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Examination of ExteNet Applications and On-Site Review of Existing Verizon Service for Small Cell Node Deployment for Verizon Wireless Customers

City of Monterey, California

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Background

CTC is an independent engineering consulting firm with more than 35 years of experience assisting public sector clients with communications engineering, design, and analysis. The principal radio frequency (RF) specialist and licensed professional engineer who completed this review combine for more than 65 years of experience analyzing and field-testing wireless radio frequency signal propagation, including an extensive knowledge of current and cutting-edge antenna systems, towers and all the related hardware equipment required to deliver wireless services. We currently assist numerous municipalities with wireless antenna structure management and review services.

Our wireless engineers and "tower team" have processed more than 5,000 tower- and antenna-siting applications for our clients nationwide, giving us insight into the many alternatives available to mitigate the impact of new facilities on a community—as well as an understanding of zoning standards and rights-of-way (ROW) issues that protect the public interest yet permit deployment of new wireless services to benefit residents.

Through our client engagements, we have evaluated applications related to wireless carriers' voice and broadband deployments. We have wide-ranging experience with conventional macro sites, distributed antenna systems (DAS), and small cell deployments. We have evaluated and advised our public-sector clients on applications from all national carriers and infrastructure

providers, including without limitation AT&T, Clearwire, Cricket, Sprint, T-Mobile, Verizon Wireless, Crown Castle, Mobilitie, and others.

In the applications reviewed in this report, ExteNet Systems, Inc., is seeking permission to deploy a network of 13 small cell nodes on existing and replacement vertical infrastructure within the public right-of-way in the City of Monterey, California. This deployment would typically consist of adding an omnidirectional cannister-style antenna on existing or replacement utility poles in the public right-of-way, with associated electronics either mounted on the pole or placed within an adjacent underground vault. (In two of the proposed locations, numbers 12 and 13, an existing marbelite streetlamp would be replaced to accommodate a new antenna on top with internal wiring and undergrounded electronics.) This proposed network of small cell nodes is intended to provide additional wireless service capacity, using the 1900 and 2100 MHz spectrum (licensed to Verizon Wireless) for the mostly residential area approximately bordered by Franklin Street to the north, Pacific Street to the east and Skyline Drive to the west and south.

Site Survey Findings

Exhibit 1 shows the map provided to the City of Monterey by ExteNet to predict the coverage of these 13 small cell nodes, alongside with the existing macro cells in the four corners of the map. These macro cells are the current generation of multiple panel antennas (sometimes camouflaged as flagpoles, trees or as attachments to building tops) which are typically 150-200 feet off the ground and are meant to cover a 1-to-3 square mile area. This means that all the cellphones (and other devices) for that carrier in that area would necessarily connect back to that cell site.

As consumers increasingly adopted smartphones, their demands and use for data increased exponentially and the macro facilities are either too distant from the user device to achieve broadband speeds or generally lack the bandwidth to handle the increased demands from the same service area. As a result, wireless network architecture dependent solely on macro facilities is no longer an efficient solution from an engineering standpoint.

Instead, to fully deploy robust 4G and (soon) 5G LTE networks with increased capacity and speed, carriers are investing in small cell deployments across the country. Each small cell node in the deployment typically covers an area of between 800-to-3,000 square feet, depending on antenna selection and terrain. Because these small cell nodes can reuse the same frequencies over and over, and since there are so many (in this case, 13 sites instead of the single macro site), these small cells will accommodate many more users and afford each a significant amount of data throughput at any given time.

On November 7 and 8, 2017, I undertook extensive field measurements at each proposed small cell node site as well as canvassing the entire proposed coverage area to determine existing Verizon Wireless signal levels. Initially, I visited three of the Verizon Wireless macro sites (downtown on the roof of the Marriott hotel at 350 Calle Principal, a camouflaged flagpole in the shopping center at 1301 Munras Avenue, and a parking lot at 1213 Forest Avenue) to take baseline readings of the existing Verizon Wireless signal strength and perform data throughput (i.e., data speed) tests. These measurements would provide a best-case scenario for gauging the performance of the existing Verizon Wireless network. Exhibit 2 shows the results of the network performance tests at each existing macro site location:

Exhibit 2 – Baseline Signal Strength and Throughput Measurements at Nearby Verizon Wireless Macro Cell Sites

Macro Cell Site Location	350 Calle Principal Marriott Hotel Roof	1301 Munras Ave. Flagpole in Shopping Center	1213 Forest Ave. Parking Lot
Signal Strength (at street level)	-75 dBm	-49 dBm	-62 dBm
Ping Test	29 milliseconds (msecs)	28 msecs	28 msecs
Download Throughput	23.71 megabits per second (Mbps)	63.44 Mbps	39.90 Mbps
Upload Throughput	23.19 Mbps	31.19 Mbps	28.13 Mbps
Active Frequency Bands	700 MHz, PCS, AWS	700 MHz, PCS, AWS	700 MHz, PCS, AWS

Signal strength is simply a measurement of the signal being received from the cell site, a quantification of what people are accustomed to calling “bars of service”. It is measured in decibels per meter (dBm) and is a negative number. An excellent signal (5 bars) is typically -75 dBm, while a marginal signal (1 bar) would be approximately -105 dBm. Signal strength is largely dependent of the distance of the cellphone from the cell site, as the signal rapidly dissipates as it propagates from the antenna.

The ping test measures (in milliseconds) how long it takes for the cellphone to make a roundtrip from the user’s device to a server on the Internet via the nearest cell tower. The ping test can help determine capacity issues on the cell network since you will be competing with all the other connected cell users for the internet connection. A slower speed indicates a capacity

Exhibit 3 – Signal Level Measurements in the City of Monterey