State-Wide Telecommunications Coverage Plan

Introduction

Connecticut's General Statutes require the Connecticut Siting Council (Council) to develop a plan for state-wide telecommunications coverage and to revise such a plan as necessary. [1] In 2006, the Council previously prepared a plan, which was narrowly limited to forecasting the number of additional wireless telecommunications towers and rooftop sites that could be expected to be developed in the state between 2007 and 2012. This 2013 Plan will attempt to be broader in scope by identifying trends and issues that are affecting this rapidly changing industry.

The Council's role in the development and deployment of wireless telecommunications facilities is defined by state statutes. According to its enabling laws, the Council does not choose or develop the sites for these facilities. Such sites are generally proposed by private companies that own and lease towers or by the companies that provide the commercial wireless services. 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. State statutes also require the Council to promote the sharing of towers wherever technically, legally, environmentally and economically feasible in order to avoid the unnecessary proliferation of towers in the state.

The Council employs several different administrative procedures to fulfill its telecommunications responsibilities. Any person or company seeking to put up a new tower must submit to the Council an application for a Certificate of Environmental Compatibility and Public Need. A Certificate application goes through a formal process that typically takes approximately five to six months and includes a public hearing in the municipality in which the tower is being proposed. To place its antennas on a tower that has already been built, a wireless carrier must submit a Tower Share request to the Council. Before changing antennas or related ground equipment at a site where it has been operating, a wireless carrier must notify the Council of its intent to make the changes and identify what the changes will be. The Council also has a petition process for special instances such as raising the height of an existing tower or installing wireless antennas on electricity transmission towers.

The records generated from its various administrative processes give the Council an excellent idea of the extent of the state's wireless communications infrastructure. It maintains databases that give the locations of existing towers (and also non-tower sites such as rooftop antenna installations) and which carriers are operating on which towers. The records also identify which frequencies of the radio spectrum the different carriers are using and what technologies are being employed by the commercial carriers. All of this information will be considered in the preparation of this plan.

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[1] C.G.S §16-50ee (P.A. 04-226)

Where We Are

Cellphones are an inescapable feature of civilization's landscape in the early 21st century. Everywhere we look, people are talking, texting, tweeting, taking photographs, checking email, sending email, navigating the internet, downloading apps, using apps, and playing games on some kind of hand-held wireless device.

In the United States, from 2006 to 2011, wireless subscriber connections grew from 233 million to 331.6 million, an increase of 42 percent.[2] During the same period, the population of the country grew by four percent from 299.4 million to 311.6 million people.[3] This means that there are more wireless subscriber connections than there are people in this country.

Cellphones are just as ubiquitous in Connecticut. In 2012, there were 3.3 million wireless subscribers in our state, which equals a wireless penetration rate of 92% of the state's 3.5 million residents.[4]

As wireless phones proliferate, more people rely on them as their only phone. In 2011, approximately one third of all households in the country were wireless only. In Connecticut, the percentage of wireless only households is somewhat less. Approximately 13.6% of our state's households were wireless only in 2012.[5] The table below shows the national growth in wireless only households since 2007.

Table 1: Increase in Wireless Only Households, 2007 - 2011

Year	No. Wireless Only Households Nationwide (millions)	% Wireless Only Households of all Households Nationwide
2007	18.6	15.8%
2008	23.8	20.2%
2009	28.8	24.5%
2010	34.7	29.7%
2011	41.2	34.0%

(Data from Census Bureau's Current Population Survey and Table 1 of Blumberg SJ, Luke JV. Wireless Substitution: Early Release of Estimates from the National Health Interview Survey, July-December 2009, National Center for Health Statistics (NCHS), May 2010.

With so many wireless phones in use, they have become more important in emergency situations. The Federal Communications Commission estimates that approximately 70 percent of 911 calls are placed from wireless phones. The Council received confirmation of this estimate at a public hearing for a new telecommunications tower proposed for Willington. At this hearing, the Director of the Tolland County Mutual Aid Fire Service stated that approximately 70 percent of the 40,000 emergency 911 calls received annually by the Service are made from wireless phones.

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[2] CTIA Wireless Quick Facts, http://www.ctia.org/media/industry_info/index.cfm/AID/10323
[3] U.S. Census Bureau, Annual Estimates of Population
[4] CTIA, Wireless in Connecticut - 2012
[5] CTIA, Wireless in Connecticut - 2012

Connecticut's Coverage

The near universal use of cellphones has created the need for near universal cellphone coverage. Connecticut is fortunate being a small, compact state in that the infrastructure system of wireless antenna sites has been built out to the extent that most of the state now has access to wireless coverage (see Figure 1 – 2013 Statewide Coverage Map).

According to Council records, there are 1549 wireless telecommunication sites used by the commercial carriers in our state. Of this total, 775 of the sites are stand-alone towers used by the commercial carriers; 683 sites are located on rooftops, water tanks, billboards, or other non-tower structures; and 91 antenna sites are located on utility transmission line structures. In addition, there are approximately 191 towers and other sites that are used by state police, municipalities, utility companies, ham radio operators, television companies, or small private companies.

During the years 2007-2012, the Council approved a total of 88 new telecommunications sites for the state, a rate of approximately 15 new towers per year, or an average annual growth of 1.7% in the number of towers in the state (see the table below). The number of new towers during this six year period is substantially less than the 161 new towers that were projected for the state by the 2006 Plan. Based on its recent activity levels, the Council predicts that the number of new towers in the state will continue to increase by 10 to 14 per year during the next five years.

Year	New Stand-Alone Towers Approved	New Non-Tower Facilities Approved
2007	20	2
2008	13	1
2009	12	1
2010	16	4
2011	10	1
2012	7	1
Total	78	10

(Source: Siting Council Records)

For the purposes of this plan, all the municipalities in the state were grouped into quintiles according to their respective population densities, based on their 2010 populations (See Figure 2 – State of Connecticut Population Density, 2010). 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 (less than 160 persons per square mile). These towns are located in two general areas: the northwest corner of the state and the northeast corner of the state. The towns in the northwest corner with minimal coverage include Canaan, Colebrook, Cornwall, Goshen, Kent, Litchfield, Morris, Norfolk, Salisbury, Sharon, Warren, Washington, and Winchester. The poorly covered towns in the northeast corner include Ashford, Canterbury, Pomfret, Salem, and Woodstock. Lyme is another low-density town 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, 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, Somers, and Stafford have areas that are lacking coverage.

Only two towns, Glastonbury and Ridgefield, in the next more densely populated quintile—659 to 1303 persons per square mile—have significant areas where there may not be any coverage.

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. Its hilly nature can leave locales without coverage within areas where generalized mapping may indicate coverage should be available.

Many of the towns where coverage is currently lacking are among those towns expected to see the highest percentages of population growth during the next ten years (See Figure 3 – Projected Population Growth by Municipality, 2010 – 2020)[6]. Just as with population densities, Connecticut municipalities were sorted into quintiles based on projections of ten-year population growth. The quintile with the highest projections included those towns expected to experience over nine percent population growth. 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.
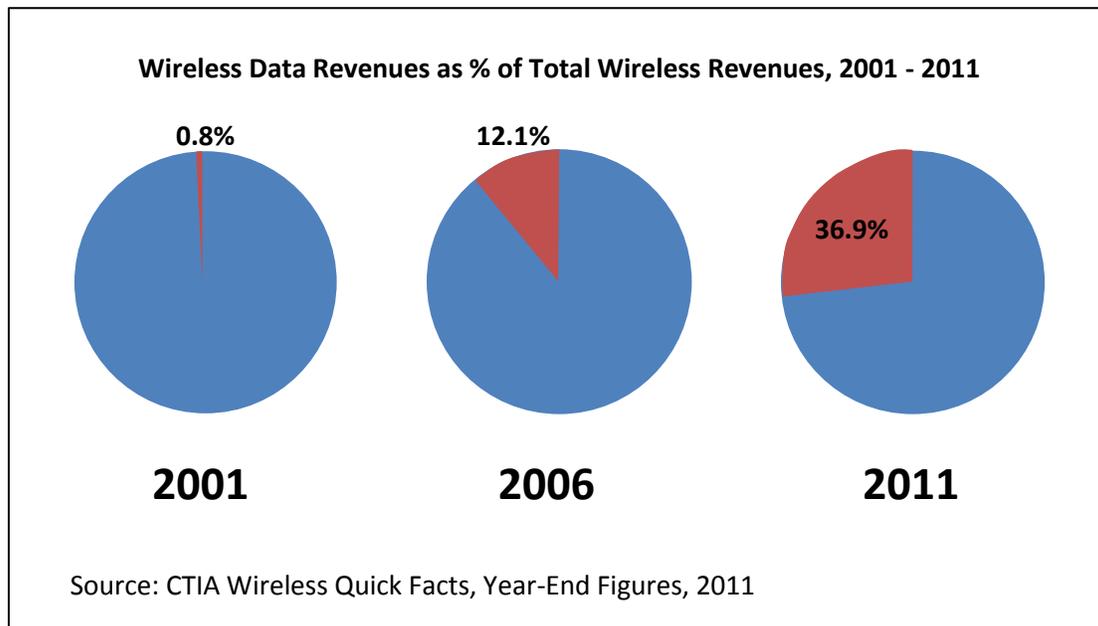
Recent Trends

Data vs. Voice Transmission

Perhaps the most significant recent trend in the telecommunications industry over the past ten years has been the exponential growth in the demand for data transmission. A good indicator of this growth is the increase in wireless company revenues attributable to the transmission of data. According to figures from CTIA, a trade association for the wireless communications industry, from 2001 to 2011 annualized

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[6] Connecticut State Data Center, *Population Projections for Connecticut Municipalities from 2020 to 2030 by Age, Ethnicity and Sex Distributions*, May 2007.

total wireless revenues for the nation increased by 260% from $65.3 billion to $169.8 billion. In 2001, data revenues accounted for 0.8% of total wireless revenues, or $490.8 million. By 2011, data revenues accounted for 36.9% of total wireless revenues, or $62.7 billion. This is an astounding growth rate of 12,775% over ten years. This growth is depicted in the following charts.

Wireless Data Revenues as % of Total Wireless Revenues, 2001 - 2011

0.8%   12.1%

36.9%

2001   **2006**   **2011**

Source: CTIA Wireless Quick Facts, Year-End Figures, 2011

This phenomenal growth in data transmission is driven in large part by the increasing penetration of smart phones among wireless subscribers. Most industry observers agree that by mid-2012 approximately 50% of wireless subscribers in the country were using smart phones. In 2011, the typical smartphone generated 35 times more mobile data traffic (150 MB per month) than the typical basic-feature cell phone (4.3 MB per month of data traffic).[7] The recent introduction of "connected devices" such as tablets, e-readers and other similar devices is another development that will contribute further to the acceleration of wireless data traffic. In 2011, a tablet typically generated 3.4 times more traffic than a smartphone (517 MB per month vs. 150 MB per month).[8]

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 signals for everything from commercial radio and television stations, garage door openers, police calls, airline pilots talking to control towers, ham radio operators, medical diagnostic equipment, and satellites used to gather weather information. The portion of the spectrum that can be used for commercial purposes ranges from 30 kilohertz (kHz) to 300 gigahertz (GHz). Because the demand for use of the radio spectrum is so great and so varied, it needs to be carefully managed so that competing uses do not interfere with one

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[7] Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2011-2016
[8] Ibid.

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 Megahertz (MHz) range, Personal Communications Service (PCS) frequencies in the 1900 MHz range, and Advanced Wireless Services in the 2100 MHz range. Connecticut's wireless providers also employ Long Term Evolution (LTE) technology that is transmitted in the 700 MHz and in the 2100 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 256 kilobits per second considered to be the minimum threshold for broadband internet service. Today's broadband technology, however, is capable of much faster speeds — up to 159.2 gigabits per second. Although broadband internet access can be delivered over cable systems such as Digital Subscriber Lines (DSL), wireless broadband's flexibility and versatility is generating an increasing demand for its fuller deployment.

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

Congress acknowledged the importance of wireless access to the internet by directing the FCC to develop a National Broadband Plan to ensure that all Americans have access to broadband capability. With more people having wireless access to the internet and using devices and applications that consume greater and greater amounts of information, the increased demand for mobile data will soon exceed the wireless capacity available to deliver the demanded amounts of data. In recognition of this looming eventuality, the National Broadband Plan includes the commitment to make available for broadband use an additional 500 megahertz of the radio spectrum within 10 years (of 2010 when the Plan was published), of which 300 megahertz should be made available for mobile use within five years.

Wi-Fi

Wi-Fi (also Wifi or WiFi) 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." Hotspots can be as small as one room or extend over an area of many square miles. Unlike mobile phone users, persons using Wi-Fi connections generally do not have to subscribe to a particular carrier's service in order to

access 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 are often provided by businesses as a service to their customers. Coffeeshops and chain bookstores are stereotypical hotspot providers. Hotels and other similar establishments frequented by travelers, particularly business travelers, are other common providers of Wi-Fi access. Increasingly public facilities, especially libraries, are providing Wi-Fi access for the people who use them. Some municipalities—Manchester is a good example—are building wireless networks to provide Wi-Fi access on a city-wide basis, or at least in densely developed business districts. The biggest obstacle to the establishment of more Wi-Fi networks that cover municipalities is finding a business model that will recoup the costs of the investment needed to deploy such systems.

4G

The evolution of cell phones has progressed with the development of ever more efficient 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: from 2G to 3G and now to 4G, meaning fourth generation.

Today's most commonly deployed 4G technology is LTE, an initialization of Long Term Evolution. It is well-suited for wireless broadband use as it was designed specifically to increase the capacity and speed of wireless data networks using new digital signal processing techniques.

Beginning in 2011, the commercial wireless carriers who provide service in Connecticut aggressively deployed the equipment necessary to upgrade their networks to make them 4G capable. At the time this plan was prepared, approximately 80 % of the State's cellphone sites on stand-alone towers and transmission line structures have been upgraded with 4G equipment. As can be seen in Figure 4 (2013 Statewide 4G Coverage), most of the areas of the state with cellphone coverage now have 4G coverage.

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 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.

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.

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* (the SCIP), 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, was created as a provision in the Middle Class Tax Relief and Job Creation Act of 2012 and is intended to provide emergency responders with a single platform for daily public safety communications. 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. When it is fully deployed and functional, FirstNet will provide high-speed data transfer and commercial grade voice service and will support the integration of local public safety networks.

M2M – Machine-to-Machine

As wireless technology becomes more pervasive in our society, it is being used in more and more applications that allow machines to communicate with one another. Two examples have been discussed here previously: utility companies' use of wireless technology to monitor and operate components of our electrical grid, and in the deployment of advanced metering systems. The increasingly widespread

use of GPS (Global Positioning Systems) is another example—satellites communicate a position to the GPS device which then uses the information to locate itself on its stored memory of local road networks.

Industry analysts estimate that there were 1 billion M2M devices in use in 2010 and forecast that this number will grow to somewhere between 12 and 50 billion by 2020.[9] 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 M2M systems possible. Items that once cost hundreds of dollars now cost the equivalent of a cup of coffee. The spread of cloud computing and the ubiquity of smartphones will also help drive the adoption of M2M technology.

The increased deployment of M2M wireless devices, however, will add another competing user in the growing demand for spectrum bandwidth.

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[9] "Rise of the machines: Moving from hype to reality in the burgeoning market for machine-to-machine communication," The Economist Intelligence Unit, 2012.
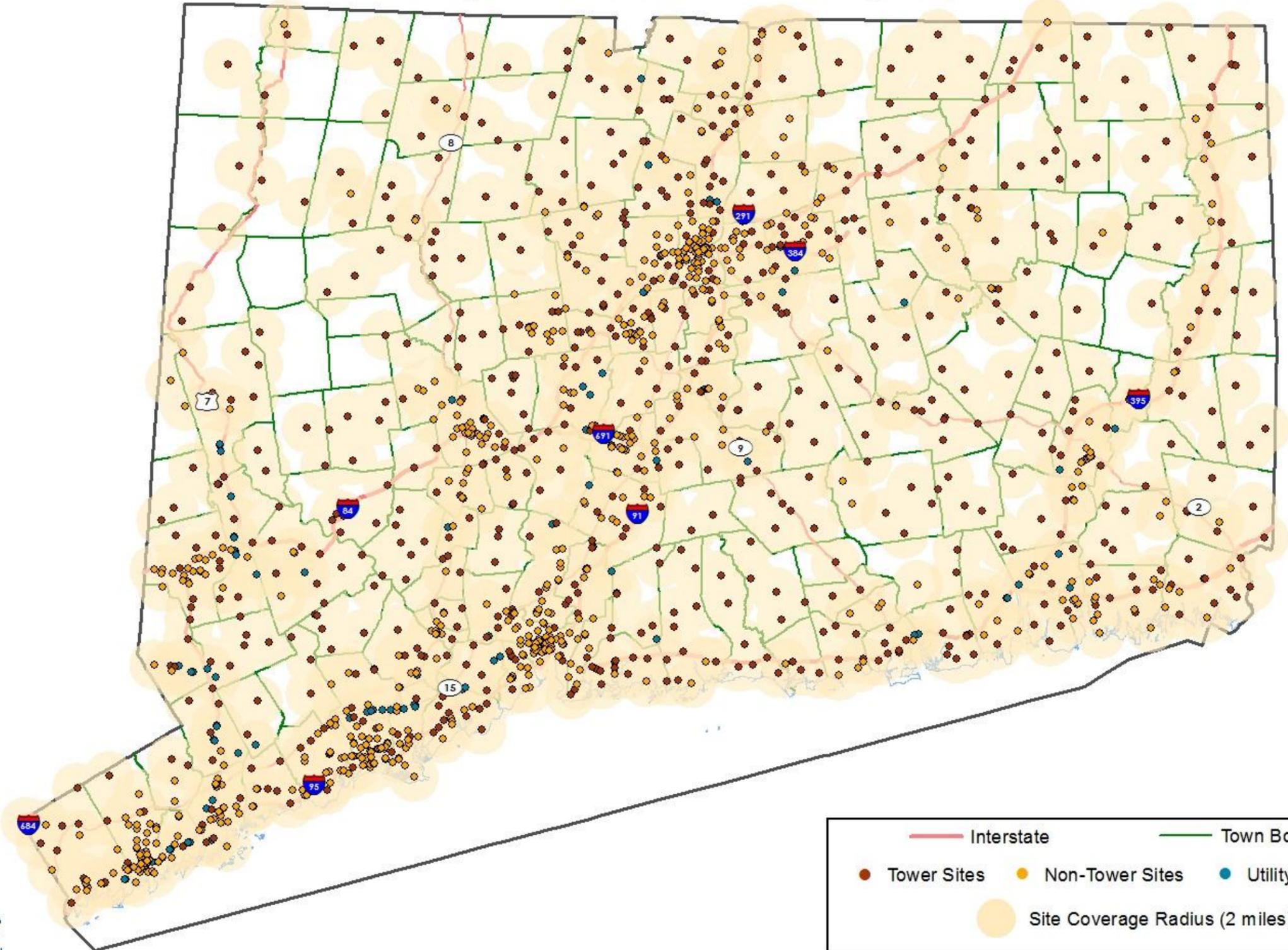
Conclusions

❖ Wireless communications, particularly wireless broadband, has evolved from an amusing diversion to an integral part of the web of modern society. The basic systems upon which our society depends—including the electrical grid 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. Many of these poorly covered, low population density towns are expected to experience relatively high percentage population growth over the next ten years.

❖ 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 extension of WiFi service to principal areas of business, as well as tourism, activities will be a critical factor in keeping such locations competitive as business and tourist destinations. Connecticut's largest cities should seek ways to ensure the availability of WiFi, at least in their central business districts.

❖ As wireless communications become increasingly important, the competition for more bandwidth of the radio spectrum will become more intense. In the allocation of the radio spectrum, policy makers should ensure that sufficient spectrum is available for public and quasi-public uses, i.e. governmental agencies, utility companies, and public safety organizations.

Figure 1 - 2013 Statewide Coverage Map

Figure 2 - State of Connecticut
Population Density, 2010

Population Density by Town (sq. mi.)

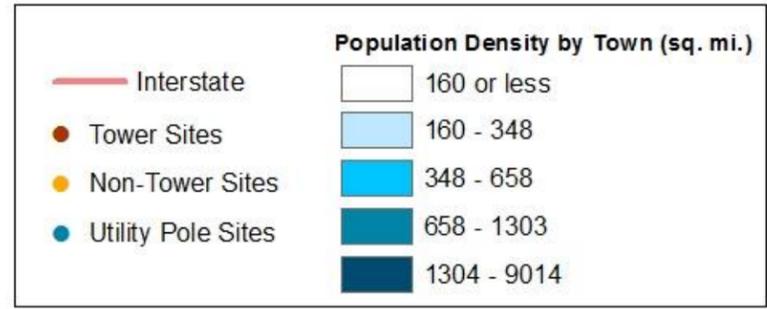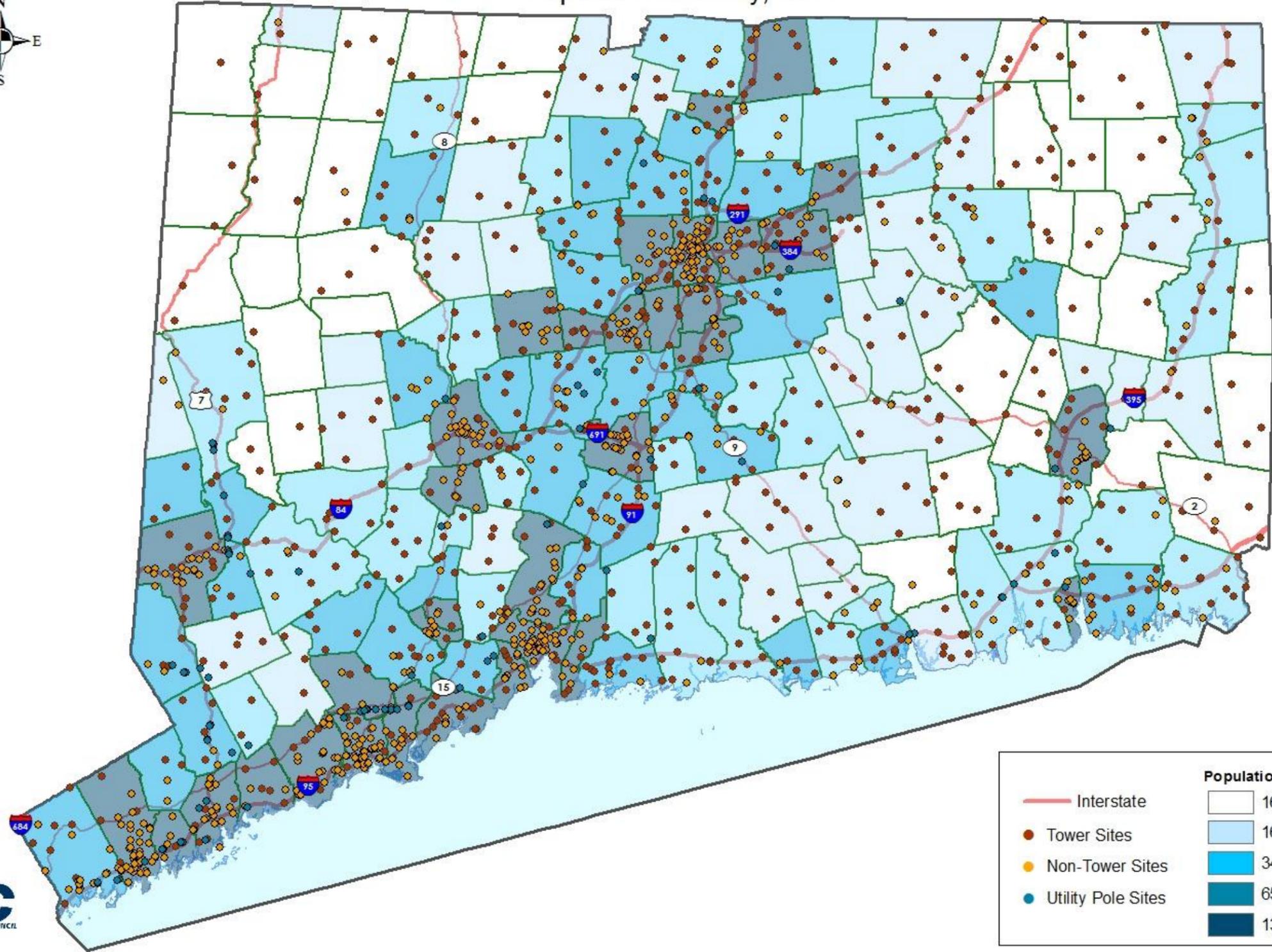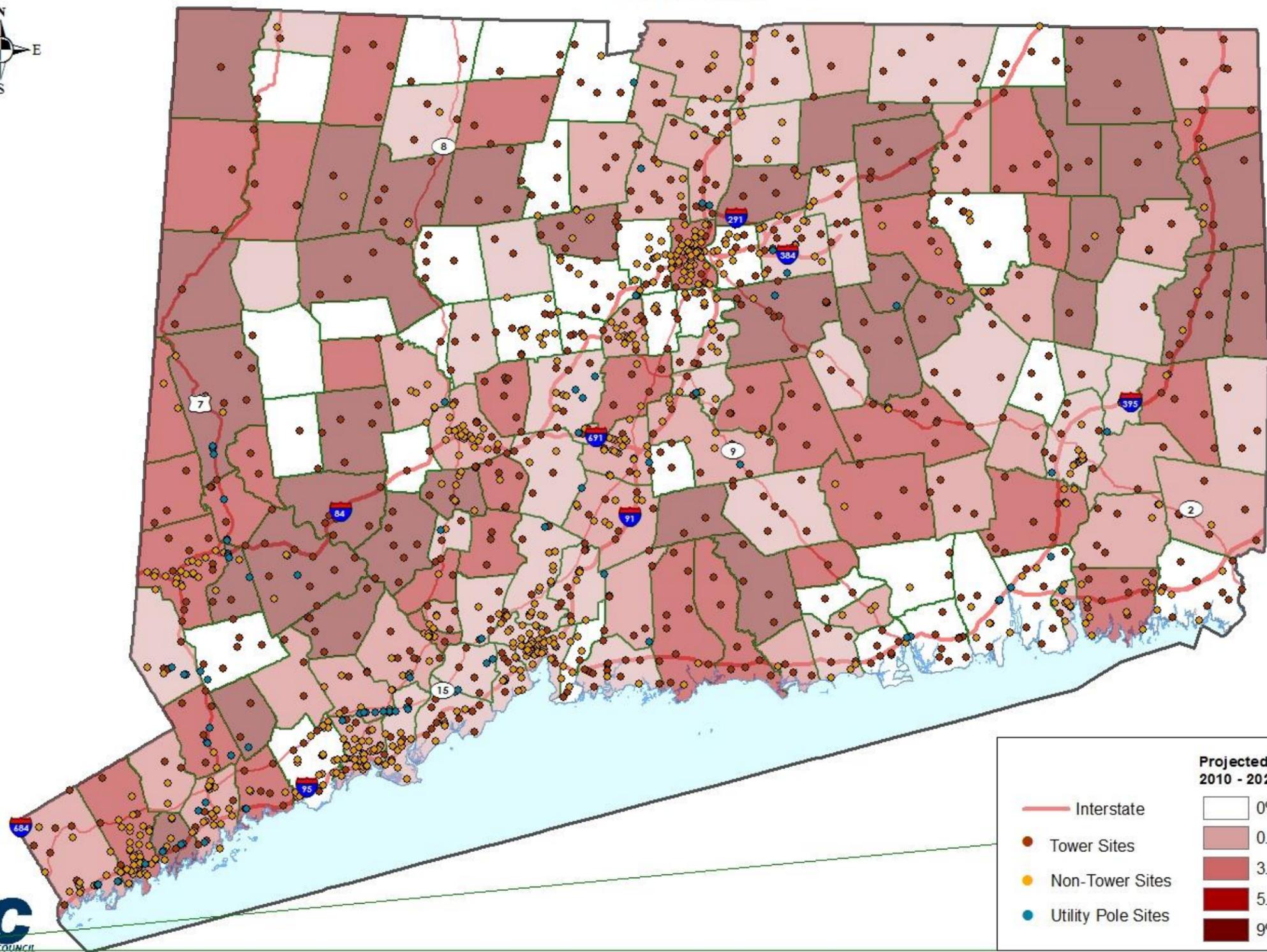|	
—— Interstate	☐ 160 or less
● Tower Sites	☐ 160 - 348
● Non-Tower Sites	☐ 348 - 658
● Utility Pole Sites	☐ 658 - 1303
	☐ 1304 - 9014

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Figure 3 - Projected Population Growth by Municipality
2010 - 2020

Interstate

Tower Sites

Non-Tower Sites

Utility Pole Sites

Projected % Population Growth,
2010 - 2020

0%

0.01 - 3.5%

3.6 - 5.6%

5.7 - 8.9%

9% or more

Figure 4 - 2013 Statewide 4G Coverage Map
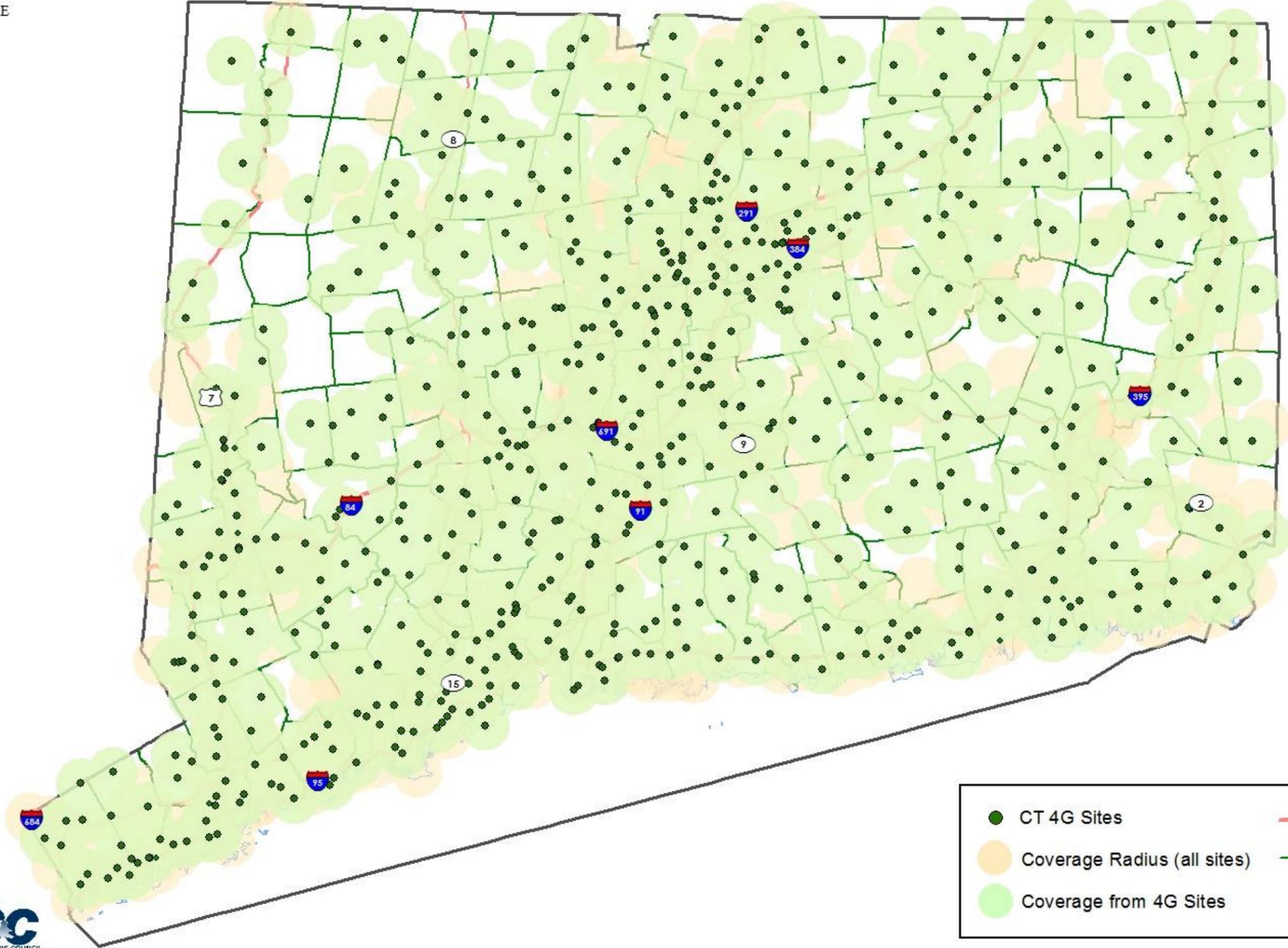
Legend:
- CT 4G Sites
- Coverage Radius (all sites)
- Coverage from 4G Sites
- Interstate
- Town Boundary

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