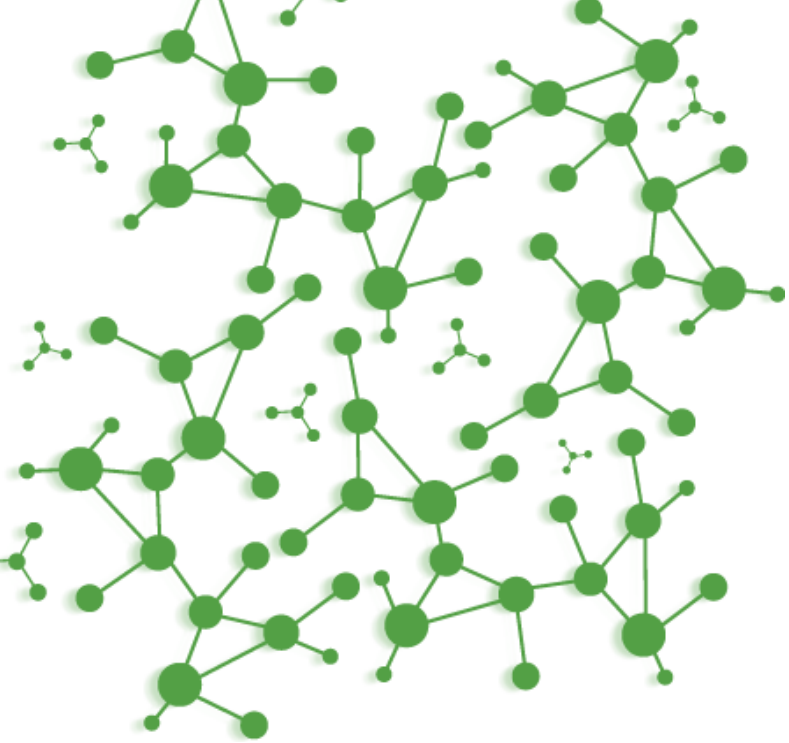

Building the ecosystem for small-cell backhaul

A conversation with Ed Chang, VP Product Management, and Eric Vallone, Senior Manager, Product Management, Cisco

By Monica Paolini
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Monica Paolini. Good afternoon and welcome to this conversation with Ed Chang, Vice President of Product Management at Cisco, and Eric Vallone, Senior Manager of Product Management at Cisco. I'm Monica Paolini and this conversation is part of a Senza Fili report on small-cell backhaul. The report provides an update on small-cell backhaul solutions and on the evolution of mobile operators' requirements for small-cell backhaul.

Today we will be talking about a new initiative on building the ecosystem for small-cell backhaul led by Cisco. Ed and Eric, thank you very much for joining us today.

I would like to start by asking you to give us an overview of the announcement you recently made on trying to create an ecosystem to move beyond a single solution.

Ed Chang. As background, we definitely see the large growth in data traffic as driven by the subscribers out there, both human subscribers and also machine to machine. And this data traffic growth is driving the need to deploy smaller and smaller cells in the rural, urban, or suburban environments.

Now, with the deployment of these small cells, clearly there needs to be a way to connect or to backhaul these cells to the rest of the mobile operator network. And what we're seeing is that there are many different locations where this small cell could be located. It could be on the side of a building, it could be on a lamppost, it could be on a bus stop, it could be in a rural area or in a small town somewhere. To drive connectivity to these new small cells, there is a need for multiple technologies to provide backhaul. The small-cell backhaul at a broader level can be broken up into a wired connection or a wireless connection.

In the wireless connection space, what we have announced is an ecosystem of partners that provide leading technologies in their own areas, which will be incorporated into the overall Cisco best-in-class mobile backhaul solution, the unified MPLS for mobile transport (UMMT) solution.

Monica Paolini. Can you tell us a little about what Cisco brings to this ecosystem? And who are the partners, and how do you select them?

Ed Chang. What we bring to the overall solution – and the ecosystem is part of the solution – is end-to-end connectivity for the mobile operators, from the small-cell site all the way back to their mobile core network. And that includes different types of connectivity, which includes wireless backhaul.

As part of that, we have formed an ecosystem of partners. They include BLiNQ Networks, DragonWave, Fastback Networks, NEC, RADWIN, and Siklu. And all of these bring their own unique technologies to wireless backhaul. What we use in our solution depends on the operator needs – where the small cell is located, what type of transmission speed they need, whether they

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need LOS or NLOS for each particular small-cell location. We would then work with any one of these ecosystem partners to deliver that end-to-end solution.

Monica Paolini. All the vendors you selected occupy different regions in the space of wireless backhaul solutions. Do you anticipate mobile operators will select different wireless solutions, in combination with wireline, and work with both you and the other vendors in the ecosystem to decide where to deploy what?

Ed Chang. Because there is going to be a large variety of installation locations for the small cells – as mentioned earlier, urban, suburban, or rural – many of these operators want to connect the small-cell locations, in the case of an urban environment, to the macro site itself. Between the macro-cell site and the small-cell site, both LOS and NLOS wireless technologies will be needed. So depending on how far the small cell is from the macro-cell site, what type of conditions are there between the two locations – in terms of buildings, trees, and other factors – we would then work with our ecosystem partners to come up with the best wireless solution to meet that particular installation type. And in some cases, we do envision working with multiple ecosystem partners at the same operator, because at different locations there may be different conditions, where one ecosystem partner's product may work and provide better characteristics than another ecosystem partner's.

Monica Paolini. In your vendor lineup, you have a wide range of solutions – PMP, PTP, licensed and unlicensed, different bands – and that gives mobile operators a lot of flexibility, but also you provide the ASR901 router, a common element.

What is it that vendors need to do in order to be able to be part of the ecosystem?

Eric Vallone. There's some fairly extensive certification and testing that we're putting them through before they can be a part of this ecosystem. They need to support unified MPLS for mobile transport architecture. There are some very specific tests that they need to perform, in terms of quality of service, of being able to fit into our management architecture, of how they handle timing across the network, of how they support IEEE 1588 and/or synchronous ethernet, and of how they support SLA management, including Y.1731 and IEEE 802.1ag. And to top it off, it's more than having a great technology; it's also having deployable technology. Not only do these vendors pass certification, they also have been actively deployed in concert with our Cisco technology in live customer networks.

Monica Paolini. It is support of the proper functionality and proving that it is actually working in real deployments.

Ed Chang. We are doing a two-part certification. The ecosystem partners all have their unique capabilities to provide the physical layer of connectivity, whether it is LOS or NLOS, PTP or PMP. They are the experts in the wireless transport connection end-to-end. And to what Eric said earlier, we need to make sure that the traffic, which is primarily ethernet traffic on an end-to-end basis over this wireless transport and over the routed infrastructure for overall backhaul, satisfies various requirements such as synchronization, packet timing, SLAs, Ethernet OAM, resiliency and scalability. So it is kind of a two-part technology certification: one is the wireless transport, and then on top of that is the ethernet or IP end-to-end features that we need.

Monica Paolini. Can you tell us a little more about the MPLS support they need to have? Why is it important for mobile operators?

Ed Chang. We feel that MPLS is important for mobile operators for a number of reasons.

From an overall scalability perspective, because mobile operators are going to have multiple numbers of nodes out there, and a node in this case is a small cell, you can imagine that it could be a 5x or 10x increase of small-cell versus macro-cell type of deployments. What operators want, and MPLS provides, is to have scalable connectivity to all these end points or small-cell sites, to provide the OAM and the SLA capabilities, to provide resiliency. For example, in the case of failover, if the path is broken, operators have an alternate path between the macro site and the small-cell site itself. All of these features are what operators have confirmed they need in a macro backhaul environment, and we do see many operators asking for the same functionality extended to their small-cell sites.

Monica Paolini. As mobile operators realize that they need to use different technologies, wireless or wireline, there is really a burden on their end to

manage this diversity, because not only are they using different air interfaces, but also different features and different capacities. So from a management point of view, it can be quite challenging. Is that what you are seeing in the market?

Ed Chang. Yes, we definitely see that. We're clearly seeing a multivendor environment out there for operators to choose from. And when you have a multivendor environment, each vendor technology and management system configuration is always going to be a bit different. So what we have been asked from operators is to provide an overall management system, which Cisco also provides, and it is called Prime. All this is integrated, to the extent that we can, with some of the ecosystem partners' management systems themselves – for example, their element management system for the device.

And the area that the operators are asking us to provide on an end-to-end basis starts with fault management – for example, if something breaks or they spot a fault. Provisioning: provisioning of the capacity on an end-to-end basis, provisioning of the SLAs, provisioning of the scalability and reliability features.

And then the third area they are asking us to do is on performance management. So that they can manage to their service level agreements, they can look at the OAM features, like Y.1731, to ensure the quality of the overall end-to-end circuit. An overall end-to-end management system is one thing we are working on.

Eric Vallone. The overall, end-to-end management system is designed to be a multivendor system from the ground up, to not only manage Cisco equipment but to manage other vendors' equipment.

To take it back to one part of your original question, I think what a lot of it is going to come down to is whether to deploy service at a location or not. I don't think carriers are going to have a choice but to be able to leverage multiple technologies. If not, they won't be able to reach their customers everywhere.

And that is, again, why we take the multivendor approach. It's to make sure that we can leverage these industry-leading solutions, so the carrier doesn't have to say no. If they need to increase capacity in a particular area, they have the ability to do so. Or if they hit a dead spot, they know they have the tools in their toolbox to be able to deal with that.

Monica Paolini. There is another dimension to that. You have a multivendor environment on the small-cell end. But you may also have another vendor in the macro layer. Operators that deploy small cells in the same frequency band they use for macro cells need to coordinate transmission. And that imposes even more stringent requirements on latency and reliability of the backhaul link. And I was wondering whether that has been a driver for you to step into this area, and what is it that you are doing to ensure that, for instance, latency is at an acceptable level?

Ed Chang. That is where our overall solution comes into play – the universal MPLS for mobile transport. What we envision as a deployment scenario is a small-cell radio and our ASR901 series router, then you have the wireless backhaul. On the other end, you have the wireless backhaul termination and then another ASR901 series router, which then connects the macro-cell site back to the operator.

And it is exactly between the macro- and the small-cell sites where SLAs' performance characteristics such as latency and error rate are measured, between the routers themselves. This is where all the intelligence is, and that is why we think we need to have MPLS all the

Figure 1. The ASR901 router. Source: Cisco

way out to the small-cell site. And with that we are able to measure the physical layer characteristics and the latency between the two routers.

Monica Paolini. We have talked so far mostly about the performance of the backhaul link, but another issue is installation. How are you going to ensure that installation is effortless, simple, and fast?

Ed Chang. Certainly the opex of deploying small-cell sites could grow as you send people out there. So our approach in the overall solution is to have zero-touch provisioning capabilities within the routers. We are working with the ecosystem partners also to enable this in their products. When you install the device, once the small cell lights up it finds its home-node location, which then provides its configuration down to the devices at the small-cell site. And this minimizes the amount of management capabilities you would need. You would not need to send a technician to the small-cell site to configure those devices, as this can be done remotely over the network.

Eric Vallone. Talking about the provisioning of the system itself, there is also the alignment of the antennas, and different technologies have different characteristics used to connect to end points, for instance in a microwave link. With NLOS we typically have easier operationalization than with LOS, but there are tradeoffs. Nonetheless the vendors we are choosing are absolutely leading in this industry to ensure the minimal operational requirements for antenna alignment and sync between units.

Monica Paolini. So there is going to be some variability depending on whether you will have LOS or NLOS, PTP or PMP links.

Eric Vallone. In general there is going to be a benefit of NLOS when you are looking at today's technology. It does not have to be a benefit forever, but it is definitely a benefit today.

Monica Paolini. Is there a particular challenge when you have multi-hop backhaul, with small-cells two or three steps removed from the aggregation point, and you may have different technologies – for instance, one step may be fiber, then two wireless technologies, with different performance characteristics?

Eric Vallone. That's one of the key attributes for any mobile backhaul system, with any of the varying technologies from the aggregation point in the mobile core, all the way out to the eNodeB or the small cell where the radio sits, and in the middle you have an IP-routed network, a microwave link, and the small-cell itself. There is a plethora of technology out there, and operators are looking very closely at the key performance characteristics across all these technologies.

One is packet timing or synchronization, on an end-to-end basis, between the radio and all the way to the aggregation site. In between you have a multitude of technologies that require key performance metrics that mobile operators are looking at.

The other technology they are looking at is OAM, which is used for SLA measurements such as delay and jitter on the link itself. Again, this link traverses multiple technologies from the cell site all the way to the aggregation point.

Monica Paolini. In addition to 4G small cells, you can also have carrier Wi-Fi small cells for access. Does your approach work with Wi-Fi small cells as well?

Eric Vallone. The connection to the user can be both through licensed (3G, LTE) and unlicensed spectrum (Wi-Fi). Once the connection is set up, all the backhaul characteristics that we mentioned earlier when talking primarily about licensed small cells apply to a Wi-Fi radio, if Wi-Fi is used to provide access to the subscriber.

Monica Paolini. What is the roadmap for your ecosystem? How is it going to evolve over time?

Eric Vallone. Increasing overall capacity per cell site is a main priority. Hand-in-hand is a reduction in the overhead and latency associated with that. We also see the ability to minimize the operational cost of the solution as a priority. Further, on the provisioning aspects that I talked about earlier, this may entail an easier installation of the wireless unit. One alignment technology, such as beamforming, may minimize the operational costs of turning up the solution. As I have alluded to earlier, the potential of deep integration within the router, the wireless unit, and potentially even the small-cell unit product that we have in our portfolio are other priorities for the coming years.

Monica Paolini. Ed and Eric, thank you very much, it was a pleasure talking to you today.

This conversation is part of a Senza Fili report on small-cell backhaul that provides an overview of small-cell backhaul solutions, along with in-depth conversations, like this one that we just had, from meeting with vendors who participated in the report. The report can be downloaded from the Senza Fili website at **www.senza-fili.com**.

Acronyms

3G	Third generation
4G	Fourth generation
eNodeB	Evolved NodeB
IEEE	Institute of Electrical and Electronics Engineers
IEEE 1588	Precision time protocol (PTP)
IEEE 802.1ag	Connectivity fault management (CFM)
IP	Internet Protocol
ITU	International Telecommunication Union
ITU-T	ITU Telecommunication Standardization Sector
LOS	Line of sight
LTE	Long term evolution
MPLS	Multiprotocol label switching
NLOS	Non line of sight
OAM	Operations administration and maintenance
PMP	Point to multipoint
PTP	Point to point
SLA	Service level agreement
UMMT	Unified MPLS for mobile transport
Y.1731	ITU-T recommendation Y.1731

About Senza Fili

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About the author

Monica Paolini, PhD, is the founder and president of Senza Fili. She is an expert in wireless technologies and has helped clients worldwide to understand technology and customer requirements, evaluate business plan opportunities, market their services and products, and estimate the market size and revenue opportunity of new and established wireless technologies. She has frequently been invited to give presentations at conferences and has written several reports and articles on wireless broadband technologies. She has a PhD in cognitive science from the University of California, San Diego (US), an MBA from the University of Oxford (UK), and a BA/MA in philosophy from the University of Bologna (Italy). She can be contacted at **monica.paolini@senzafiliconsulting.com**.