Max Throughput in 20 MHz with MU-MIMO

Scorch Communications in New Zealand Deploys PMP 450m to Deliver Maximum Throughput in Minimum Spectrum

> "Customer demand for bandwidth is high and growing. Spectrum is becoming scarce. With PMP 450m we were able to dramatically increase throughput in a narrow 20 MHz channel, positioning us to fulfill continuous demand."
>
> - NICK RINGDAHL, NETWORK OPERATIONS MANAGER, SCORCH COMMUNICATIONS

Challenge

SCORCH COMMUNICATIONS PROVIDES CONNECTIVITY FOR BUSINESS AND residential customers throughout New Zealand's greater Canterbury region. Well-versed in multiple technologies, Scorch has been satisfying their customers for more than a decade. To stay at the top of their game, Network Operations Manager Nick Ringdahl and his staff constantly monitor customer data usage trends and network performance. As end user needs evolve, the Scorch team tracks and tests the latest improvements in available technology.

"We have a very dense site with very little available RF spectrum," said Ringdahl. "Our customers are streaming video and making VoIP calls. Even just a few years ago, this would mean that we'd need to install another radio. Now, with available RF spectrum at a premium, we were becoming locked in with rising demand, but no spectrum to support capacity increases."

Customer satisfaction issues were starting to appear during peak periods for streaming video on YouTube and Netflix. The existing Access Point (AP) with its 20MHz wide channel struggled to handle the load in the unlicensed 5.7 GHz spectrum. Given the population of APs, there was just not enough spectrum available.

"If anything, our customers were glad to pay for more throughput for VoIP and streaming video," says Ringdahl. "We defined our aim to increase service delivery levels and allow further expansion of the site within the same 20 MHz channel."

Scorch had tried some technologies in other locations with the same results: services were adequate, but without synchronization they simply could not scale the network to meet present or future demand.

In addition, after having already made an investment in their current Cambium PMP 450 network equipment, the cost and labor of a complete replacement was prohibitive.

Solution

SCORCH THEN CHECKED OUT CAMBIUM'S NEWEST RELEASE, PMP 450M WITH CNMEDUSA™ Massive MU-MIMO (Multi-User Multiple Input, Multiple Output) technology, an AP that

interoperates with existing PMP 450 Subscriber Modules (SM). PMP 450m – with integrated beam forming antenna array and 14 dual polarity transceivers, has the ability to communicate with up to 7 SMs simultaneously – dramatically increases sector capacity while utilizing existing subscriber deployments and operating in the same 20 MHz channel width.

The PMP 450m can deliver more than 400 Mbps of actual throughput in a 20 MHz channel. This equates to an industry-leading 20+ bps/Hz, and over 40 bps/Hz when deployed in frequency re-use configurations.

Scorch decided to put the system through its paces. One single PMP 450m AP was installed in a trial environment to replace an existing PMP 450 AP.

Scorch used Cambium Networks' free LINKPlanner software to map out their existing PMP 450 subscriber connections and then plan the migration to a PMP 450m AP, including checking overall predicted customer signal levels for any possible issues before equipment was installed. LINKPlanner also let Scorch compare real world before/after results for each subscriber to ensure maintenance of overall signal to the end users – field measurements matched predicted readings exactly.

The PMP 450m AP is currently servicing a sector with 55 live customers.

PMP 450m Access Point with cnMedusa Massive MU-MIMO technology	
Frequency	5.150 – 5.925 GHz
Throughput	More than 400 Mbps in a 20 MHz channel
Synchronization	GPS Synchronization

PMP 450 and 450i Subscriber Modules	
Frequency	2.4, 3.5, 3.65, 4.9 – 5.9 GHz
Throughput	125 Mbps in a 20 MHz channel
Synchronization	GPS Synchronization

Results

BELOW ARE SNAPSHOTS FROM SCORCH'S LINKPLANNER SOFTWARE PERFORMANCE SUMMARY. THE FIRST chart shows performance for the PMP 450, the second shows performance of the PMP 450m, and the comparison demonstrates the 3X improvement in throughput.

Performance Summary (ITU-R)

View in Spreadsheet

SMs per DL modulation

x8 (256QAM MIMO-B)	0	0.0%	0.00 Mbps
x6 (64QAM MIMO-B)	2	3.8%	0.59 Mbps
x4 (16QAM MIMO-B)	4	7.7%	1.19 Mbps
x2 (QPSK MIMO-B)	16	30.8%	4.75 Mbps
x4 (256QAM MIMO-A)	0	0.0%	0.00 Mbps
x3 (64QAM MIMO-A)	0	0.0%	0.00 Mbps
x2 (16QAM MIMO-A)	0	0.0%	0.00 Mbps
x1 (QPSK MIMO-A)	30	57.7%	8.90 Mbps
Total	52	100.0%	15.43 Mbps

SMs per UL modulation

x8 (256QAM MIMO-B)	0	0.0%	0.00 Mbps
x6 (64QAM MIMO-B)	1	1.9%	0.06 Mbps
x4 (16QAM MIMO-B)	3	5.8%	0.17 Mbps
x2 (QPSK MIMO-B)	6	11.5%	0.35 Mbps
x4 (256QAM MIMO-A)	0	0.0%	0.00 Mbps
x3 (64QAM MIMO-A)	0	0.0%	0.00 Mbps
x2 (16QAM MIMO-A)	0	0.0%	0.00 Mbps
x1 (QPSK MIMO-A)	42	80.8%	2.44 Mbps
Total	52	100.0%	3.02 Mbps

Total Mean Predicted Throughput

x8 (256QAM MIMO-B)	0.00 Mbps
x6 (64QAM MIMO-B)	0.65 Mbps
x4 (16QAM MIMO-B)	1.36 Mbps
x2 (QPSK MIMO-B)	5.10 Mbps
x4 (256QAM MIMO-A)	0.00 Mbps
x3 (64QAM MIMO-A)	0.00 Mbps
x2 (16QAM MIMO-A)	0.00 Mbps
x1 (QPSK MIMO-A)	11.34 Mbps
Total	**18.45 Mbps**

PERFORMANCE OF PMP 450

▦ View in Spreadsheet

SMs per DL modulation			
x8 (256QAM MIMO-B)	0	0.0%	0.00 Mbps
x6 (64QAM MIMO-B)	0	0.0%	0.00 Mbps
x4 (16QAM MIMO-B)	12	23.1%	12.05 Mbps
x2 (QPSK MIMO-B)	38	73.1%	38.16 Mbps
x4 (256QAM MIMO-A)	0	0.0%	0.00 Mbps
x3 (64QAM MIMO-A)	0	0.0%	0.00 Mbps
x2 (16QAM MIMO-A)	0	0.0%	0.00 Mbps
x1 (QPSK MIMO-A)	2	3.8%	2.01 Mbps
Total	52	100.0%	52.21 Mbps

SMs per UL modulation			
x8 (256QAM MIMO-B)	0	0.0%	0.00 Mbps
x6 (64QAM MIMO-B)	19	36.5%	4.24 Mbps
x4 (16QAM MIMO-B)	31	59.6%	6.93 Mbps
x2 (QPSK MIMO-B)	2	3.8%	0.45 Mbps
x4 (256QAM MIMO-A)	0	0.0%	0.00 Mbps
x3 (64QAM MIMO-A)	0	0.0%	0.00 Mbps
x2 (16QAM MIMO-A)	0	0.0%	0.00 Mbps
x1 (QPSK MIMO-A)	0	0.0%	0.00 Mbps
Total	52	100.0%	11.62 Mbps

Total Mean Predicted Throughput	
x8 (256QAM MIMO-B)	0.00 Mbps
x6 (64QAM MIMO-B)	4.24 Mbps
x4 (16QAM MIMO-B)	18.98 Mbps
x2 (QPSK MIMO-B)	38.60 Mbps
x4 (256QAM MIMO-A)	0.00 Mbps
x3 (64QAM MIMO-A)	0.00 Mbps
x2 (16QAM MIMO-A)	0.00 Mbps
x1 (QPSK MIMO-A)	2.01 Mbps
Total	**63.83 Mbps**

PERFORMANCE OF PMP 450M

Actual performance of equipment in the field matches the above predictions. Over a 24-hour period, the system provided a maximum capacity of 60 Mbps of throughput.
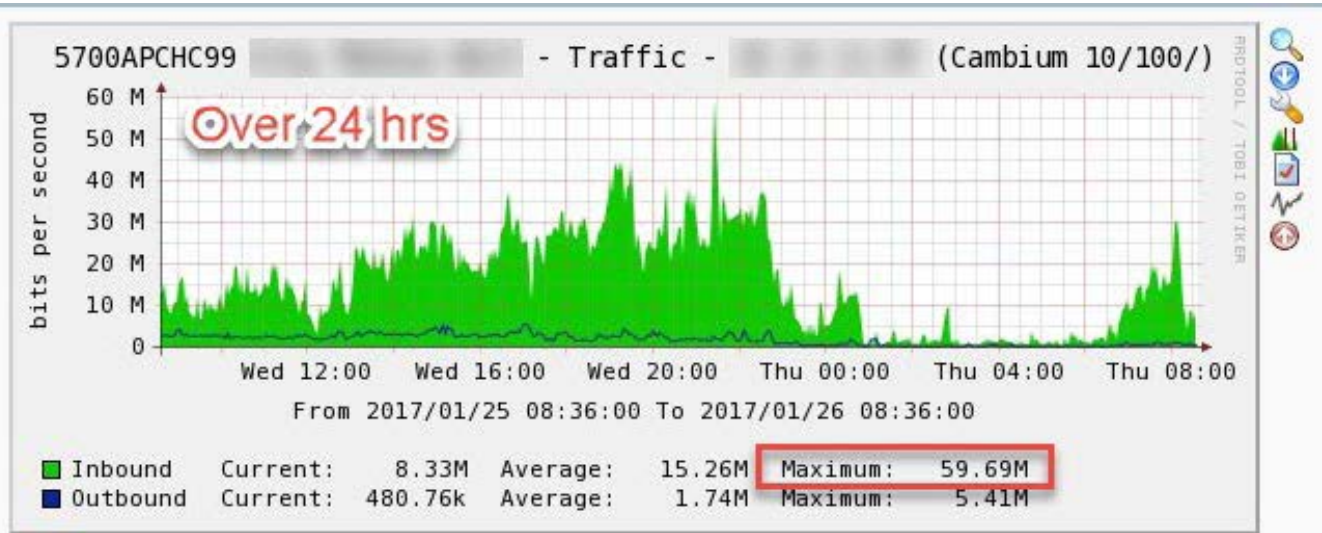
Even during peak demand evening hours, seen highlighted below, the system consistently provided 60 Mbps of throughput.
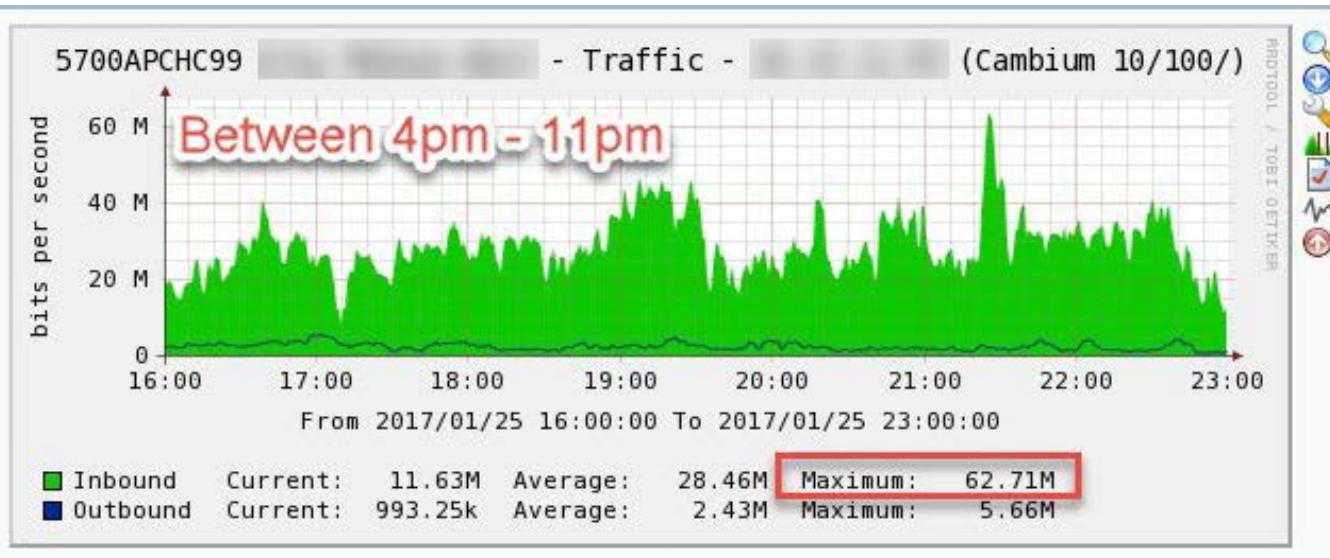
"Simply outstanding," says Ringdahl. "With the new PMP 450m replacing the old AP, we made no changes to any subscriber equipment, and video streaming now results in less buffering and more overall bandwidth fairness being made available to all subscribers, especially during peak periods. The primary gain has been our ability to increase the customer density on the new PMP 450m AP while under the same 20MHz channel."

"Where previously we were reaching the upper 90% of frame utilization during heavy peak evenings, the packet discards now tell a very different story with the overall discarded packets being as low as 0.5% over a 40-day period," said Ringdahl. "We've seen no indication that the PMP 450m AP is reaching capacity and have confidence that we can continue to increase the subscriber module density. This is a great result for us on a 20 MHz channel."

"Another significant improvement is that the Link Test for Multiple VCs now shows us that even in a peak loading situation, the PMP 450m AP gives a much more balanced bandwidth allocation for all subscribers. This results in fewer customer service issues during heavy peak evenings when all subscriber modules are concurrently using bandwidth."

On the aggregate level for the network, VoIP call quality has been maintained while Scorch continues to expand the site further, and they now plan to migrate their older network of PMP 100 equipment onto the new PMP 450 architecture, maximizing connectivity and revenue for the RF resource commitment while still using a 20 MHz channel.

"We're a long time Cambium user and have seen the technology proven over the course of many years. Our ability to use GPS sync is a major win. With PMP 450m, we can provide business and residential customers the connectivity they need, while adding new customers to grow the subscriber base. That's good business for us, but what makes it great business is that we're doing it all in the same 20 MHz of spectrum."

About Scorch Communications

www.scorch.co.nz

Scorch Communications (Canterbury) Ltd is an established services company with extensive backgrounds in Radio Communications and the IT Industry, deploying technology that provides reliable and affordable broadband services to the rural market throughout Canterbury, New Zealand and the surrounding areas.

Why Scorch Communications chose Cambium Networks

• **Scalability –** Supporting connectivity demand as the network grows.

• **Spectral Efficiency –** Transmitting the most data in the least amount of available RF spectrum.

• **High quality of service -** Providing consistent service as new cameras and capabilities are added to the network.