Cambium Networks

ePMP 3000 Field Experiences

Cambium Networks conducted a round-table discussion and webinar with two Wireless ISPs (WISP) actively deploying the ePMP™ 3000 product line in their operation. A transcription of the discussion is below. A video of the entire webinar is available at this link. The transcription has been edited for clarity and brevity but the content has not been changed.

Attendees:

- Giuseppe Socci, Network Administrator, Dimensione, a WISP in Italy
- Matt Larsen and Drew Wicker, Vistabeam, a WISP in the United States
- Sakid Ahmed, VP of ePMP Business, Cambium Networks
- Bruce Collins, Director of Product Management, Cambium Networks

Giuseppe: Hello, everyone. I'm the Network Administrator at Dimensione. We are in Italy. We are in the market since 2007. We are operating in four Italian regions: Molise, Abruzzo, Puglia and Campania. And we have now about 10,000 customers using our services. Not only residential customers but also businesses and many municipalities.

Matt: Vistabeam has been in business since 2004. We serve some very rural areas of Colorado, Nebraska, and Wyoming. We're about 4,300 wireless subscribers right now. Most of our customers are residential but we have about 20% commercial and small business customers on our system.

Bruce: Can you give us a some background on how you're using the ePMP 3000?

Matt: Well, we've got some greenfield deployments where we've got either all ePMP 3000 access points (AP) and Force 300 series Subscriber Modules (SM). We also have greenfield deployments where we've mixed PMP 450m facing the more populated areas in town, and the ePMP 3000 faces the rural areas.

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We've also gone back through our existing network where we've had capacity issues with either ePMP 1000 or 2000 and replaced those access points with ePMP 3000. So, we have a complete mix of Force 200, elevated radios, Force 300 and even ePMP 1000 SMs, all connected to the new 3000 access points.

Sakid: So, in the ePMP 3000 greenfield deployment, what is the average number of subscribers you have on an access point?

Matt: About 25 or 30 is the maximum number we've got so far.

Sakid: So, 25 to 30 per sector, are you planning to put more? Are you watching your utilization on that AP? Are you offering higher bandwidth packages? What is the new lay of the land once you put up e ePMP 3000s?

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Matt: So right now, we're offering 25 and 50 Mbps packages. We're hoping to have some 100 Mbps packages that we'll offer in select areas, especially if we've got all ePMP 3000 series SMs and access points and enough fiber backhaul to carry the traffic. We will continue to load it up until we see our frame rate get high, and we'll find out where it ends up at that point. But right now, we're pretty comfortable with 35 to 40. Once we start getting beyond that we'll look at performance and kind of see where it's at.

We've certainly seen increases in capacity, changing from the ePMP 1000 to the ePMP 2000 and then to the ePMP 3000. We previously had access points that we had closed off for new sales that we were able to open back up and onboard new customers. Honestly, we realy haven't watched MU-MIMO really closely. But we are seeing increases in capacity and we're able to onboard new customers and deliver an acceptable level of service to them. It must be working.

Sakid: Right. As operators deploy more of our ePMP Force 300 series subscribers, there are two ways to monitor the capacity of network and how the ePMP technology is handling the increased load.

First, when you have a decent enough separation between SMs, you can go to the monitor wireless page and look at the groupable STA column. You should start seeing increasing numbers, which indicates that for a particular SM, there are more numbers of SMs that could be grouped for MU-MIMO.

Second, look at the throughput chart graph. There is a MU-MIMO gain performance meter. And I want to remind everybody that at the end of the day, getting MU-MIMO grouping is just one aspect. You also need to have data to push. You need those group subscribers to be asking for data at the same time for the algorithms to kick in and do multi-user MIMO.

As the number of customers grows and the package offerings are higher, it becomes a reality. Although I have seen that, in a lot of cases, operators are offering larger packages. But that doesn't necessarily translate to more data demand from residential users. Everybody likes the idea of 100 Mbps packages but the average household rarely pulls anywhere close to 100 Mbps, so that's an interesting thing to watch.

Bruce: Let's swing back to Giuseppe, how are you deploying ePMP 3000 today, what kind of services, packages, etc.?

Giuseppe: We started with ePMP 3000 equipment about six months ago with some beta testing. We have now more than 25 ePMP 3000 access points. And I can't say which is the limit for now because we haven't reached that yet. But we have some sectors with more than 40 users which are at very low frame usage on 20 MHz channel. I'm very curious to see how many users we can put in there.

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We saw better latency, even for 802.11n clients in backwards compatibility, and better sensitivity. We can achieve higher modulations with the same signal. We are now connecting both 11n and 11ac subscribers on the same sector without having performance loss. We also tested greenfield with very good performance. We saw about 100 Mbps, or sometimes more, on greenfield deployments. We also saw very good upload performances even if there is no beamforming uplink, for now, thanks to better sensitivity of the radio. So, for us, the experience is very positive.

Bruce: Okay. And are you using any of the Elevate capabilities?

Giuseppe: No, we didn't use Elevate since we prefer to use only Cambium Subscriber Modules because of their radio quality. So, we didn't use Elevate.

Bruce: Remind me the packages that you're offering to your residential users?

Giuseppe: We start with 10 Mbps package, and we are offering up to 30 Mbps packages to residential customers. We offer up to 50 Mbps to business customers and sometimes even more if they ask for more bandwidth. You asked about multi-user MIMO - we saw a good multi-user MIMO grouping. I can see a good part of the traffic to be in multi-user MIMO mode during peak hours, in particular during streaming of football events. I tried to also generate some traffic using customers' routers, and I can see multi-user MIMO kicks in doing about even 200 megabits per second of real TCP throughput. And I can't say too much about actual gains from 3000 because I have to put more users on sector to push their limits. But this seems to be very promising for us.

Sakid: Giuseppe, how are you monitoring AP throughput consumption? Are you looking at some tool or your core router?

Giuseppe: We are monitoring by using our routers and our internal system. We developed some internal software to monitor everything. We monitor using SNMP and with routers for bandwidth consumption during peak hours and so on.

Bruce: Switching back to the guys from Vistabeam. Which particular models are you using with the 3000? Are you standardizing on a particular Force 300 model, or do you use different models in different situations?

Matt: We primarily use three models: The Force 300-16, the Force 300-25 and then the connectorized SM, the CSM. Given the distance of a lot of our customers from the access point, we've used a lot of the connectorized SMs. We've had some really good success with that model.

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Bruce: What makes you decide when to use a 300-16 versus a 300-25? Do you take both out to the field in the truck, or do you decide ahead of time that "I'm going to need to use this one for this location?"

Matt: We have a rough idea based on just the distance from the customer to the access point. However, we do carry both models in the truck. And based on the noise floor, sometimes we've had to upsize the antenna to try to create a better signal to noise ratio. So, it's really not static between different towers. It really depends on the noise level.

Bruce: With the latest release of software what's the reliability been with your network?

Matt: It's been pretty good. It has fixed a lot of the issues that we had on earlier firmware versions. We have been having some GPS sync issues. We've got a small sample of our access points losing GPS sync and then disconnecting the customers. So, hopefully, that clears up soon. It's not across the board, but it's more than we'd like to see.

Giuseppe: During the beta testing, as you can expect from development software, reliability wasn't like it is now. We had some issues with disconnections and some crashes, but it was normal and expected. Initially we tried the ePMP 3000 equipment on some selected users. But when we saw a reliable platform with early 4.3 build framework, we did some greenfield sectors with new customers with great results in terms of performance and reliability.

Starting from release 4.4, I can say we have great stability on mixed environments, so not only in greenfield environments. We started to move users, real users on 3000 and started to replace some subscriber modules with 300-16 and 300-25, for customers with a lot of internet activity to benefit from higher modulations and multi-user MIMO support. We are now having great results and no issues at all. Our experience is positive.

Sakid: Zero-touch from cnMaestro™ is back in as well as some additional stability fixes. And then soon after that, we'll have a 4.5 beta release out as well with additional features.

Bruce: What is your process when you take a new subscriber module out of the box? What do you do to set it up and take it to the field and install it? Essentially, can you summarize your provisioning process?

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Giuseppe: We are using custom software we developed internally to provision our new customers, and it provides to the installer all the information about the sector he's connecting to. This helps the technician choose the best sector based on its current load and aim the antenna correctly, calculating which signal he should have based on its position cached from GPS. Then it can automatically push the correct configuration export with the user data to the subscriber modules.

Bruce: When you go out do you have a modulation mode in mind for that SM, or do you set some parameters for the installer to say "I want to get at least this signal level" or do they have a target signal level?

Giuseppe: We have some target signal level based on the profile the user is activating. So, for 10 megabits there is one signal, for 20 megabits there is another signal target level, and so on. So, depending on the package the user is activating we require more signal at the time of installation.

Bruce: And do you have customers ask for an upgrade package? They start out on 10 Meg and then ask to get more, or do they generally stay with what they initially purchase?

Giuseppe: We are constantly having users asking for upgrades. Our installers try to put new customers on the highest signal level as possible. We can do upgrades without having to go to the customer.

Bruce: And then for new installs where you have an ePMP 3000 access point deployed, are you only using Force 300 SMs or are you still installing the Force 180 or Force 200 on those as well?

Giuseppe: We decided to go forward with only Force 300 SMs both for 3000 AP and 2000 AP. No more 802.11n SMs for us.

Bruce: A similar question to the team from Vistabeam. What is your provisioning model and a little background on what your approach is to procure SMs and select SMs going forward?

Drew: As far as the provisioning model for our 50 Mbps packages, we're requiring at least an MCS 9 or better. For our 25 Mbps packages, we tend to get MCS 5 or higher. And then as far as SMs, we've stopped buying Force 200 completely as well. We're deploying all Force 300 whether it be a 1000, 2000 or 3000 access point.

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Bruce: I think we're at that pivot point where compatibility mode is making that an easier decision. Another question specifically to you, Matt, you mentioned that you're using the CSM. Which particular antennas are you using with that and when do you decide to go with the CSM versus the 25?

Matt: We're using the parabolic dishes from KP Performance. And we're also using the UltraDish from RF elements. We use whatever antenna we need to create the modulation rates that we're requiring. So, if it's a 50-megabit package and we're requiring at least an MCS 9, we'll use whatever antenna we need to create those conditions. We've had some very close shots in town where it's extremely noisy where we've had to use the horns.

We also have rural deployments where we have customers successfully connected out at 10 miles or more on that 50-megabit package with appropriate modulation rates and signal to noise ratio. It really just varies from situation to situation.

Sakid: On that front, since you guys are very rural, Wyoming, Nebraska, Colorado, what is the average deployment distance in their network?

Drew: The distance varies. In some places where we have a more dense population, our radius of coverage will be in the three- to five-mile range. When we get out into some more rural areas, we've actually successfully connected people up to 10 miles as long as we've got a connectorized subscriber module with either a dish or a large grid attached to it. The furthest we have is a test of a 50 Mbps connection at about 10 miles. That was actually with an ePMP 1000 connectorized SM before we had access to the 300 series connectorized SM.

We're hoping to do some 10-mile radius in a few low-density locations. We've got an access point in the right location — if we've got something that's up on a hill and visible from a long ways away, then we'll look at doing the larger radius. I wouldn't necessarily count on it in all situations, it has to be fairly rural and there shouldn't be a lot of noise in the area in order to support the speeds that we want to offer, but we have been able to do it.

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Sakid: A follow-up question for both of you: Do you see a place for the ePMP 3000L in your network? Maybe Vistabeam can go first.

Drew: Yes, absolutely. We've already begun deploying the ePMP 3000L. We've deployed it on Omnis in a very rural area where we've got very few customers within a five-mile radius. We deployed it to fill in some gaps in coverage in town on a water tank or something like that.

Matt: We're probably going to be deploying a lot of them where we have these little piers that go out into the middle of very rural areas. And we were in CAF (Connect America Fund) areas, in a couple of counties that we have to serve a very low customer density, where within five miles there might only be five or six possible customers. So, those are places where we're probably going to deploy a lot of the ePMP 3000L APs. They will probably not get overloaded at any point in the next 10 years. So that's where we're going to be doing quite a few of those.

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Bruce: Giuseppe. Are you guys using that?

Giuseppe: Yes. We have deployed 3000L on small sectors, and we saw good performances from higher modulations and latency. Latency is lower than 2000 and 1000. So, in some places we are replacing, and in some we are using 1000 radio with 3000L radio.

Bruce: I guess a similar question on the subscriber module side, if you're going out on a new tower, it sounds like you're putting up a 3000 or a 3000L. Are you deploying any more 2000s at this point?

Giuseppe: For us, no, we are deploying only ePMP 3000 and ePMP 3000L.

Bruce: ePMP 300 is a two-by-two access point. So, it doesn't do the MU-MIMO capability that the full ePMP 3000 has. But it still has some of the capabilities that the 802.11ac wave two technology brings. And it's IP67-rated. It's quite capable with the horn antennas, or as Matt and Drew said, on an Omnidirectional antenna.

Bruce: How do you decide which access point to put a subscriber module on if you have a 450m and an ePMP 3000 on the same tower?

Drew: Basically, we point the 450m into the area that has the most potential customers in it. So, for example, we have a tower in one of our CAF-2 areas and we analyze the locations. One direction had several hundred locations versus the other three directions that all had less than 50. For the three directions that didn't have as many potential locations, we use ePMP 3000, and for the one that had a lot more we used the PMP 450m. In that scenario, 450m is available in one direction, and 3000 is available in the other direction. We do have to make sure our installers know what is actually available. We're also seeing really good performance out of the 450m.

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Sakid: What would be the two things in your mind that's the most important for you to continue successfully rolling out this product?

Giuseppe: My first request is about latency. We would like to see a lower latency on the ePMP platform. This is a highly requested feature from our users, so this is the same for us. And another thing that would be nice to see is more bandwidth on the same channel. But there is a physical limit, so not much more.

Sakid: So, yours are latency because you're gaining customers and then whatever we do to squeeze more bandwidth out of the same channel bandwidth. Got you.

Giuseppe: Yes, latency is very important for us. We have lots of gamers, so they always ask for lower latency on our network. Or we can do this with backbones and so on, but on the ePMP platform, we can see 10 to 15 milliseconds. It's the part where there is more latency.

Sakid: Right. So, 2.5-millisecond frame support will be there in 4.5 release, and that one will reduce some latency while sacrificing a tiny bit of throughput. But I will also say that overall, the ePMP scheduler is designed in a massive point-to-multipoint system to keep the TCP throughput relatively high, but in some cases sacrificing latency. So, that's why we have things like ability to lock the highest modulation so that we don't keep trying and retransmitting packets to get a higher throughput.

We will elaborate more on that in the future. But I think we're going to start taking a look at how to present an option where you can optimize latency when it's important and sacrifice throughput and vice versa. So, just a tunable item.

Giuseppe: Sure. It would be great, but 3000 has already a better latency than 2000. So, I can see the improvement.

Sakid: Right. Matt, did you guys have a couple of items that you wanted to highlight?

Matt: So one, I think it would be helpful if we had some better tools to figure out how to manage the MU-MIMO and to figure out how to do the groupings better. And second, if there was a way to collect RF temperature of different channels of spectrum over a period of time, it would be useful to help us figure out when there's interference or select the most optimal channel for us to use.

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I think it'd be nice to have some tools like that to help with planning. Despite the fact we're in rural areas, we have some very, very crowded RF. We're rural enough that there have been a lot of wireless ISPs. And being able to figure out the best channel to operate in and how to optimize to get the most performance out of that channel would be helpful. The platform seems to be really good as far as being tolerant of interference and scaling up. It would be nice to have some more tools to optimize.

Sakid: So, on the first one, Matt. I'm not sure if you're aware but go ahead and take a look at our download section on the support website. There's a capacity planning tool that has been updated for 3000. Between the link planner and the capacity planning tools, you can start understanding MU-MIMO capacity and how to plan your network. So, take a look at that capacity planning tool, I think it'll be quite helpful to set you in the right direction.

And the second comment, I understand it, and I think that, to some extent, there's a Holy Grail solution where every SM and AP can collect interference information over time and give you recommendations. But in the short term, we'll start thinking whether there's some type of background scripts that can run a downtime for SMs to also go into spectrum analyzer mode, collect the information and send it to something. So, it's certainly an interesting problem to solve. So, thank you for those.

Bruce: We're coming close to the end here, so I'll open the floor to you, Giuseppe Where do you see your growth coming from in the future, and what are the challenges that you see in achieving that growth?

Giuseppe: I think our main challenge today is regarding 5 GHz spectrum and interference. There isn't so much space in this unlicensed band. It's difficult for us to reach high modulations to offer more bandwidth. So, licensed operators with LTE and other technologies are also our competitors. We are competing with fiber providers, which are offering plans up to 200 megabits per second here. But our biggest advantage over them is our support, reliability and quality of the networks thanks to the ePMP platform.

And our network is all under our complete control. We are very fast in solving equipment failures, and that's very appreciated by our customers. I'm optimistic about the future because fiber is an opportunity to bring more bandwidth to the towers. So, in the future, we can offer higher speed to customers using the ePMP platform and and benefits from multi-user MIMO from ePMP 3000. We are constantly reducing sector distances from our users. So, we can achieve higher modulations and use wider channels. So, we can do higher speed to users.

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> "Up until about a year and a half ago, we didn't have any Cambium deployed in our network. And now we're up to about probably 40%, 50% of our network is Cambium. And that's the direction we're going in for all of our future deployments. And I think what we've seen is the fact that, you know, we're able to get some faster speeds out there. And one of the big things we're trying to get to is to deliver at least 25 Mbps speeds to all of our customers."
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Bruce: Matt, Drew, comments for the future?

Matt: I think it's interesting to point out before I talk about the future, just the fact that we were not a Cambium shop up until about a year and a half ago. We didn't have any Cambium deployed in our network. And now we're up to about probably 40%, 50% of our network is Cambium. And that's the direction we're going in for all of our future deployments. And I think what we've seen is the fact that, you know, we're able to get some faster speeds out there. And one of the big things we're trying to get to is to deliver at least 25 Mbps speeds to all of our customers.

We have a very, very rural area, so there are not a lot of choices for service. One of the things we're trying to do is to make sure we can get as much of that out to as many people as possible. Then we start filling in the faster speeds in areas where we've got more backhaul.

We feel like the Cambium platform is the right one to be able to get that speed out to some very, very rural places that haven't had very good choices, or very many other alternatives. That's the direction we're going in. Then we'll definitely try to do some more of the higher speed services in the denser areas. But the main thing for us is extending that 25 Meg out as far out as we can get, and then filling in the places where there's more demand for it.

Bruce: Thanks for the endorsement and for coming on board as a Cambium customer. We really do appreciate that as we continue to develop these products.

Thanks for joining the webinar.