Menkes Associates, LLC

Verizon Wireless Cell Site Application
dated November 1, 2016
57 Portsmouth Avenue
Stratham, NH 03885

Radio Frequency Evaluation and Recommendations

January 6, 2017

Introduction

At the request of Mr. Tavis Austin, Town Planner, Town of Stratham, NH, Menkes Associates, LLC reviewed the Cellco Partnership (d/b/a Verizon Wireless) application for a proposed new cell site to be located at 57 Portsmouth Avenue, Stratham, NH. Specifically, the following documents were reviewed:

- Stratham, NH Zoning Ordinance, adopted March 1987, last amended March 2016; Section 19: Telecommunications Facilities
- RF Report by C Squared Systems dated October 31, 2016 included in the Application for Special Exception and Conditional Use Permit/ Site Plan Review for Proposed Monopole at 57 Portsmouth Avenue by Cellco Partnership d/b/a Verizon Wireless, submitted by Mr. Robert E. Baker, Esq., attorney at McLane Middleton

Executive Summary

The predicted Radio Frequency (RF) coverage plots submitted by C Squared Systems on behalf of Verizon Wireless currently lack measured calibration data and details of the propagation model used in their production to adequately validate the conclusions for both the need and proposed location of the new tower.

Assuming the uncertainty of the predicted coverage plots can be resolved, and they are indeed representative of the coverage in the area, the coverage plots would indicate that a substantial gap in reliable Verizon Wireless service exists in the Stratham area under consideration. The construction of the proposed cell site at 57 Portsmouth Avenue does provide additional coverage that mitigates a portion of the gap along the major roadways and in the areas considered to have unreliable service. This is based on the presumption that the coverage plots shown in Attachments A and B of the RF Report can be evaluated relative to each other, in their existing state of uncertainty.

The proposed cell site at 57 Portsmouth Avenue does however leave a substantial coverage gap to the east which, if cellular traffic warranted, would require an additional cell site to address in the future.

The remainder of this report addresses the data submitted which lead to these conclusions.

Review of the Submitted RF Coverage Plots and Maps

In support of the application, Verizon submitted two RF coverage plots identified as Attachments A and B in the C Squared RF Report. These plots are computer generated predictions, not actual measured data. To produce the computer generated RF coverage plots, a complex computer model is employed to calculate the signal strength in small geographic bins over the larger area of interest. The bins are integrated, assigned a color code based on user-defined thresholds for signal strength, and plotted on a superimposed map of the area under study.

A number of commercial software packages are available that provide the tools to produce such predicted coverage plots; C Squared Systems specified that they used the software package deciBel Planner. The technology of predicting RF coverage is quite mature and usually produces results that are sufficiently accurate for RF analysis and design as long as the engineer enters the properly defined parameters into the tool and uses the appropriate propagation and clutter models (clutter refers to the RF signal absorbers on the terrain, e.g. trees, buildings, water, etc.) for the area under consideration. There is no supporting data from the applicant indicating the propagation model employed, the clutter data, the terrain data, or any measured drive test data of the existing system that might have been used to calibrate the tool.

As an alternative or in addition to using measured drive test data of the existing network to calibrate the computer model and validate the predicted coverage plots, the RF engineer can opt to perform a crane test at the proposed site. A crane test consists of elevating a single omni-directional antenna to the height of the antennas on the proposed tower. An RF signal is broadcast from the omni-directional antenna, and the received signal strength and the GPS coordinates are measured in the surrounding area via a calibrated receiver. The received signal strength is then plotted on a map of the area, based on the GPS information, as a series of colored dots to represent bands of received signal strength. In addition to not including any measured drive test data of the existing network, the applicant did not include any crane test results to validate the coverage plot of the network inclusive of the proposed new cell site. Consequently the predicted coverage plots are indeterminate without corroborating data.

C Squared Systems chose to use 700 MHz as the propagation frequency in producing these predicted coverage plots even though Verizon Wireless is licensed to offer LTE in the 2100 MHz band, and will likely do so in the not too distant future. Using the lower frequency band at 700 MHz results in greater signal propagation, by as much as 10 dB, and a much smaller coverage gap on the plots.

The threshold for the color-coding of the predicted RF coverage plots is subjective and a function of the carrier's quality metrics for service. Verizon has chosen to display two distinct signal strengths of -90 dBm and -95 dBm as the required metric for quality Long Term Evolution (LTE) service. For LTE, one measures the strength of the Reference Signal Receive Power (RSRP) received at the mobile device. Although there is no industry standard for the appropriate value of RSRP, this value is generally derived from the RF link budget (maximum allowable RF path loss), mobile receiver sensitivities, penetration losses, and dropped call performance, and/or data throughput rates. In other deployments throughout the northeast familiar to this author, Verizon has used a RSRP value of either -105 dBm or -100 dBm; this is a much weaker received signal than the -90 dBm or -95 dBm used to produce the coverage plots included in this application. The use of the “hotter” RSRP value of -90 dBm or -95 dBm results in a larger coverage gap. The combination of lack of measured drive test data for calibration purposes, the use of the lower frequency of 700 MHz, and the “hotter” RSRP level, create uncertainty in the coverage plots being representative of Verizon’s current and proposed system performance in the area. The Boards should request that the supporting calibration data and missing details be supplied.

Alternative Sites

Section 19.7.3 c of the Stratham Zoning Ordinance requires an applicant to submit “Substantial Evidence that no existing towers or structures are located within the geographic area required to meet the applicant's engineering requirements.” Sections 5 of the C Squared Systems RF Report states that “there are no existing structures suitable for collocation with respect to its network requirements”, however Section 6 lists only the existing and proposed Verizon sites considered. No list of competitor’s towers or tall structures is included in the report. Although this author is not familiar with all cellular service in the Stratham area, it is surprising how other service providers provide coverage in the area without existing cell towers. Additionally, the Ordinance states that the Planning Board may share information on existing inventories and pending applications for a cell tower with other applicants. The RF Report does not indicate whether the applicant made inquiries with the Planning Board about such inventories or pending applications.

As regards alternative locations for the proposed cell site, any number of sites along Portsmouth Avenue with a similar elevation to the proposed location would be viable assuming the site is available for lease and zoned appropriately. A particularly attractive location would be near the intersection of Bunker Hill Avenue and Portsmouth Avenue because of it higher elevation. It is recognized that the applicant had previously attempted to obtain approval for such a site, but was denied by a vote of the Town.

Alternative Technologies

The cellular industry has a number of diverse technologies available to deliver service to its subscribers; each has its purpose and specific application. The predominant alternatives consist of small cells or distributed antenna systems (DAS). Small cells are primarily used to add additional capacity to an existing network. They are low power and have limited propagation. As a result they are typically used in buildings and in special venues such as stadiums, arenas, and as campus solutions. DAS is similar to small cells in that it is intended to provide coverage in a small area where a relatively stealth solution is mandated. They have the benefit of being able to accommodate multiple service providers, but may be difficult to deploy, maintain, and back-up in the event of an extended power outage.

The topography in and around Stratham is challenging in that the elevation has over 125 feet of variation over a relatively short surface distance. If the coverage plots are assumed to be representative of the gap in reliable service that exists in the area, then the size of that coverage gap is quite large in area. The optimum approach to provide reliable cellular service in the presence of wide elevation variations and a large coverage gap is to correspondingly mount the transmit and receive antennas at a high elevation since radio propagation at cellular frequencies is primarily line of sight. This is best accomplished with a tall tower as is being proposed in this application.

Capacity Discussion

Attachments C and D of the RF Report show the “best-server” plots for the Verizon cell sites in the area. Attachment C shows the existing system, and Attachment D shows the result inclusive of the proposed cell site at 57 Portsmouth Avenue. It should be recognized that these plots were also computer generated and suffer from the same uncertainties as the coverage plots, however their value is in roughly showing how the cellular traffic is currently handled and will be handled once the proposed cell site is on line.

The discussion in the text is confusing in that it mixes Verizon’s general need for additional data capacity on its wireless network in light of the rapidly expanding data demand with the finite “radio-resources” within a cell site. The appropriate issue here is the latter. Verizon Wireless has been planning for the explosion in data demand across its network for years and has a well-documented plan to address those needs. That plan includes deploying LTE at 2100 MHz, reclaiming its spectrum currently being used by its 3G technology and converting it to LTE service, and providing data and voice service over local Wi-Fi networks.

For attachments C and D, it is more appropriate to consider the limitations of radio access resources at a cell site. All cell sites have limited resources that are allocated in supplying service. These include, among others, limited transmit power and limited data capacity. It is not clear from the text of the RF Report which one (or both) is the limiting issue with the surrounding cell sites.

When a cell tries to service a mobile device that is at the extreme of the cell’s coverage range, it requires more transmit power to deliver a viable signal to that device. This reduces the amount of transmit power that the cell site can use to support other mobile users and ultimately results in the blocking of additional users trying to obtain service from the cell. Similarly a cell site has limited data capacity based, in part, on the fundamentals of the LTE technology. Verizon measures a cell's data capacity by tracking a metric called Forward Data Volume. Forward Data Volume is a measure of the data throughput per hour, per sector (a cell is typically made up of three individual transmit-receive sections, called sectors, pointing in geographical directions approximately 120 degrees apart). Verizon has specific maximum limits for this metric that indicate when a sector is approaching full capacity. Unfortunately neither blocking data nor any Forward Data Volume metrics were provided to support the claim of capacity limitations. Rather, geographic area and population data are used to parametrically support the capacity claims.

Notwithstanding the lack of appropriate technical data to support the capacity discussion, the best-server plots are consistent with expectations in the presence of a large coverage gap and the addition of a new cell site to mitigate that gap. It would be fully expected that the new cell site would assume some traffic from the surrounding cell sites freeing up resources in those cell sites.

Conclusions

The predicted Radio Frequency (RF) coverage plots submitted by C Squared Systems on behalf of Verizon Wireless are lacking calibration data and details of the propagation model used in their production to adequately validate their conclusions. Additionally, the predicted RF coverage plots display Reference Signal Received Power (RSRP) of both -95 dBm and -90 dBm. These signal levels are "hotter" than Verizon has typically used in other locations in the northeast and result in presenting a greater coverage gap. However to offset this, the plots were produced using the lower frequency band of 700 MHz rather than the higher frequency band at 2100 MHz. Using the lower band at 700 MHz reduces the coverage gap because of lower propagation loss at 700 MHz. The combination of the "hotter" received signal and the lower frequency may offset each other, leaving just the issue of calibration in question.

Although the C Squared RF Report claims that there are no existing structures suitable for colocation with respect to its network requirements, they did not include a list of existing potential structures other than Verizon's current and proposed structures to determine the extent or thoroughness of their search. Further, the applicant did not provide any indication that they queried the Planning Board relative to any inventories of existing or pending towers or structures.

No radio frequency emissions report was submitted for the proposed new cell site, as required by the Town zoning ordinance.

Assuming the uncertainty of the predicted coverage plots can be resolved, and they are indeed representative of the coverage in the area, the coverage plots would indicate that a substantial gap in reliable Verizon Wireless service exists in the Town of Stratham. A new cell site at 57 Portsmouth Avenue would mitigate, but not entirely eliminate that gap, and offload traffic from the surrounding cell sites.

Prepared and submitted by:

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attachment

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BACKGROUND SUMMARY:	Strong wireless system and radio frequency engineering experience acquired by working closely with wireless service providers, global standards organizations, and major wireless infrastructure development enterprises. RF consultant to numerous Zoning Boards, and legal firms. Bell Labs Fellow.
EXPERIENCE: 2010 to	President and founder of Menkes Associates, LLC, a consultancy providing wireless telecommunications expertise to municipalities and legal teams. Accepted as an expert-witness before numerous planning boards on proposed cell tower siting and the use of alternative technologies.
12/06 to 12/07	CTO, Alcatel-Lucent Wireless Business Group. Responsible for technology guidance, RF system capacity and throughput projections, global wireless standards strategy and implementation, and development organization quality objectives and adherence. Managed the creation of Alcatel-Lucent's 4G wireless strategy. Provided customer support and was the interface to the technical press and analyst community.
5/00 to 12/06	Vice President, Lucent Technologies Global Wireless Systems Engineering and Architecture. Managed the architecture and systems engineering efforts for all digital wireless products. Provided customer support for the deployment of wireless infrastructure, challenging RF issues, and system optimization.
3/94 to 5/00	Director, Wireless Systems Engineering. Responsible for overseeing the development of the systems requirements for the analog, and digital hardware and software infrastructure products, and RF engineering tools. Managed the specialized RF engineering groups tasked with assisting service providers address challenging RF and system optimization issues. Responsible for negotiating the RF performance requirements for all wireless contracts.
10/92 to 3/94	Head, Wireless Development Project Planning and Management Department. Established and ran the Work Program Planning and project management for the teams that developed Lucent Network Systems hardware and software products. Provided project management support for the early stages of the digital technology air interface development programs.
11/89 to 10/92	Technical Manager, AT&T Bell Labs, Cell Site Systems and RF Engineering Group. Responsible for generating the hardware requirements for all analog and digital base station products. Conducted specialized RF engineering studies for carriers to add coverage and capacity to existing systems and to plan initial transition to digital technologies. Developed RF engineering guidelines for early digital systems.

9/87 to 11/89	Supervisor, AT&T Bell Labs, DC Plant Design Group. Managed the development of the industry's first microprocessor-controlled telecommunications battery plant. This new plant tripled the energy density of previous offerings and provided control, monitoring, and customer interfacing through menu driven firmware and high-quality speech synthesis. Awarded Bell Labs Fellow for this achievement.
4/78 to 9/87	Supervisor, AT&T Bell Labs, Rectifier and Battery Plant Design Group. Developed central office power equipment including battery charging rectifiers, battery plants, dc distribution systems, inverters, uninterruptible power supplies and custom power supplies.
6/69 to 4/78	Member of Technical Staff, AT&T Bell Labs Radio Protection Switching Department. Developed digital signaling protocols and circuits for use in microwave radio protection switching systems. Designed the control logic and insertion modulator for the single sideband radio protection switching system as well as the monitoring system logic for the initial trials of Data Under Voice on microwave radio systems. Taught in-hours courses in digital and microprocessor design, and fundamentals of electronic switching systems.

EDUCATION:

Carnegie Mellon University, Pittsburgh, PA
Graduate School of Industrial Administration
Certificate, Business Program for Executives

Northeastern University, Boston, MA
B.S.E.E., M.S.E.E., Communications Theory Major

PUBLICATIONS AND PRESENTATIONS:

"IMS in Support of Terrestrial and Satellite Based Communications Systems" NASDAQ, September 2007.

"The Road to 4G" Alcatel-Lucent Analysts Conference, March 2007.

"Building the Next Generation UMTS Wireless Networks" CDMA World Focus Annual 2001.

"Wireless Mobile Communications at the Start of the 21st Century" IEEE Communications Journal, January 2001.

"CDMA Network Infrastructure Evolution" CDG World Congress, June 1997.

"CDMA–The State of the Technology" Network Wireless Systems Technical Seminar, September 1996.

"An Adaptive AC Input Monitoring Algorithm for Microprocessor Controlled Parallel Processing UPSs," Proceedings of the IEEE International Telecommunications Energy Conference, June1987.

"A Microprocessor Controlled System Battery Plant: A New Concept in Central Office Power," Proceedings of the IEEE International Telecommunications Energy Conference, November 1984.

"A Stored Program Controlled Triport UPS," Proceedings of the IEEE International Telecommunications Energy Conference, May 1981.

PATENTS:

Five U.S. Patents