

December 4, 2020

To: City of Petaluma

**From: Snehil Tiwari, Radio Frequency Design Engineer
Verizon Wireless Network Engineering Department**

**Subject: Statement in Support of Verizon Wireless's Proposed Facility
611 Western Avenue, Petaluma**

Executive Summary

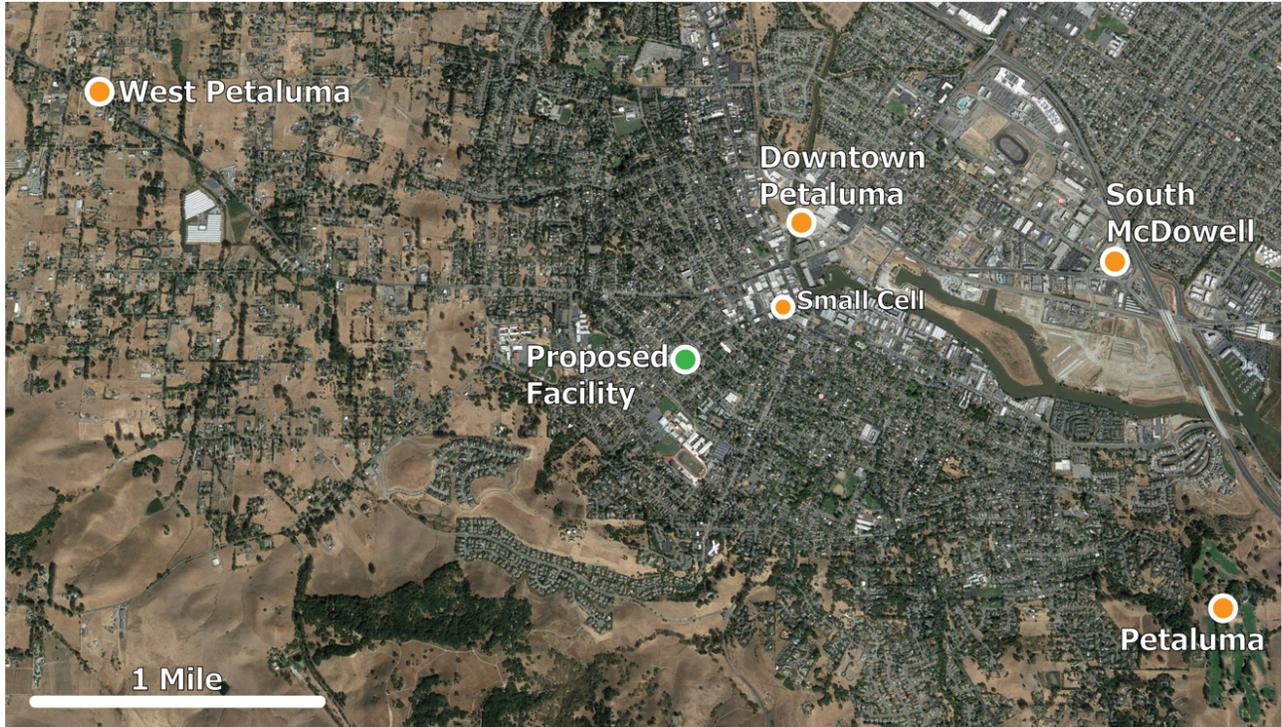
Verizon Wireless has identified a significant gap in its fourth-generation (4G) long-term evolution (LTE) service in the south Petaluma area. This area currently receives inadequate LTE service coverage from existing Verizon Wireless macro facilities: the Downtown Petaluma facility 0.6 miles northeast, the South McDowell facility 1.5 miles east, the Petaluma facility 1.9 miles southeast, and the West Petaluma facility 2.1 miles northwest. A small cell facility recently installed on Kentucky Street downtown, 0.35 miles east, provides targeted service to the downtown area only. A network map appears on the following page.

Due to the distance from existing macro facilities, there is a gap in reliable LTE in-building service coverage in the south Petaluma area, west of downtown. Additionally, there is a lack of dominant signal in the gap area, which compromises signal quality for customer handsets and degrades network performance. Further, accelerated growth in voice and data use by Verizon Wireless customers has increased the demand on the existing Verizon Wireless network, which compromises network accessibility and reliability, and has led to low data throughput.

To meet increased local demand for service, Verizon Wireless is deploying efficient high-speed fourth-generation LTE technology. In the Petaluma area, 60 percent of Verizon Wireless's LTE bandwidth is in the mid-band AWS (2100 MHz) and PCS (1900 MHz) frequencies, with 40 percent in low-band frequencies (700 and 850 MHz). A bandwidth chart appears on the following page. Higher frequencies mean greater data capacity. However, the mid-band frequencies do not travel as far as low-band frequencies, and require facilities closer together and closer to the end user to provide reliable LTE service.

I describe below the significant gap in coverage that Verizon Wireless seeks to remedy (the "Significant Gap"). To provide reliable LTE service in the south Petaluma area, the Significant Gap must be remedied through construction of a new rooftop facility at the Petaluma Creamery at 611 Western Avenue (the "Proposed Facility").

Network Map – Existing Facilities in South Petaluma Area and Proposed Facility



Verizon Wireless Spectrum in Petaluma Area

Band	Frequency	LTE Bandwidth	Percent of total bandwidth
700 MHz	700 MHz	10 MHz	20%
850 MHz	850 MHz	10 MHz	20%
PCS	1900 MHz	10 MHz	20%
AWS	2100 MHz	20 MHz	40%

Coverage Gap

Verizon Wireless is experiencing a gap in its LTE service coverage in the south Petaluma area, west of downtown. There is a lack of reliable LTE in-building coverage in residential neighborhoods along Washington Street west of High Street to North Webster Street, and along Webster Street west of Upham Street to Benjamin Lane, as well as areas south. This includes part of the Petaluma High School campus, and the area of multi-unit housing north of Fair Street and west of Douglas Street. (Collectively, the “Coverage Gap”)

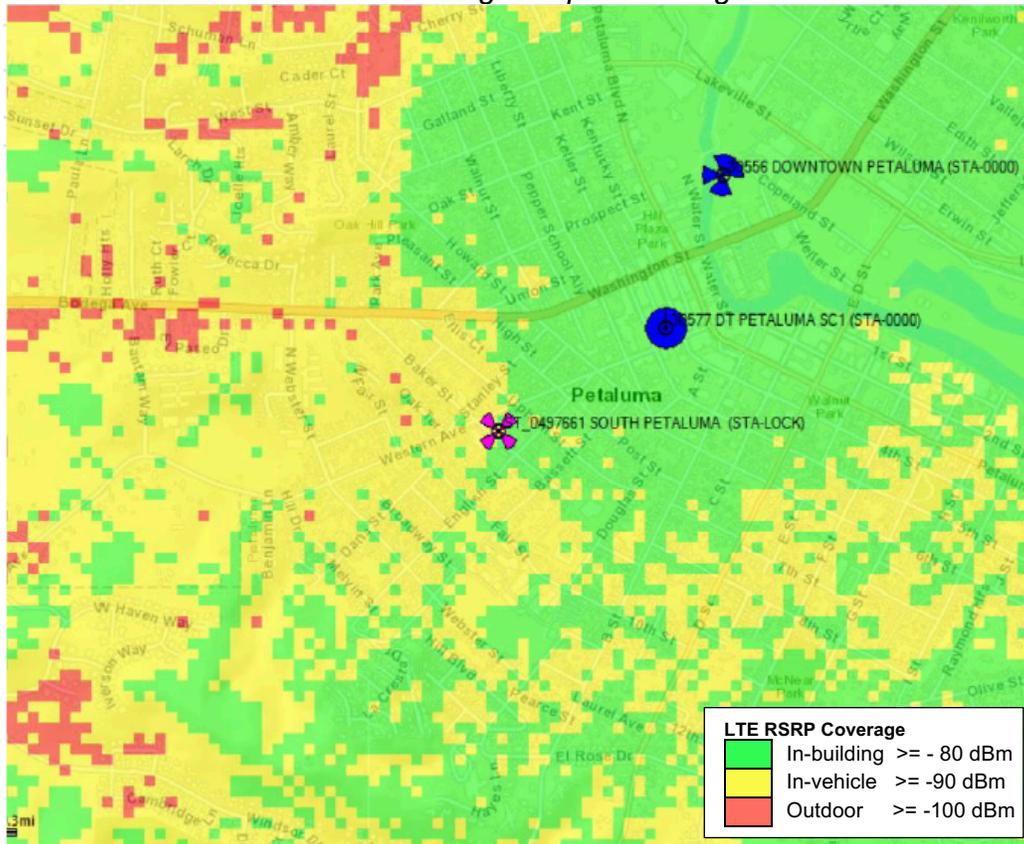
The Proposed Facility will provide new reliable LTE in-building coverage to these areas, with a population of 1,870 residents.

The following coverage maps show existing and proposed coverage for each the 700 MHz and AWS LTE frequency bands. With similar frequencies, the 700 MHz and 850 MHz bands have similar propagation characteristics, as do the AWS and PCS bands. The maps are prepared using Verizon Wireless’s Atoll tool.

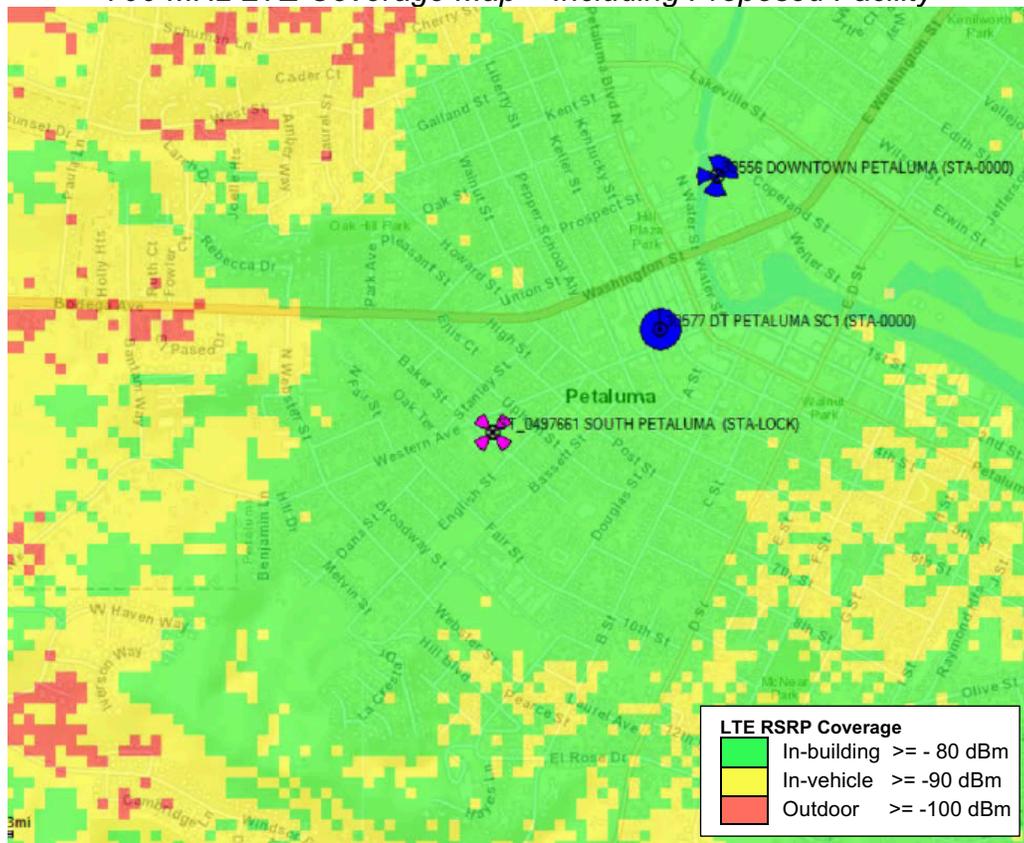
Reference signal received power (RSRP) is a measurement of signal level in decibels (dBm), which is a negative number that decreases due to distance and other factors. The LTE RSRP coverage thresholds are:

	In-building ≥ -80 dBm. Green depicts good coverage that meets or exceeds thresholds for reliable network coverage in homes and vehicles.
	In-vehicle ≥ -90 dBm. Yellow depicts reliable in-vehicle coverage only.
	Outdoor ≥ -100 dBm. Red depicts reliable outdoor service only.

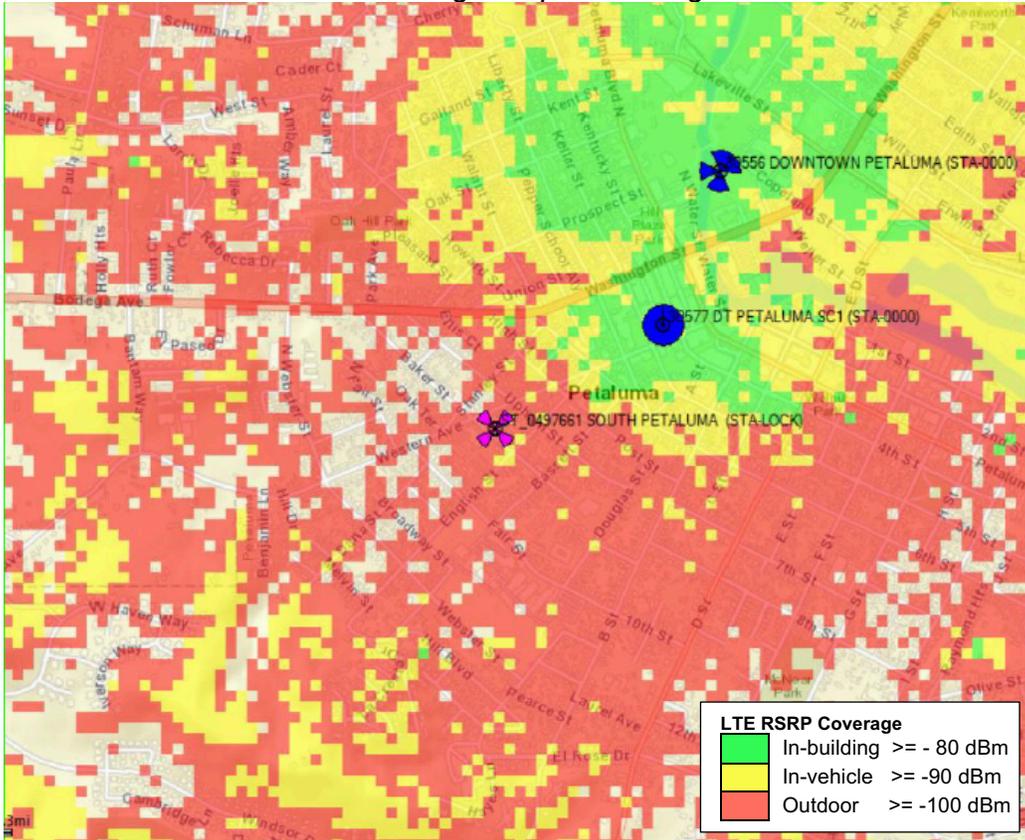
700 MHz LTE Coverage Map – Existing Facilities



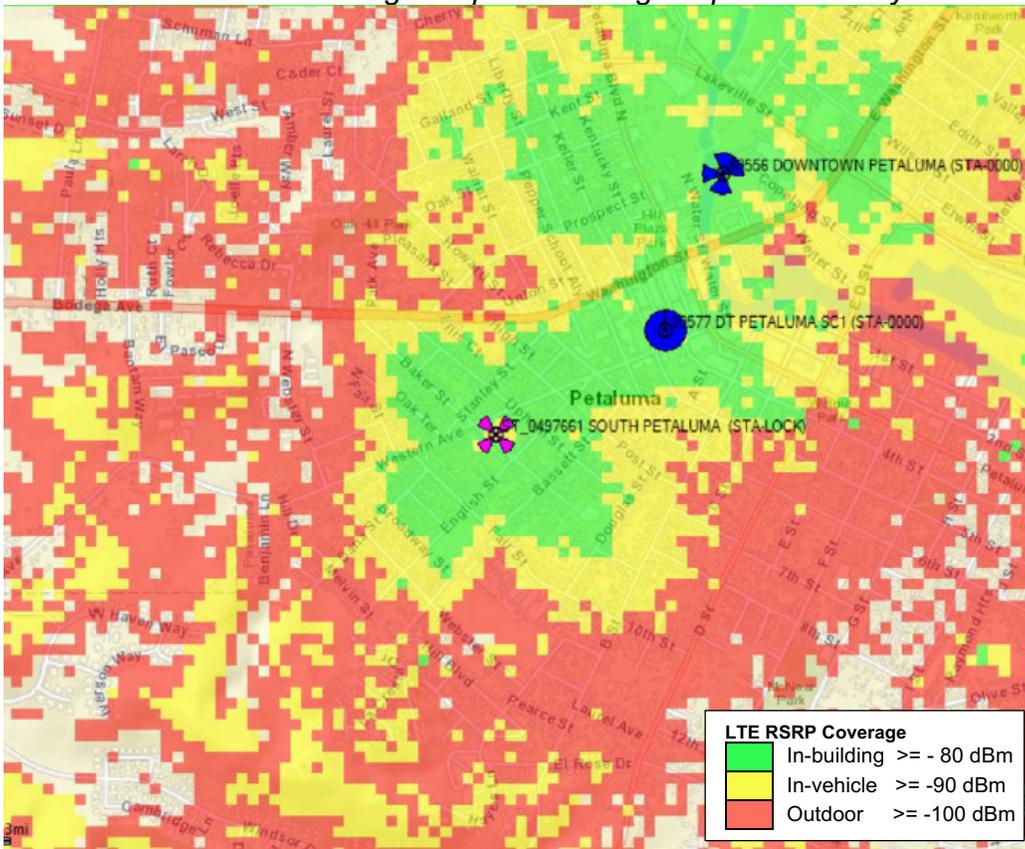
700 MHz LTE Coverage Map – Including Proposed Facility



AWS LTE Coverage Map – Existing Facilities



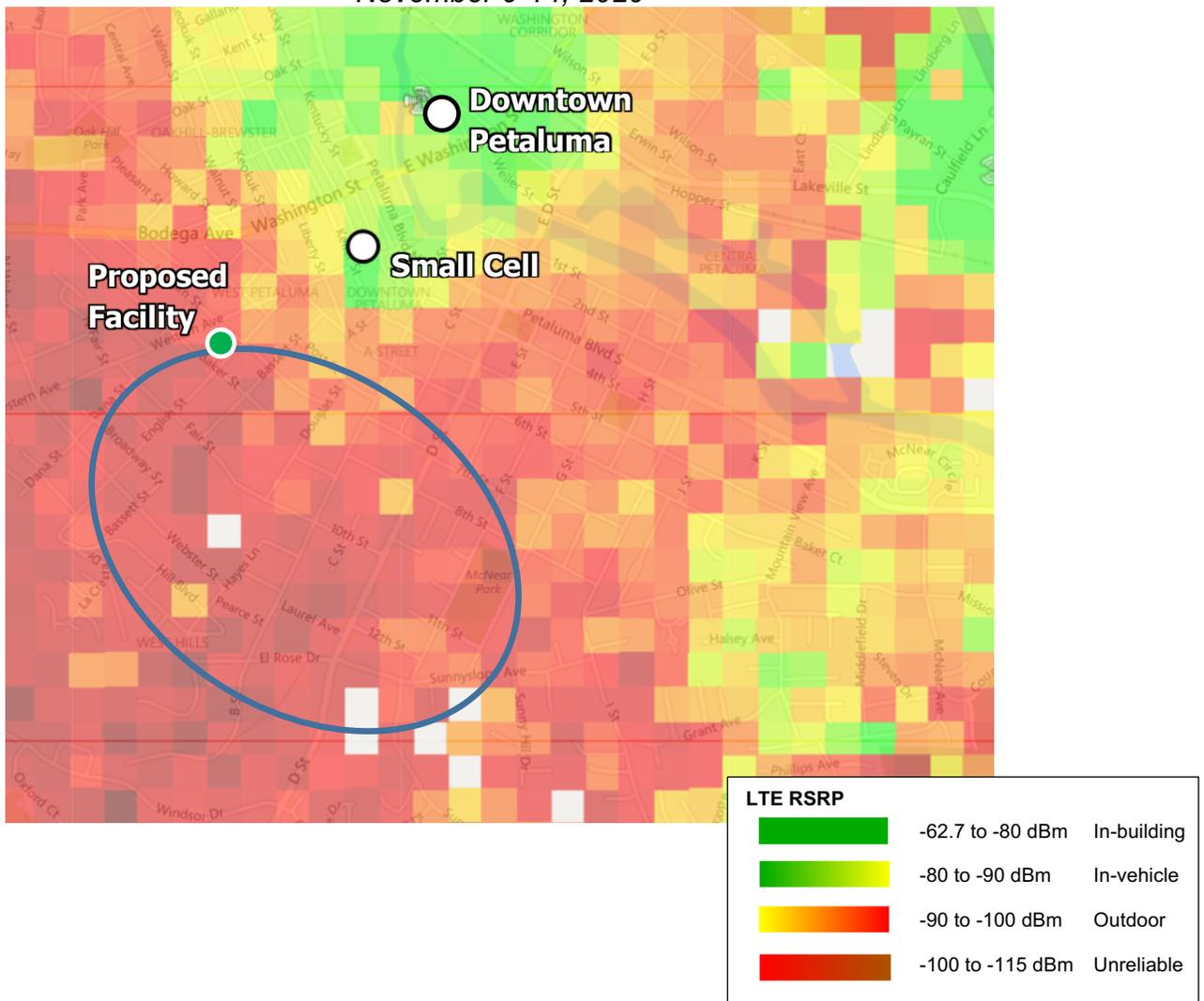
AWS LTE Coverage Map – Including Proposed Facility



The following map shows the average signal level (RSRP) from existing Verizon Wireless facilities received by customer devices in the gap area over six days from November 9-14, 2020. The customer devices report this data to the network, and Verizon Wireless uses its TrueCall software tool to analyze this data and optimize system performance.

The map shows how signal level from the existing Verizon Wireless facilities decreases with distance. Similar to the coverage maps, yellow and red squares show decreasing signal level. For example, the broad area of red squares in the circle south of the Proposed Facility indicates only an outdoor level of service or worse.

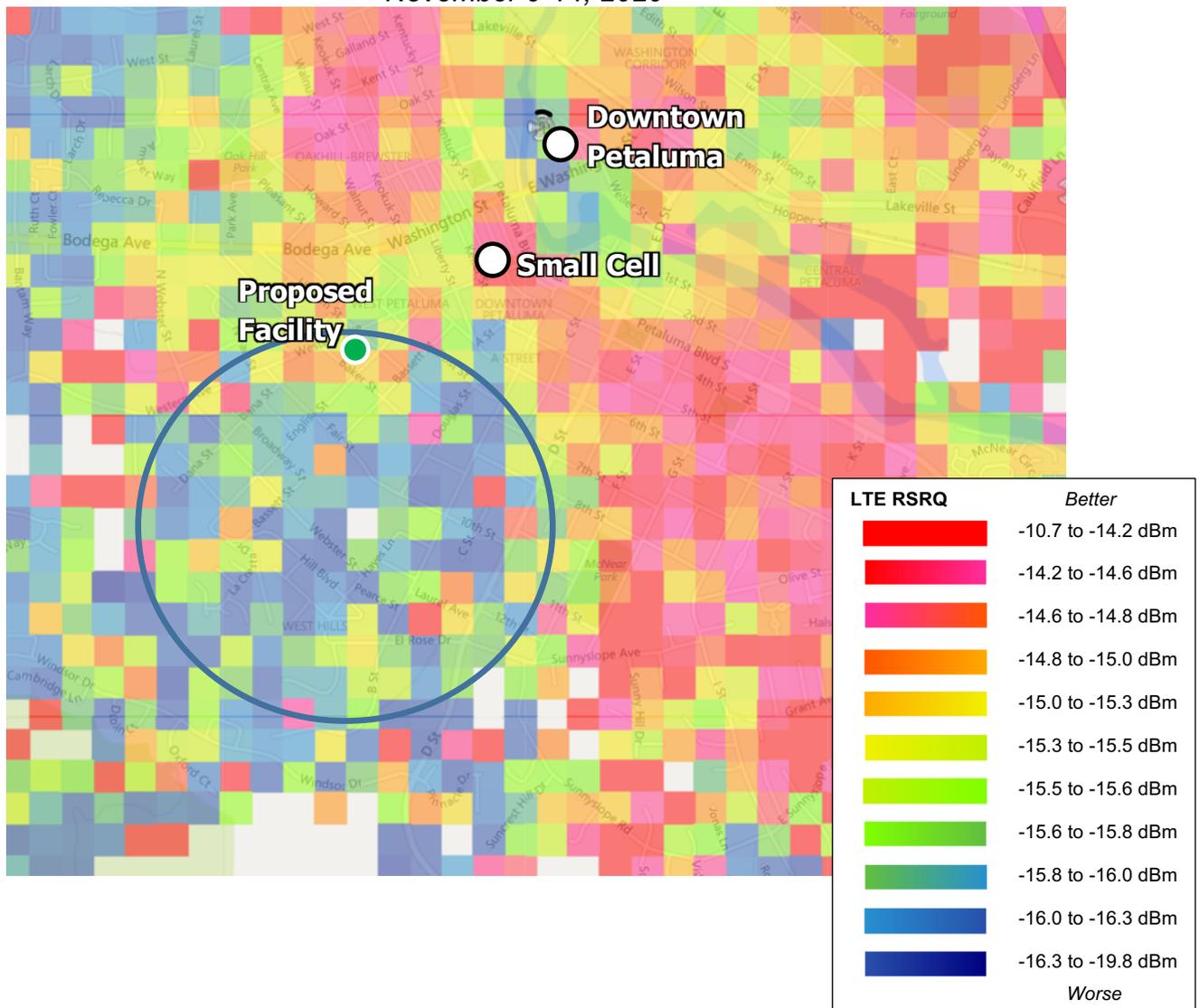
*Existing LTE Signal Level Measured by Customer Devices
November 9-14, 2020*



The next map shows the average reference signal received quality (RSRQ) reported by customer devices during the same period. RSRQ reflects the ratio of the signal level from existing Verizon Wireless facilities compared to interfering signal levels. The lower the number, the lower the interference, indicating better signal quality. Along with RSRP described above, RSRQ data assists the network in assigning customer handsets to particular facilities. A low RSRQ number indicates improved network performance and better connectivity for customers in the area.

The map shows how a lack of dominant signal and the presence of interfering signals compromises network connectivity around the gap area near the Proposed Facility. For example, the area within the circle has few red or orange squares that would indicate low interference and better service quality. Instead, the mostly green and blue squares indicate too much interference, poor service quality, and declining network performance.

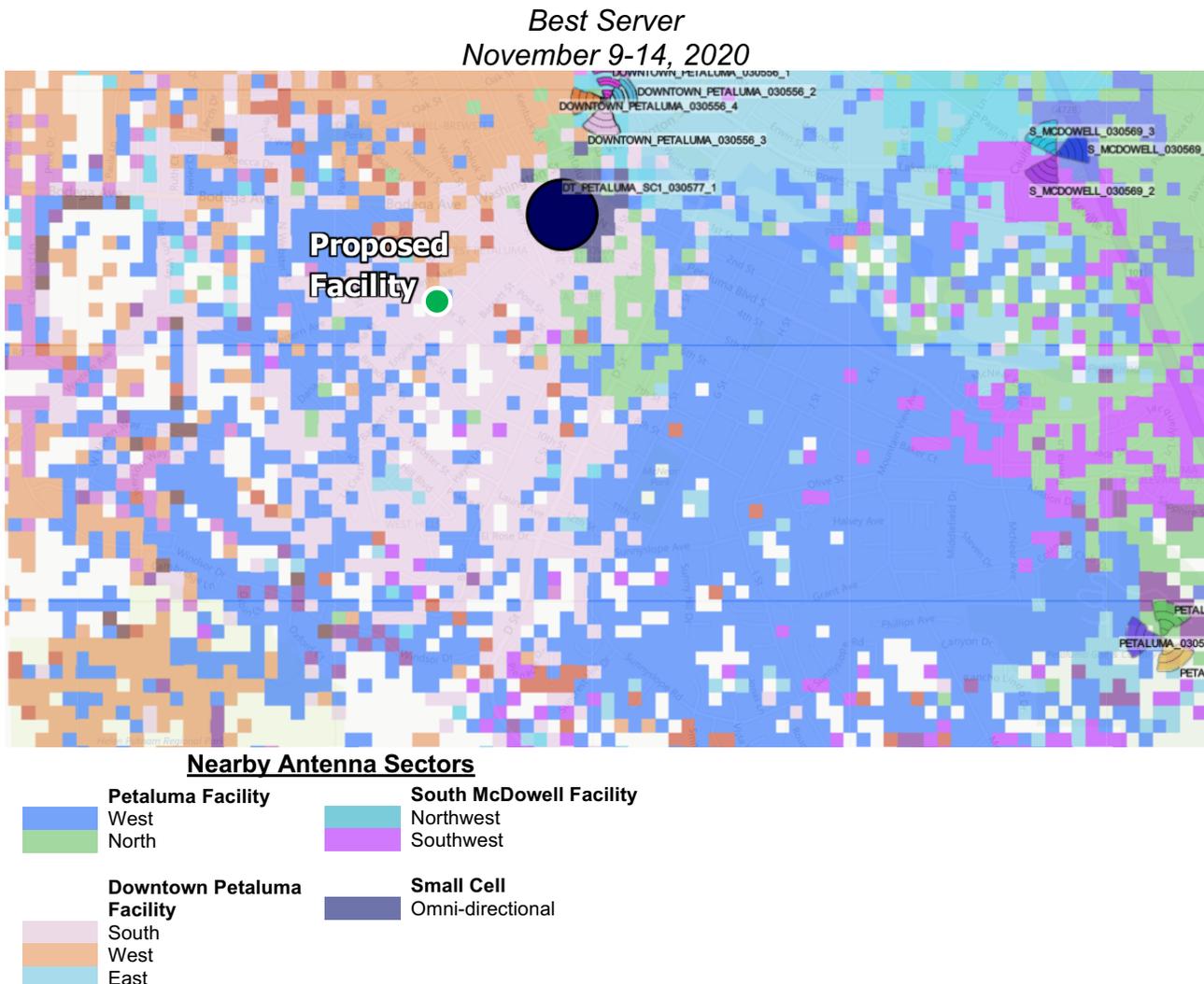
Existing RSRQ
November 9-14, 2020



The following map shows the typical best server, depicting which existing facility antenna sector generally provides the strongest signal to an area, as reported by customer devices. Dominant signal from each antenna sector is depicted in a different color. The colors of the nearby antenna sectors serving the gap area are described in the legend. White squares indicate a lack of an adequate sample for that area.

Although dominant, the signal from existing Verizon Wireless facilities is weak in the gap area. The Petaluma and Downtown Petaluma facilities (shown in dark purple and pink) provide the most dominant signal to the gap area around the Proposed Facility, but their signal is significantly intermixed, along with signal from other facilities. The Petaluma facility serves a particularly large area, including most of the users in the gap area.

The lack of strong, reliable dominant signal degrades network performance, resulting in unreliable service, particularly during busy hours. This affects the reliability of Verizon Wireless service for residents, workers and visitors as well as for communications with emergency services personnel. The Proposed Facility will provide strong, new dominant signal to the gap area, allowing the existing facilities to devote their resources to users closer to their location. This will improve network performance in the gap and the greater area.

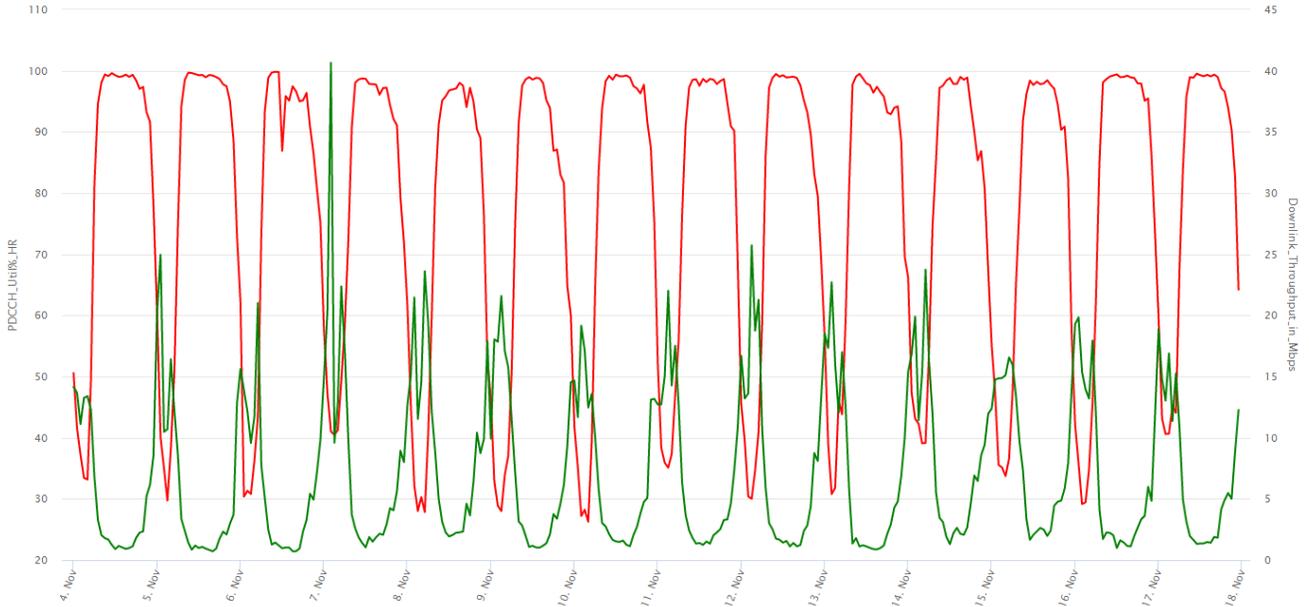


The following charts show the high demand on the Petaluma facility west-facing antenna sector serving much of the gap area. The charts show how, with increased demand, data throughput is severely reduced. The red line (left axis) shows the percent of use of the physical downlink control channel (PDCCH), which tells customer devices what resources they should access on the data channels. The percentage increases as more customer devices access the network, and this reflects increased demand. The green line (right axis) shows the downlink data throughput in megabits per second (Mbps).

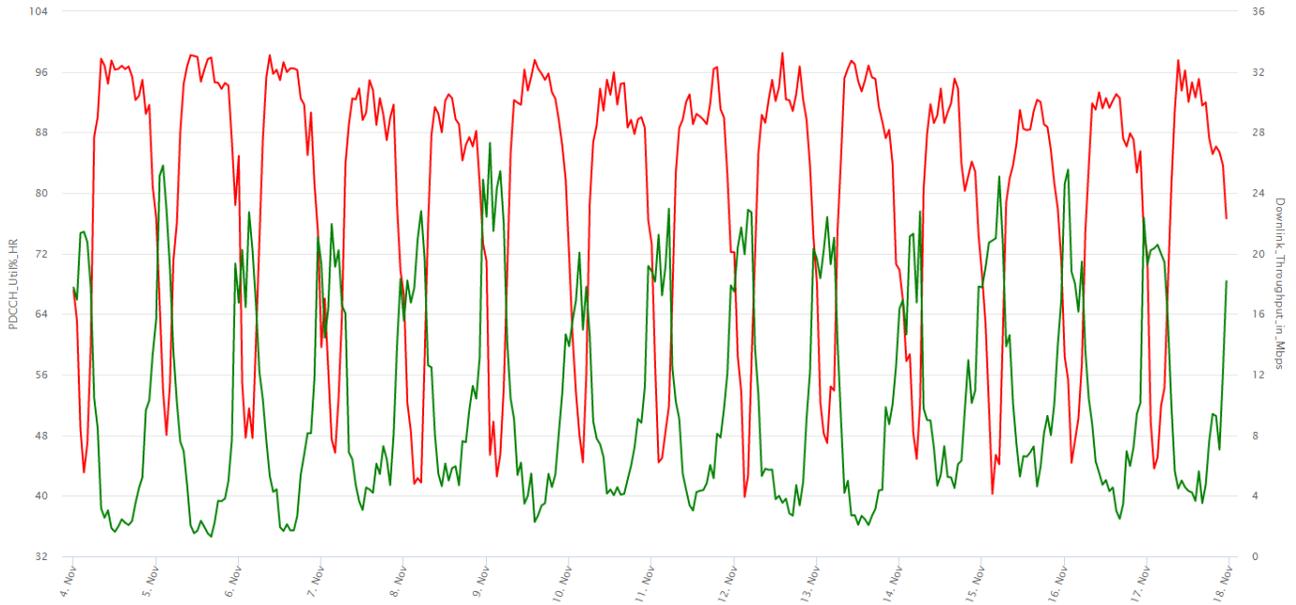
When PDCCH use approaches 100 percent – typically between 11:00 a.m. and 5:00 p.m. daily – data throughput correspondingly dips as low as two Mbps. Customers already connected to the network experience delays and poor service, while customers attempting new connections are unable to access the network.

Low downlink data throughput particularly compromises data-intensive functions including voice calls and streaming data and video. These services can be critical to first responders communicating between ambulances and hospitals and for fire response and real-time criminal identification. This data evidences the need to provide a new facility closer to the gap area.

PDCCH Use v. Data Throughput
Petaluma Facility West-Facing Antenna Sector
November 4-17, 2020
Low-Band Data (700 MHz and 850 MHz)



High-Band Data (AWS and PCS)



- Percent of PDCCH use
- ◆ Downlink data throughput in Mbps

Conclusion

As cellular networks mature, the network must be supplemented with more sites closer to customers, in part due to the increase in demand on the network. The LTE technology used by Verizon Wireless to provide fourth-generation service requires facilities closer to customers, and this service cannot be provided adequately by the distant facilities serving the gap area. These coverage challenges result in the Significant Gap in Verizon Wireless LTE coverage in the south Petaluma area. Verizon Wireless must deploy the Proposed Facility to provide reliable LTE service to customers and to avoid further degradation of its network in the area of the Significant Gap.

Please feel free to contact me with any questions or comments regarding Verizon Wireless's proposed facilities.

Respectfully submitted,



Snehil Tiwari
RF Design Engineer
Network Engineering Department
Verizon Wireless

My responsibilities include planning, design and implementation of improvements to network infrastructure to provide reliable service. I have over 17 years of experience in the wireless communications industry, with proficiency in various planning, design and optimization tasks for wireless networks. I received my Master's degree in electrical engineering from the State University of New York at Buffalo.