Building the small-cell backhaul toolkit for mobile operators

**A conversation with
Greg Friesen,
Vice President of Product
Management, DragonWave**

**By Frank Rayal
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Frank Rayal. Hello and welcome to this conversation with Greg Friesen, Vice President of Product Management at **DragonWave**. My name is Frank Rayal. This conversation is part of Senza Fili's report on small-cell backhaul that gives an update on small-cell backhaul solutions and on the evolution of the mobile operator requirements for small-cell backhaul.

Today we are talking with Greg Friesen at DragonWave, a leader in microwave backhaul solutions used by carriers and in other market verticals as well. Greg, thank you very much for joining us in this conversation on small-cell backhaul.

I would like to kick this off by asking you to give us an overview of DragonWave and more detail about your solution for small-cell backhaul.

Greg Friesen. Thank you very much, Frank. DragonWave, as you mentioned, is a leader in microwave backhaul, and we have products from the 2 GHz band all the way up to the 80 GHz band. We have historically focused on all-outdoor and packet microwave systems, and have expanded on those in recent years with hybrid capabilities and split-mount systems as well. We focus on mobile operators, but also have a large customer base in enterprises and vertical market, as well.

Small cells have been a strong focus of ours over the past year or two. We have a number of products that have been announced over the past two years. The first was our Avenue Link, which is a very small, compact product with an integrated antenna in the 24–60 GHz range, delivering over 500 mbps full duplex of capability. Next product, which we have just recently introduced, this year, is the Avenue Link Lite, which is our sub–6 GHz point-to-point product, also in a very small, integrated package with antenna, available in the 2.3 to 5.8 GHz, licensed and unlicensed bands. We view that as an important addition to the portfolio. Where the Avenue Link has a very high capacity for aggregation links and sometimes for access links, the Avenue Link Lite is a very good complement to that by providing non-line-of-sight and near-line-of-sight capabilities when obstructions are in the path, to help increase the network coverage.

Frank Rayal. Can you give us more details on the Avenue Link product in terms of performance metrics and other important parameters?

Greg Friesen. In terms of performance capabilities, the Avenue Link is in the 24–60 GHz band. Reach capabilities depend on the band, but can go anywhere from 500 meters to a couple of kilometers. Capacities are in excess of 500 mbps, with support for up to 2048 QAM, varied low delay at 0.1 milliseconds, full Ethernet OAM capabilities, and compression capabilities to further increase the traffic capacity beyond that 500 mbps. There is a bulk compression capability as part of the Avenue Link.

Frank Rayal. The licensing regime for spectrum in the 60 GHz band is very different from the lower bands, and maybe some features of the product may be different. Can you elaborate on that?

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Greg Friesen. Yes, certainly the 60 GHz licensing regime in most places is an unlicensed band, so there are obviously benefits to that, in that it means that you can deploy very quickly and rapidly and you don't have to acquire spectrum. There is no annual cost, and it helps improve the economics. The downside, of course, is that there can be interference; however, the interference environment is much different than that in some of the more traditional unlicensed bands, like 5.8 GHz, in that in the 60 GHz band there isn't broad consumer use today. The beam width is very narrow and, in addition, the propagation distance is quite short because of the high air loss in this frequency band. So there is much less frequency and interference concern in this band than in other unlicensed bands, and then there is much more spectrum, but nonetheless it is still something that has to be engineered around.

Figure 1 Avenue Link (24 – 60 GHz)

Figure 2 Avenue Link Lite (sub-6 GHz)

Frank Rayal. How does your technology compare to solutions from other vendors in the 24–60 GHz bands?

Greg Friesen. I think that one of the key things in all of those bands is that we developed and integrated a 5-inch antenna to have a very small, compact footprint. We believe that it is very important in terms of deployability.

We support up to 2048 QAM at some of those lower bands, and 512 QAM at the 60 GHz band, which is industry-leading in this space. We also support the only bulk compression engine which can provide 30%-plus of capacity gain, so we feel that we are quite differentiated in terms of capacity capabilities that also can enable you to use lower modulations, because

you've got the compressor, which can help you increase your reach capabilities.

Frank Rayal. I am curious, does the data compression work on a per-traffic type, or on all the data at the same time?

Greg Friesen. It is assignable per traffic. Basically, there are four compressors, and you can assign each of your four queues to a compressor to be compressed or not be compressed, or to different compress settings.

Frank Rayal. Can you address the different versions and capabilities you have on the Avenue Link Lite and the sub–6 GHz product?

Greg Friesen. The Avenue Link Lite is targeted more at the last mile of the microcell network. It has capacity capabilities up to 230 mbps and it supports near- and non-line-of-sight deployments. It is fairly low-latency as far as TDD systems go – 1 to 2 milliseconds latency for the system. Some of the things we have built in, to differentiate, and are focusing on are, of course, the delay and minimizing the packet delay variation. We do cut-through prioritization for timing packets, and we also support 1588 transparent clock and synch E, both of which we believe are quite important for deployment of LTE and LTE-TDD networks.

Frank Rayal. Now if you can address the frequency bands, because I think I heard you saying that you have the product in the 2 GHz bands in addition to the 5GHz band.

Greg Friesen. That is right. We've just released the product. The first band we are releasing that is just becoming generally available is the 5 GHz band. So 4.9–5.8 GHz, and the next band, which we will be releasing early fall, is the 3.5 GHz, and we will be following that up with the 2.3–2.6 GHz bands at the end of the year.

Frank Rayal. What is the maximum channel bandwidth that you can do in that product?

Greg Friesen. We support user-selectable channel bandwidths from 5 to 40 MHz.

Frank Rayal. What are you hearing from the operators on deployment issues, and how do the products you have address the deployment issues?

Greg Friesen. Well, I think one of the things we are hearing is that it is not one-size-fits-all, at all, in terms of small-cell backhaul, and that is why you can see that we have pretty wide breadth of products and solutions. Some operators own 3.5 GHz spectrum, so that can be something very attractive to them. Some own 2 GHz spectrum, some are willing to deploy unlicensed and others are not, and that may be 5.8 unlicensed or perhaps 60 GHz unlicensed, and then some have bands in the 24–38 GHz bands. Some may have 26 GHz spectrum or 38 GHz spectrum, and a lot of that will vary by market and even location in the market.

Operators are looking to us to provide a complete solution that they can use in many areas of their network, and that means more than just a good 60

GHz product or just a 5.8 GHz product, but a wide tool kit and solution set that can help them deploy a wide network in many areas.

Frank Rayal. I think that is going to be one of the major challenges in terms of scaling small-cell deployments. Different solutions have to be deployed in different scenarios, so how do you help the operators in terms of minimizing the deployment timelines and then making the deployment and the design faster?

Greg Friesen. A couple of things we are doing there. One is all these products have very similar Ethernet capabilities, and they are all managed by a single management system, our DragonView management system, which enables end-to-end provisioning. We have made the systems have a fairly wide beamwidth, wider than some of the traditional systems to simplify alignment, and we have built in a number of alignment and commissioning tools to simplify deployment. Going forward, our future vision is to do more integration with base station vendors – and we have started that discussion with some of the key players – to be able to maximize the reuse of all resources and have a single install rather than two separate installs when you are mounting a base station and a backhaul link.

Frank Rayal. When it comes to integration, do you think all solutions will be considered, or will there be a focus on a specific band or specific type of solution, let's say line of sight or PTP versus PTMP?

Greg Friesen. I think, for the same reasons I discussed earlier, that it won't, although it would be ideal to be

able to focus on a single band. We think that we will need to offer a pretty wide set of solutions. There may be some band that we can hit that are higher-volume, that we target more integration on, and that maybe are more suitable for integration, but we certainly see and believe that the base station vendors have a common vision that we will need a wide set of solutions and won't be able to just integrate with one product.

Frank Rayal. If I may ask a technical question: The 2048 QAM modulation, I hear a lot of people talking whether it is useful or not useful, and on the benefits of having it. What is your view on that?

Greg Friesen. Certainly you are right, 2048 QAM has a reduction in system gain, so that results in a reduction in link range. In small cells, though, you are not that constrained in the link range, especially in the 24–38 GHz bands when you have a 400-meter link. The capabilities of these bands are well beyond that – so it fits actually quite well in the small cell, and then 2048 QAM can provide about a 30% increase in throughput, even in longer links.

Because we have hitless adaptive modulation, we can allow the user to take the benefit of these higher modulations during clear periods when there is no rain, which is 99% of the time. And then the system will switch down during heavier rain back to what you would have been operating at regularly in a 256 QAM or 128 QAM, so it is really just taking advantage of those good weather conditions, which is most of the time, and increasing throughput during those periods.

Frank Rayal. When it comes to operator requirements for small cells, my feeling is that there has been a bit of confusion, or still a bit of searching, for really what we need to have for small cells in terms of availability, latency and throughput. From your point of view in discussing with the different operators, what do you see are the key requirements, and how have you addressed them in your product line?

Greg Friesen. I completely agree with you, I believe that there is still a lot of confusion – and I don't think that it is just confusion. I think that the spectrum varies a lot by operator.

Taking one of the parameters that you discussed as an example, the availability, so many operators have said, "Well, a small cell is part of my mobile network, and therefore I expect the same in backhaul availability for my small-cell network as my mobile network, and so I want four-9's or five-9's on this small-cell network," and that drives all sorts of things, like battery backup, redundancy, etc.

Other operators look at it differently and say, "Well, I have redundancy already, in that I already have coverage in this area, and this is really augmentation and capacity increase to my coverage, so my redundancy is the macro network, it doesn't need to be through the backhaul in the small-cell network, and therefore I would much rather optimize costs on this network, not have redundancy, and I accept the lower availability, maybe a three-9's, maybe even a two-9's and a five, so I am willing to look at different parameters."

Certainly you want availability. I don't think there is a right answer, I think that each operator has a different mentality and a different perspective, and we are working to support all of those.

In terms of delay, you do see ranges in delay, but typically from the operators we are seeing fairly low delay numbers. Typically they are targeting 5 to 10 millisecond end-to-end delay across the entire backhaul network, and so that may mean multiple hops through Ethernet switches, maybe even through some fiber as well. So certainly we are seeing that fairly commonly.

We also see a very wide range in capacity. You will see anywhere from someone saying, "I just want best effort, just to be able to have my cell working," or even, "5 to 10 mbps will work," others are saying, "I am using this as a capacity-increase strategy and I need at least 100-plus mbps per site." We do see a very wide range, and we are certainly working towards covering the higher end of that range. We believe that even if the capacity is not expected to be there short-term, in the long term the operator is going to grow into it.

Frank Rayal. These are tough issues, and I think it has a lot to do with the way small cells are deployed and the coordination aspects between the macro-cell layer and the small-cell layer, so we will see how these things will develop.

What are your thoughts on the total cost of ownership for small-cell deployments, and specifically the backhaul? We see the base stations have been

reduced significantly in cost, going from a three-sector site to a single-sector site with much lower power, but backhaul solutions across the entire bands are pretty much the same thing still.

Do you think that there is a significant issue here related to cost, and how can the industry move forward and address that, and how are you trying to address that with your products?

Greg Friesen. First of all, I think if we look at DragonWave, we have seen the average selling price go down quite a bit, and our costs go down quite a bit, over the past ten years, definitely double digits per year.

That said, that certainly is not enough for a small cell. We are not looking for tens of percent here – we are looking for 3 to 5 times the difference, sometimes more. So a significant reduction.

There are three key areas to address this. One is the site cost – the cost of site leases, site acquisition, etc. We believe that the best way to address that is through a very small and low-weight solution, and that is what we are targeting and what we have built.

The second is the actual equipment cost, so we are working to optimize that, although that is one of the smaller portions of the total cost of ownership. In addition to that is the part which often gets locked in with that equipment cost, the capex, is the spectrum cost, so by having a flexible array of spectrum options, we are looking to allow the operator to minimize their spectrum cost.

Third and probably most important is the operation costs – the cost of deploying and maintaining the network. By simplifying the solution, doing as much integration as possible, and providing as much Ethernet OAM as possible. We are certainly trying to minimize that by offering end-to-end visibility in our management system, and very simple installations.

So all three areas we are going after. We believe the most important is the opex area. The second most important is the space and the site cost. The third is the capex costs.

Frank Rayal. In terms of future evolution of your product line, how do you see that evolving, and what are some of the key features that you plan to introduce in the future?

Greg Friesen. Obviously the one that everyone talks about is size, weight and cost, so we will be looking to optimize around that, as new technologies and new chips come out, and there is more integration on chips.

We will be looking to leverage that, and to get our products smaller and minimize the cost. That is a pretty obvious step for everyone in the industry.

The other – a more important one but one for which there is not necessarily as clear an answer on, but I hinted at – is minimizing the opex and installation cost: making it very simple to deploy, improving, simplifying alignment, and automating alignment and realignment if it gets put out of line. So optimizing opex, and installation time and cost is a very important focus of

ours, and what you will probably see us bringing on multiple features to minimize that cost.

Frank Rayal. Anything else that you would like to add in terms of final thoughts on your product line and how you see the small-cell market evolving?

Greg Friesen. We believe that we are at the infancy of this market. There have not been any large, wide-scale deployments to date. There have been some small deployments, and more of what I would call test deployments, than any wide-scale deployments. So we, as well as others, have all built products that are targeted at what we think the market requirement is, but I don't think that anyone really knows yet, because there hasn't been a wide-scale deployment to really see the challenges of street-level backhaul, which is really what we are facing here.

As we see the challenges of street-level backhaul on a wide scale, it is going to shape the operators' network architectures, as well as the product solutions that we need to offer to optimize their network architectures.

We strongly believe we are at the very early stage of this and that we have got a good solution for what we know about today, but that solution is probably going to have to evolve into things that we don't even know yet, and solve problems that we don't even know exist yet.

Frank Rayal. All right. Thank you, Greg, very much for this conversation. This was Greg Friesen with DragonWave. This conversation is part of a Senza Fili report on small-cell backhaul that provides an

overview of small-cell backhaul solutions along with an in-depth conversation like this from leading vendors who opted to participate in the report. The report can be downloaded from the Senza Fili website at www.senza-fili.com. Thank you for listening in, and, Greg, thanks again for this conversation.

Greg Friesen. Thank you, Frank.

Acronyms

3G	Third generation
4G	Fourth generation
GSM	Global system for mobile communications
HD	High definition
IP	Internet protocol
LOS	Line of sight
LTE	Long term evolution
NLOS	Non line of sight
SON	Self-organizing network
VoIP	Voice over IP
VoLTE	Voice over LTE
PTP	Point to point
PMT	Point to multi point
OAM	Operations, administration and management

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About the author

Frank Rayal is a telecom industry professional with over 20 years of experience working with network operators and system vendors to develop and deploy innovative wireless solutions. He's is a founding partner at Xona Partners a boutique management and technology advisory firm specialized in TMT and a founding member of small cell backhaul pioneer BLiNQ Networks. Frank held senior product management, marketing and business development positions at Ericsson, Redline, and Metawave. He holds a BS in Electrical Engineering from Case Western Reserve University, Cleveland, OH, and a MSc in Electrical Engineering and an MBA from the University of Toronto, Canada. Frank is a Senior Member of the IEEE, and a member of Professional Engineers Ontario.