hartland, Kent, Litchfield, Morris, Norfolk, Salisbury, Sharon, Warren and Washington. The poorly covered towns in the northeast corner include Ashford, Canterbury, Pomfret, Salem, Sterling, Voluntown and Woodstock. Lebanon and Lyme are other low-density towns (135 and 75 persons per square mile, respectively) with significant areas of poor coverage.

In the next quintile—towns with population densities of 160 to 348 persons per square mile—the towns of Bethlehem, Easton, Lisbon, North Canaan, Sherman and Stafford have significant areas where coverage may be poor.

Of the towns in the middle quintile—349 to 658 persons per square mile—Ellington, Killingly, New Milford and Somers have areas lacking coverage.

In the next more densely populated quintile—659 to 1303 persons per square mile—only two towns, Glastonbury and Ridgefield, have significant areas without coverage.

[10] 2010 Census data is used for Figure 2 and 3.

All of the municipalities in the most densely populated quintile—more than 1303 persons per square mile—are well covered, according to CSC data, as are the major travel corridors.

One of the biggest challenges faced by wireless carriers seeking to provide coverage in our state is its topography. The sharp contours of hills and valleys can leave locales without coverage within areas where generalized mapping may indicate coverage should be available.

Future

Many of the towns where coverage is currently lacking are among those expected to see the highest percentages of population growth during the next ten years. (See Figure 3 – Projected Population Growth by Municipality, 2010 – 2020). Just as with population densities, Connecticut municipalities were sorted into quintiles based on ten-year growth projections. The quintile with the highest projections included those towns expected to experience population growth over nine percent. Among these towns, the ones with significant areas without existing coverage are Eastford, Ellington, Glastonbury, Goshen, Kent, Killingly, Litchfield, New Hartford, New Milford, Pomfret, Salisbury, Sterling, and Woodstock.

The next quintile is comprised of towns expected to experience population growth rates of between 5.7 and 8.9 percent. Among these towns, those needing expanded areas of coverage include Ashford, Barkhamsted, Bethlehem, Cornwall, New Fairfield, Norfolk, Sharon, and Sherman.

The next quintile consists of towns expected to experience between 3.6 and 5.6 percent rates of population growth. Of these towns, only Somers has significant areas without existing coverage.

Canterbury, North Canaan, Ridgefield, Voluntown, and Warren are those towns among the quintile expected to experience population growth rates of between 0 and 3.5 percent with significant areas of little or no coverage.

CSC records indicate that all the towns or cities where population is expected to remain the same or decline have acceptable coverage.

Recent Trends

Coverage vs. Capacity

Traditionally, wireless service started as a coverage-driven model which involved building a network of macrocells[11]. The first objective was to provide voice service eventually progressing to text and data. As the network matured, the use and technological advances of wireless devices (i.e., smartphones, tablets, and laptops) grew, and the demand for megabytes of data driven by the consumers also grew substantially. In particular, smartphone ownership in America has reached 77 percent up from 35 percent when this device entered the market in 2011.[12]The challenge of managing the demand for a variety of wireless services became evident. Macrocell capacity was being stressed by large venues such

[11] Macrocell is a cell used in cellular networks with the function of providing radio coverage to a large area of mobile network access. A macrocell differs from a small cell by offering a larger coverage area and high-efficiency output. The macrocell is placed on stations where the output power is higher.

[12] Mobile Fact Sheet, Pew Research Center, February 5, 2018 available at http://www.pewinternet.org/fact-sheet/mobile/

as sporting events, fairs, and conventions, including concentrated population centers and congested travel corridors. The Spectrum Act and Wireless Order defined a landscape for wireless carriers to deploy its equipment in an efficient manner. Wireless providers have installed a multitude of transmitters/receivers specific to areas of high demand through the use of existing, non-tower structures of suitable height, referred to as "small cells". Small cells (canister-style antennas) are typically installed on building facades, rooftops, or street-side utility poles and are close to the end-user to allow for extended service coverage and/or, increase network capacity. Thus the lower height antenna installations are able to off load capacity once handled by macrocells.

Wireless Substitution

As wireless phones proliferate, more people rely on them as their only phone. In 2017, approximately 53.8% of all households in the country were wireless-only.[13] In Connecticut, the percentage of wireless-only households is somewhat less. Approximately 33.4% of our state's households were wireless-only in 2016.[14] Table 2 shows the national growth in wireless-only households since 2012.

Table 2: Increase in Wireless Only Households, 2012 - 2017

Year	% Wireless-Only Households Nationwide
2012	38.2
2013	41.0
2014	45.4
2015	48.3
2016	50.8
2017	53.8

(Blumberg SJ, Luke JV. Wireless substitution: Early release of estimates from the National Health Interview Survey, July–December 2017. National Center for Health Statistics. June 2018.)

Public Safety

"Interoperability" is the most important issue for public safety wireless communications. It refers to the ability of different public safety agencies, within the same governmental jurisdiction or across jurisdictions, to be able to freely communicate with one another over wireless devices. The impediment to this ability has been that, historically, each separate public safety agency has installed its own, different wireless system using frequencies that can range from 33 MHz up to 800 MHz. Very often, these systems cannot communicate with one another, so it is not uncommon for police departments to be unable to talk with fire departments or with ambulance crews in the same town. This inability to communicate becomes exacerbated when emergencies spread across town boundaries and involve agencies from municipal, state, and even federal jurisdictions; with each agency using its own wireless system on its own frequency.

[13] Blumberg SJ, Luke JV. Wireless substitution: Early release of estimates from the National Health Interview Survey, July–December 2017. National Center for Health Statistics. June 2018.

[14] National Center for Health Statistics, National Health Interview Survey Early Release Program, released 12/2017 available at https://www.cdc.gov/nchs/data/nhis/earlyrelease/Wireless_state_201712.pdf

Public safety officials have been aware of this problem for a long time and have been working toward a solution for just as long. Part of the solution is the replacement of older, dated wireless technologies with newer technologies that can be shared across jurisdictional lines. This is a piecemeal approach, however, that depends on necessary funding being available to local public safety agencies.

In Connecticut, the state has adopted an *Enhanced Public Safety Statewide Communications Interoperability Plan*, and, under the leadership of the Department of Emergency Services and Public Protection, is working to improve public safety communication systems and infrastructure with the goal of facilitating better interoperability.

On the national level, the response has been to establish a Nationwide Public Safety Broadband Network. This network, known as FirstNet[15], is intended to provide emergency responders with a single platform for daily public safety communications. FirstNet is the nationwide public safety communications platform dedicated to America's first responders. The First Responder Network Authority formed a partnership with AT&T to deploy a much-needed technology to connect public safety to the vital information they need—every day, in every emergency. It will use Long-Term Evolution (LTE) wireless technology, the latest 4G technology being deployed by the commercial wireless carriers, in the 700 MHz range. Beginning in March 2018, FirstNet Core Network started to deploy public safety's dedicated spectrum – Band 14 – across statewide radio access networks in states and territories across the country. Furthermore, all 55 states and territories opted to continue with FirstNet to build, operate and manage each state's Radio Access Network (RAN). At the time of this writing more than 2,500 sites have added Band 14, and more than 10,000 sites are currently underway.

911 Capabilities

The 911 emergency number service has served the state and nation well since its inception in 1968. Today's digital technology offers great opportunity to improve the 911 network as wireless phones have become more important in emergency situations. According to the National 911 Program's Progress Report, 80 percent of the 911 calls placed today are by cellular phones.[16] The 911 service continues to evolve, and the nation is launching Next Generation (NG) 911. The National 911 Program has been collecting data on the progress of NG911 deployment. The State of Connecticut, at present, is capable of 50 percent processing and interpreting location and caller information for all service types (e.g., wireline, wireless, voice over internet protocol (VoIP)), as one component of the NG911 system. Also, the Text-to-911 system recently launched in August 2018 provides an additional layer of safety for residents asking for emergency assistance- with a new theme *Call if you can , text if you can't.*

Data vs. Voice Transmission

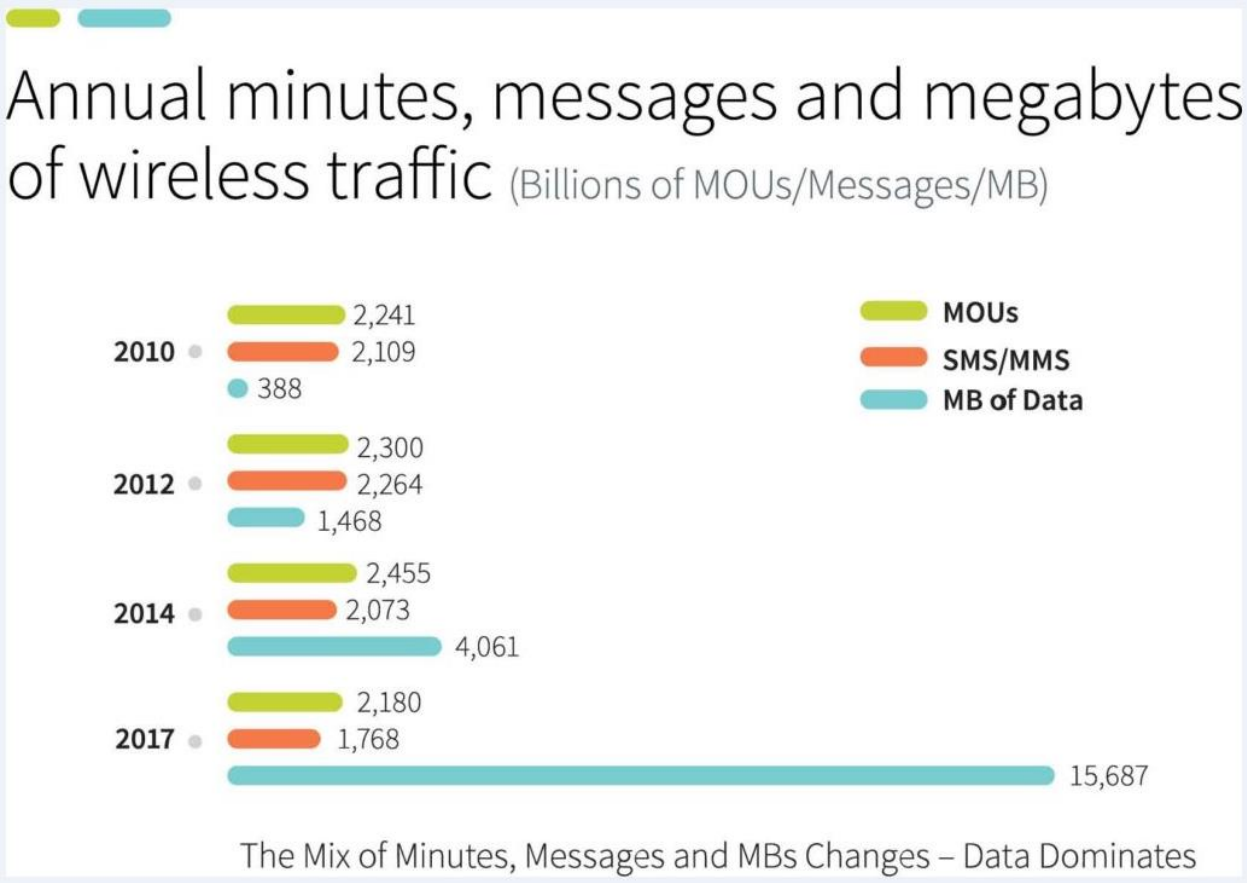
When telecommunications networks were initially built during the 1980s, they were engineered to handle only voice, while data, which includes images, dynamic spreadsheets, interactivity, and many

[15] First Responder Network Authority is an independent authority within the U.S. Department of Commerce created as a provision in the Middle Class Tax Relief and Job Creation Act of 2012. https://www.firstnet.gov/

[16] 2017 National 911 Progress Report, November 2017 available at https://www.911.gov/pdf/National-911-Program-Profile-Database-Progress-Report-2017.pdf

other forms of information much "richer" than voice, requires order-of-magnitude technological advances to transmit.

CTIA has tracked the growth of demand for data as shown in the below graphic. Minutes of use (MOU) and short messaging service – texting and multimedia messaging service - picture, video and audio (SMS/MMS) have remained steady over the past seven years; however, the megabytes (MB) of data has increased a total of 3,943 percent from 2010 to 2017 (at a very aggressive equivalent compound annual growth rate of 69.6 percent per year) which truly demonstrates the appetite for wireless technology. This furthers the view that capacity for data is the core of the wireless world.



https://www.ctia.org/news/the-state-of-wireless-2018

Wireless Broadband and the Demand for More Spectrum

Cellphone calls, text messages, and app downloads are all transmitted via the radio spectrum. This is the portion of the electromagnetic spectrum used for the transmission of any communications signals—everything from commercial radio and television broadcasts to clickers opening garage doors, police calls, airline pilots' conversations with air traffic control towers, ham radio operations, diagnoses from medical equipment, and satellites gathering weather information. The portion of the spectrum that can be used for commercial purposes ranges from 30 kilohertz (kHz) to 300 gigahertz (GHz).[17] Considering

[17] A GHz is a million kHz. In between kHz and GHz is the megahertz range (MHz). A MHz is a thousand kHz.

the great and varied demand for this spectrum, careful management is necessary so that competing uses do not interfere with one another by using the same frequencies for different transmissions. The Federal Communications Commission (FCC) and the National Telecommunications and Information Administration (NTIA) share responsibility for managing the spectrum in this country. The NTIA manages the spectrum use of the federal government, and the FCC manages the spectrum by all others, including individuals, public safety officials, and the companies providing commercial wireless telecommunications services.

The companies that provide wireless services in Connecticut are licensed by the FCC to use cellular frequencies in the 800 MHz range, Personal Communications Service (PCS) frequencies in the 1900 MHz range, and Advanced Wireless Services (AWS) in the 2100 MHz range. Connecticut's wireless providers also employ Long Term Evolution (LTE) technology that is transmitted primarily in the 600, 700 MHz, 2100 and 2500 MHz ranges.

With more and more wireless users downloading increasing amounts of data to smartphones and tablets, wireless broadband has become an increasingly important component of the rapidly evolving world of wireless telecommunications. Wireless broadband is the term used to describe high-speed internet access using wireless technology. Broadband speed is measured in download rates, with a rate of 25 Mbps considered FCC's minimum threshold for internet access. Today's fixed broadband technology, however, is capable of much faster speeds — up to 1000 gigabits per second[18]. Although broadband internet access can be delivered over wireline systems such as cable or telephone Digital Subscriber Lines (DSL), wireless broadband's flexibility and versatility is generating an increasing demand for its fuller deployment.

In order to satisfy the accelerating consumer demand for data transmission and faster download speeds, commercial wireless carriers assert that they need additional capacity in their existing networks. This extra capacity is most easily provided by making more of the radio spectrum available for their use. In response to pressure from commercial carriers, the federal government has begun efforts to free up segments of the spectrum currently being utilized by other, mostly public entities. These efforts have been formalized in a National Broadband Plan.

The FCC has reclaimed additional spectrum in the 28 GHz and 24 GHz spectrum bands. This is consistent with the Spectrum Frontiers Second Report and Order to promote the development of 5G technology, the Internet of Things, and other advanced spectrum-based services. In November of this year, the FCC proposes to offer approximately 6,000 licenses through two auctions to further ensure continued American leadership in wireless broadband, this is a critical component of economic growth, job creation, public safety, and global competitiveness.

The National Broadband Plan

As the internet develops into an increasingly integral part of our daily life, it has become a component of our national infrastructure just as important as our railroad and highway systems and the electrical grid. In addition to its use in commerce, the internet has more and more applications for health care,

[18] The Best High Speed Internet Providers, lasted updated August 7, 2018 available at https://www.reviews.com/internet-service-providers/high-speed/

education, transportation, public safety, energy usage and civic participation. It is deemed to be essential for this nation's economic competitiveness and productivity.

Congress recognized the importance of wireless broadband by directing the FCC to develop a National Broadband Plan that would ensure access to broadband capability for all Americans. At the same time, Congress also acknowledged that the increased demand for mobile data will soon exceed the wireless capacity available to deliver the demanded amounts of data. Thus, the National Broadband Plan includes the commitment to make available for broadband use an additional 500 MHz of the radio spectrum within 10 years (i.e. by 2020, since the Plan was published in 2010), of which 300 MHz should be made available for mobile use within five years.

In 2015, FCC raised the benchmark for fixed broadband speeds from the initial benchmark of 4Mbps download/1 Mbps upload to 25Mbps download/3 Mbps upload. No benchmark was declared for Mobile advanced telecommunications capability at the beginning of the NBP in 2010. Today, Mobile LTE carriers advertise 5Mbps download/1 Mbps upload capability, and the FCC[19] recognizes the mobile market's broadband speeds of 10Mbps download/3 Mbps upload capability as measured by Ookla[20]. For Connecticut, 99.1 percent of the population has fixed broadband speeds of 25 Mbps/3Mbps and 100 percent of the population has Mobile broadband speeds of 5 Mbps/1 Mbps.

Also, the FCC went through a policy shift between 2015 and 2017. Initially the FCC voted to approve the network neutrality plan, which reclassifies broadband internet as a Title II public utility including mobile broadband. The FCC further determined that the marketplace was experiencing a decline in service and reducing such barriers would promote innovation, infrastructure investment and competition to reverse this decline. Thus, the FCC reversed its position on the network neutrality plan. Nonetheless, the FCC's charge to monitor and chart the progress of advanced telecommunications capability will continue.

Wi-Fi

Wi-Fi refers to a technology that allows computers and other, similar, devices access to the internet over a localized wireless network access point, often called a "hotspot" (aka unlicensed spectrum). Hotspots can be as small as one room, or, if distributed by various kinds of hardware, can extend a greater distance. Basically, however, the frequencies at which Wi-Fi hotspots operate are extremely limited in coverage range. For that reason, they are not licensed by the FCC. In turn, the protocol for accessing Wi-Fi signals is not proprietary, and Wi-Fi signals can be freely accessed. Persons using Wi-Fi connections, unlike mobile phone users, do not have to subscribe to a particular carrier's service in order to get on the Internet, although some Wi-Fi providers may charge a small usage fee. Most of the laptop computers, tablets, and netbooks being sold today are capable of making wireless internet connections.

Wi-Fi hotspots can also be provided without restriction. They are often offered by businesses as a service to their customers. Coffeeshops, hotels, airports and other similar establishments frequented by

[19] FEDERAL COMMUNICATIONS COMMISSION, 2018 Broadband Deployment Report, GN-Docket No. 17-199, February 2, 2018, (Finding No. 47) available at https://www.fcc.gov/reports-research/reports/broadband-progress-reports/2018-broadband-deployment-report.

[20] Ookla® is the global leader in internet testing, data and analysis. Speedtest®, the company's flagship product, is the most accurate way to measure internet performance and network diagnostics.

travelers, particularly business travelers, are other common providers. Increasingly, public facilities, especially libraries, are providing Wi-Fi access.

4G and 5G

The evolution of cell phones has progressed with the development of ever more efficient, flexible, and reliable ways to process the signals used to exchange information over wireless networks. Each major advance in cell phone technology is denoted by enumerating another generation (G): 1G in the '80s provided basic voice service on an analog protocol; 2G in the '90s brought the first digital standards with improved coverage and capacity designed for voice service; and 3G in the first decade of the 21st century ushered in mobile broadband designed for voice, text and internet Today's most commonly deployed 4G technology is LTE, an acronym for "Long Term Evolution." It is well-suited for wireless broadband use, as it was designed specifically to increase the capacity and speed of handling wireless data, and seamlessly accommodates not only the three previous generations of legacy network technologies, but Wi-Fi technology as well.

Commercial wireless carriers providing service in Connecticut continue to deploy the equipment necessary to upgrade their networks to make them 4G-capable. As can be seen in Figure 1 (2018 Statewide Coverage Map), most of the areas of the state with cellphone coverage now have 4G coverage.

The industry is poised to deploy 5G before 2020. 5G will bring three improved features to the wireless communications domain: greater speed (to move more data), lower latency (to be more responsive), and the ability to connect a lot more devices at once (for sensors and smart devices). Much of the demand is driven by the multitude of devices in existence. 5G will be approached in a multi-facet way. Fixed and mobile broadband licensed spectrum will expand and a multitude of unlicensed spectrum will be part of the infrastructure to meet demand.[21]

Electric Utilities

Wireless telecommunication is becoming increasingly important for the maintenance and operation of our electrical grid. Connecticut's utility companies use wireless technologies to communicate between office and field crews, to remotely monitor the security of substations, to collect data on the ongoing performance of each company's respective portion of the grid, and to remotely operate components of the electric system to prevent or restore outages.

The frequencies used by Connecticut's utilities range from Low Band Radio frequencies around 30 MHz to bandwidths around 150 MHz, 220 MHz, 450 MHz, and 900 MHz. Utilities also use higher frequencies—in the GHz range—for microwave communications.

Wireless technology will be essential in the deployment of Advanced Metering Systems, such as those required by Section 98 of Connecticut's Public Act 07-242, An Act Concerning Electricity and Energy Efficiency. Such metering systems can provide the utilities' consumers with up-to-the-minute

[21] What is 5G? Sascha Segan, PCMag, October 2, 2018 available at https://www.pcmag.com/article/345387/what-is-5g

information about their electricity usage. This information, in turn, would allow consumers to adjust their use of electricity as its price fluctuates in response to the changing levels of demand being placed on the grid.

Utility usage of wireless technologies will no doubt increase as we move further and further toward a "smart grid," that is, an electrical infrastructure that uses digital processing and communications to improve efficiency, reliability, and flexibility in transmission and distribution.

Machine-to-Machine (M2M) evolved into Internet of Things (IoT)

IoT evolved from machine-to-machine communication, i.e., machines connecting to each other via a network without human interaction. M2M refers to connecting a device to the cloud[22], managing it and collecting data. Taking M2M to the next level, IoT is a sensor network of billions of smart devices that connect people, systems and other applications to collect and share data. As its foundation, M2M offers the connectivity that enables IoT. Here are two examples: 1) homes that are equipped with smart thermostats, and connected heating, lighting and electronic devices that can be controlled remotely via computers, smartphones or other mobile devices and 2) farming systems can help monitor, for instance, light, temperature, humidity and soil moisture of crop fields using connected sensors and deploy irrigation, as needed.

Currently industry analysts estimate that there were 11.2 billion IoT devices in use in 2015 and the forecast indicates that this number will grow to somewhere between 20.8 and 34 billion by 2020.[23] The never-ending quest to improve the efficiency and reduce the costs of business operations will provide some of the impetus for this predicted growth. Another contributing factor is the lower cost of the sensors, microprocessors and other wireless technology components that make IoT systems possible. Items that once cost hundreds of dollars now cost the equivalent of a cup of coffee. Both the cloud computing and the ubiquity of smartphones is driving the adoption of IoT technology.

The increased deployment of IoT wireless devices, however, will add another competing tier in the growing demand for spectrum bandwidth and raising concerns with security and privacy.

[22] The National Institute of Stands and Technology (NIST) describes cloud computing as "a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction."

[23] https://www.postscapes.com/internet-of-things-market-size/ - Forecast and Trends

Conclusions

- Wireless communication, particularly wireless broadband, is an integral part of modern society. The basic systems upon which our society depends—transportation, finance, energy, health and public safety networks—increasingly rely on it for their operations.

- Although by far the larger portion of Connecticut has acceptable wireless coverage, there are still areas where coverage needs to be extended. In general, these are the areas with the lowest current population densities.

- Wireless broadband access to the internet will become increasingly important for economic development, education, health care, and many other facets of modern life. For this reason, the FCC has been monitoring and adjusting policy to encourage and spur innovation and investment including reallocating radio spectrum for the continued growth in broadband access and services.

- Coverage vs. Capacity is at a crossroads of a functional wireless environment. Wireless service providers are continuing to augment its networks and begin its next chapter to deploy 5G.

Figure 1 - 2018 Statewide Coverage Map

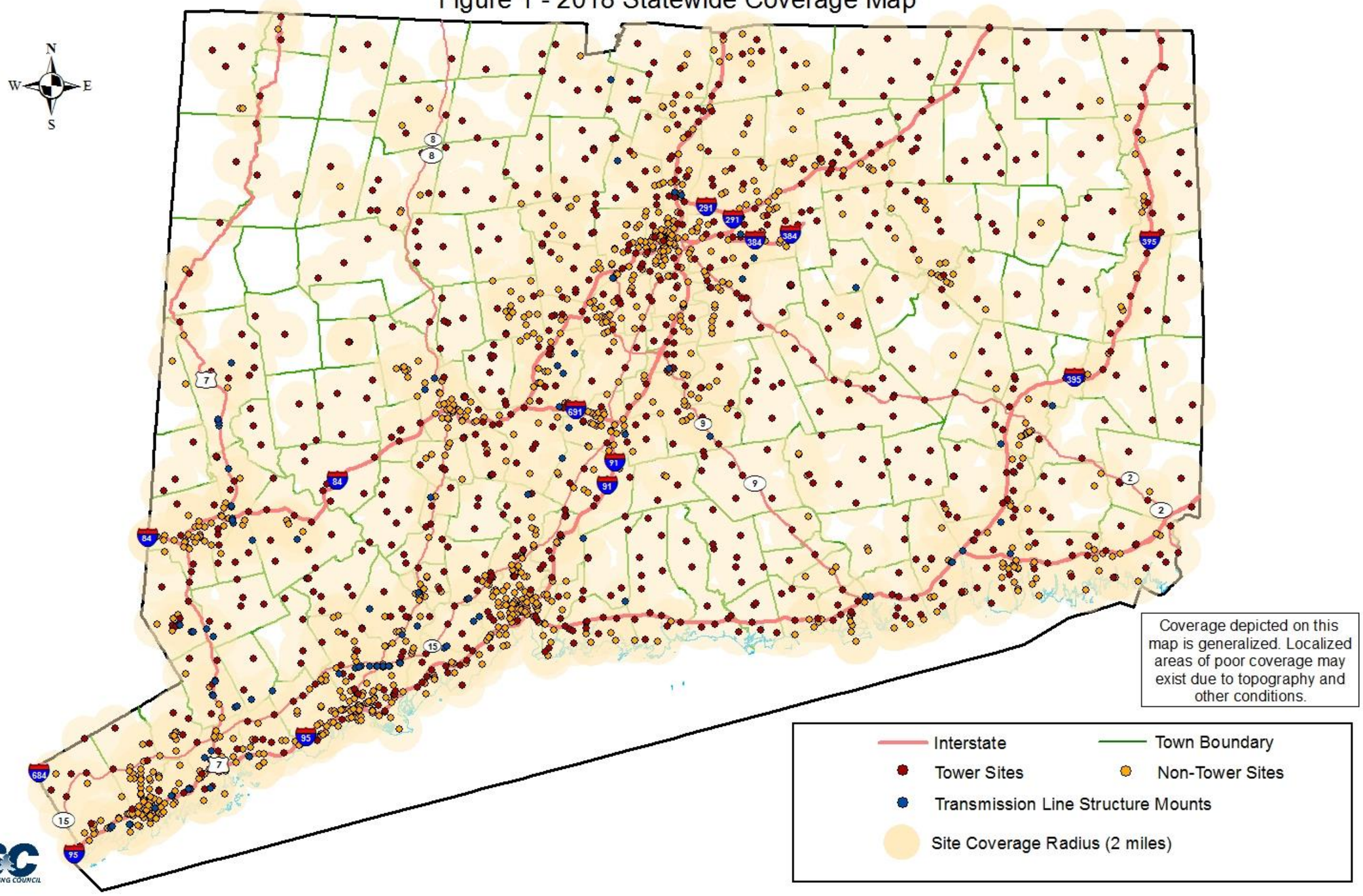


Figure 2 - State of Connecticut
Population Density

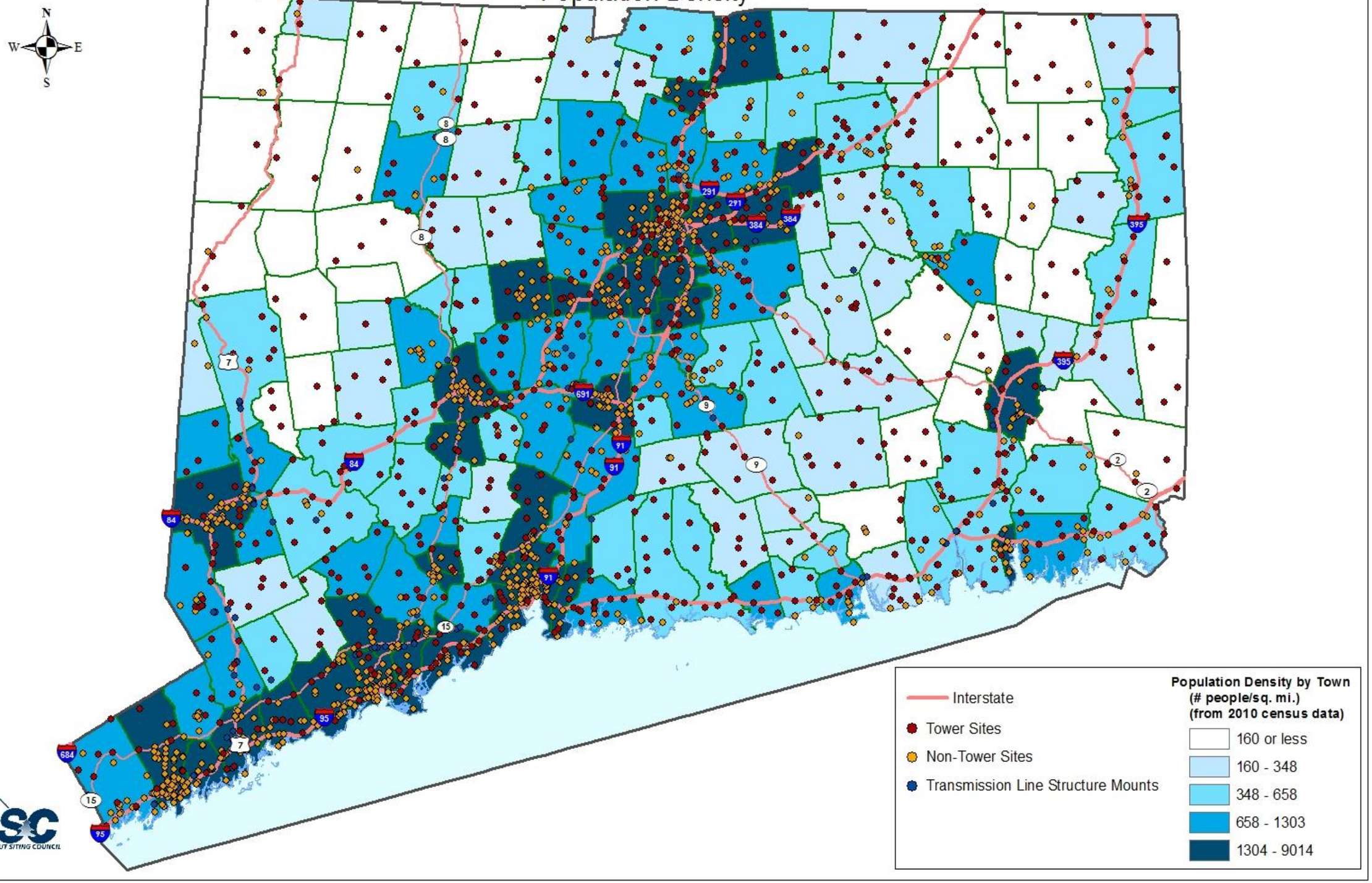


Figure 3 - Projected Population Growth by Municipality
between 2010 and 2020

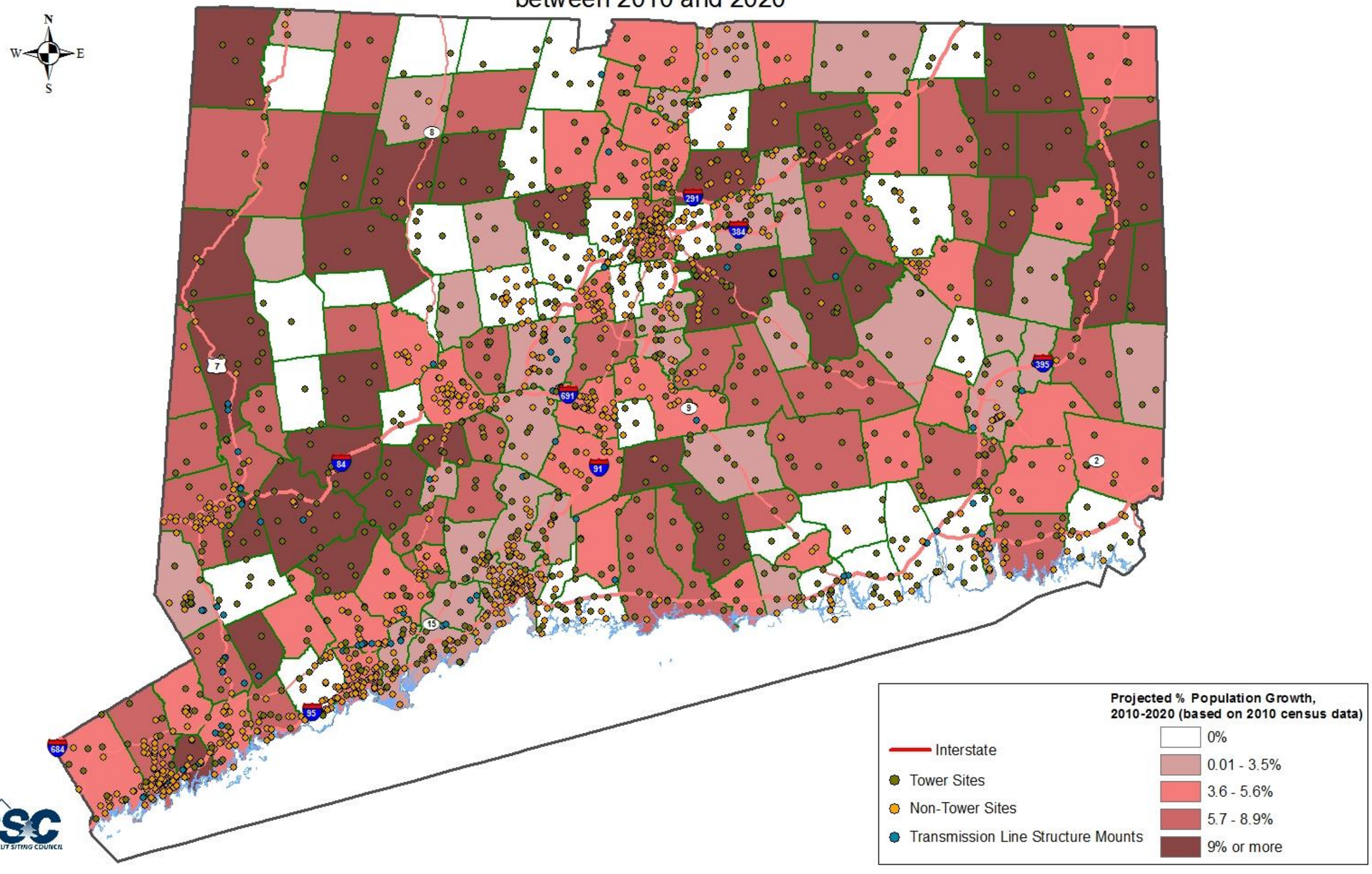
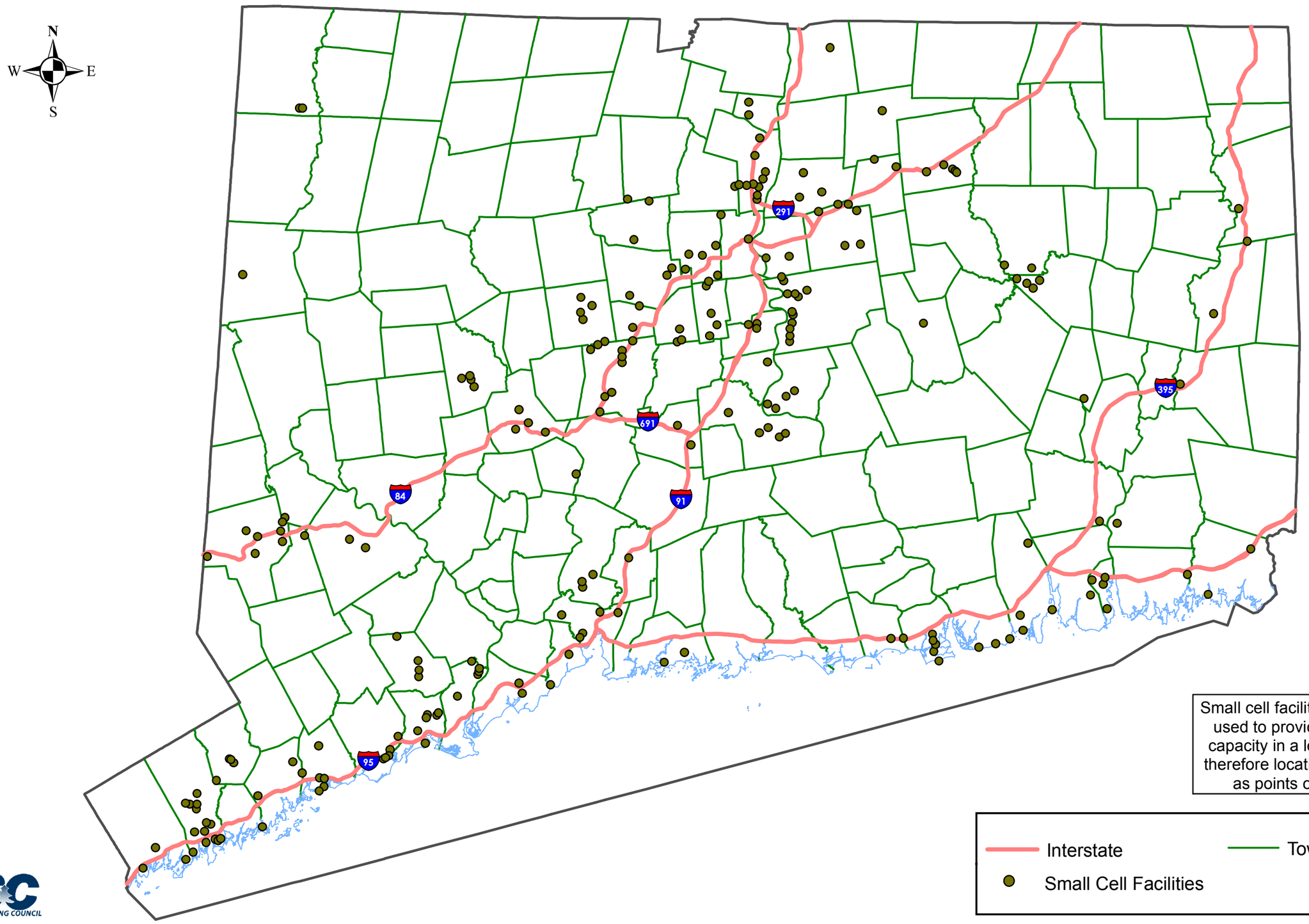


Figure 4 - 2018 Statewide Small Cell Facility Locations



Small cell facilities are mostly used to provide additional capacity in a localized area; therefore locations are shown as points on the map.

Interstate

Town Boundary

Small Cell Facilities

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