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Ciena Corporation

Coherent Pluggables Chalk Talk Question and Answer Session

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PRESENTATION

Operator

Thank you for standing by, and welcome to the Ciena Next Generation Pluggables Q&A. After the speaker's presentation, there'll be a question-and-answer session.

I will now turn the call over to Mr. Gregg Lampf. You can begin.

Gregg Lampf

Thank you, Jenny, and welcome everyone. Thank you for joining us today for the Q&A call covering Ciena's next-generation pluggable strategy.

We hope you took the opportunity to listen to the recorded webinar available on our website. We won't be giving the presentation today, obviously because we made it available about a week ago. We hope that was helpful for you to be able to take it all in and think about it and come prepared for the discussion

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today. If you have not done so, however, I know you all are well-informed about the topic, but please do listen to that at your earliest convenience.

There has been, we recognize, a lot of discussions and prognostic implications about this topic over the past few years, and we wanted to obviously engage with the community. In fact, this is an important topic and the next generation pluggables do represent an important development in our space.

As you listened to the webinar recording and engage with us today, we'd like you to consider some important messages from us. Next-generation pluggables are a natural evolution. Next-gen pluggables nearly represent the continuation of the reduction of power, cost per bit, and modularity of DWDM systems. This is not a revolution, although it will take strong vendors to compete in this space over time.

Two, customers view pluggables as one component that can address their needs. A large majority of network operators view pluggables as just one element of their optical infrastructure that often will also include transport systems. Three, Ciena is uniquely positioned. We're the only vendor with a strong degree of burglar integration, competencies and experiences, right customer relationships, and financial strength to aggressively innovate and lead this market.

Simply, we have a unique understanding of the customer's network and a breadth of solutions to cover their needs. Last but not least, this is an attractive opportunity for us. Next-generation pluggables expand our addressable market and represent an opportunity for Ciena over the next several years.

With that, we have today leading our discussion, Scott McFeely, Senior Vice President of Ciena's Global Products and Services. Scott will be joined by Dino DiPerna, Vice President R&D Optical Technology and packet-optical platforms. You would have heard him on the recording or when you listen to it later as well. We're looking forward to that conversation with all of you.

Before beginning today's discussion, I did want to remind everyone that we'll be focusing on our next-generation pluggable strategy, including use cases, markets and technologies. We won't be discussing Ciena's financial information, results, expectations or economic conditions. While we will not be discussing these items, we may talk directionally about the technology market, and as such, we please do ask you to consider these comments in the context of the risk factors detailed in our most recent 10-Q and 10-K filings.

I hope you find this engagement informative, and now I'll hand it over to Scott.

Scott McFeely

Thanks, Greg, and good morning, everyone. Thanks very much for joining us this morning and your interest in this topic. As Greg said, I hope you had a chance to have a listen to the webinar. It is a very complete perspective on how we see the market and how it touches pluggable. I wanted to thank Gregg Lampf from our Product Line, Management Team and Dino Diperna, who's with me here today, for their contribution to that webinar.

As I said, I'm joined by Dino, I thought I'd bring a friend today. Dino has been the leader of our packet optical R&D team for many, many years. Part of his team are the engineering organization that produces our coherent optics capabilities and they've driven the regeneration of our coherent optics solution in the marketplace. I'm a bit biased, but I don't think there's anybody better in the industry to speak to coherent technologies than Mr. DiPerna. I'm happy to have him here today.

With that, let's turn it over to you folks for some questions.

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Gregg Lampf

Jenny, if you'd start the questions, we're looking forward to the discussion.

Operator

Your first question is from George Notter with Jefferies.

George Notter

Hi, guys. Thanks very much.

I guess I'm still playing catch up to some degree on the presentation so forgive me if this is contained in there, but can you just walk through your product delivery timing, products, as you see these pluggable products coming into the marketplace?

I guess secondly, I wanted to ask about, there were other sort of pluggable strategies out there. One of your competitors is bouncing a strategy of point to multi-point model effectively for access networks. I think the idea there is that they're trying to reduce the amount of pluggable content in the network using a subcarrier type of model. Can you talk about that strategy and how that's compared and contrasted vis a vis what you're doing? Thanks a lot.

Scott McFeely

Thanks, George, and good morning.

First of all, just at a high level in terms of our WaveLogic 5 family of products and the rollout that you were asking about, and just to remind others on the call, our first offer in that WaveLogic 5 family was our WaveLogic 5 Extreme, which is an integrated product in a multiple of our products meant to address a number of the application spaces that we talked about in the webinar.

The second part of that family is our WaveLogic 5 Nanotechnology which is the basis basically for the various different pluggable offers that we'll have in the marketplace. I'll let Dino sort of expand on those pluggable offers in the timeline. Do you want to take a crack at that, and then I can come back and comment on the multipoint access XR technology?

Dino DiPerna

Okay. Thanks, Scott. Dino here. Good morning, everyone. Yes, as Scott said, the 5 Nanotechnology is on deck. It's obviously been in development for several years now. The short answer, George, is we're ramping production right now, and the first application is the 400ZR. We expect to be generally available with that by the middle of this year. We'll be shipping our first production units over the next several weeks to some key customers.

The ensuing modes, if you followed through the chart back in that, there's multiple modes, depending on ZR, ZR+, and their variations thereof. They'll be following up in the ensuing months and quarters through the second half of 2021.

Scott McFeely

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Thanks, Dino. Back on your multipoint question, George. That's sort of an architecture approach that we have looked at in the past, and I'll certainly say that we don't necessarily have perfect insight into what competitors might be doing in that space, but we probably have reasonably decent insights.

From our perspective, in economic value that may come with that doesn't necessarily justify our war in, what we think would be a totally parallel ecosystem required to deliberate when there's lots of volumes and lots of effort being put on, I'll just say more standard ecosystem. We think that that, at the end of the day, is going to wind up and we'll see how it plays out.

Gregg Lampf

Great. Thank you, George. Appreciate it. We can take the next question.

Operator

Your next question is from Simon Leopold with Raymond James.

Simon Leopold

Thank you for taking the question and doing this call. I wanted to maybe see if you could address some questions about the industry structure around the ZR pluggable market. Clearly, you've demonstrated strength in the DSP and the modem content, but I guess where I struggle is how you compete in a pluggable market relative to others who have a lot of experience making high-volume discrete elements.

That's certainly an area we haven't seen from Ciena in the past. I think you've alluded to having manufacturing partners, but can you help us understand how you compete or industry landscape as you see it in this particular space? Thank you.

Scott McFeely

Hi. Good morning, Simon. Thanks for the interest and the question.

Obviously, competitive dynamics have lots of different dimensions to them. I'm sort of exploring the space for a little bit here. First of all, if I just sort of think about the players and what it takes to produce a coherent modem, what we call modems, now anecdotally if you go back let's say three RSTs ago, so I think sort of walking the floor, you could count probably more than 15 vendors that claim that they were going to have 400ZR products in the marketplace and that it would have been there no later than 2020, and some were even planning in 2021 and here we are today, I think that that number is a lot smaller. So, first of all notice this stuff, to produce one isn't easy. I think you've got to look to the folks that have some coherent pedigree to have the list of folks that can potentially get there.

To your question around volume manufacturing, I will remind you under coherent modem and sort of the IPR that goes into producing our coherent modem, that we've produced hundreds of thousands of modems, and probably one of the biggest historical producers of that.

On the pluggable side, and I'll let Dino in a minute here about what statistics components are of this. On the manufacturing piece of it, you're right. We have a set of contract manufacturers that have absolutely been in the business of producing discreet pluggables and we've worked carefully with them over the period of the development of this. In the coherent space, I think we've proven that we can go from general availability to very high production levels in a very short order, and the mature regeneration that we've done from the coherent space.

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That includes, by the way, and the world probably doesn't recognize this that well, but that includes some of the key components like silicon photonic electro-optic devices that have been in our technology for a couple of generations now. The other aspect of competing on this though is, how are customers going to consume this? What does it take to actually be their strategic optical provider? There are some applications within the total application set where the plug itself could be consumed and procured independently, and we talked about that and that's primarily being on the campus metro VCI use case.

In all the other use cases, we actually still see this being very much a system player game because there's a lot of other complexities and capabilities that come into delivering the end-to-end solution to that customer base, even if part of that solution is going to be pluggables. Pluggables is not a new thing by the way for those customers in those applications. We've had them for multiple generations, but exploring the different dimensions.

Dino, maybe I'll pass it to you to just sort of talk about what the key components that make up our coherent pluggable and why we think we're comfortable both from a technology perspective and volume ramp perspective.

Dino DiPerna

Certainly, Scott. Yes, and I think, Simon, the question is certainly spot on. In the coherent world, the ingredients are quite different. Like, we're not talking about the gray optics where you're picking up EMLs, or DMLs, and CVR chips, and putting them in the box, and that this is one that relies heavily on the critical ingredients. One, you mentioned the DSP itself and the nature of its design, how it works, and the analog interfaces to it.

Scott already touched on the electro-optics part. If you look through the chart where you'll see something we call a transceiver on a chip, that's a dye scale integration, that's the whole engine in there. You just insert the light from the laser into it and all of that stuff is done on that tiny, we refer to it as the cortex, which has all the critical ingredients. The focus of the design has been to really, really optimize that integration so that it isn't a lot of manual machinery to put these things together, but it's all done in those critical components.

In there you have the DSP, you have critical high-speed analog functions, and you have the transmittal tropics, the modulator we call it, and then on the receipt side, the optical mixer and the photodetectors that provides a signal. That's one of the reasons that we believe we can leverage all our strengths and get this thing into volume production very readily.

The other thing is, and Scott touched on it, the hundreds of thousands of modems we've been making over the last 15 plus years, our test calibration methodologies and procedures in manufacturing I think are at the top of the industry, and our ability to yield these things and know how to optimize across all the parts is absolutely critical. We've lived through it over the generations of modems, and we know it's going to play a big role even in the pluggable world. I think in many ways, this space now that its high capacity coherent actually draws on our strengths, it plays to our strengths here versus us trying to assemble a more conventional IMDD or gray optic client interface. That's completely different.

Hopefully, that gives you a bit color.

Simon Leopold

Yes, no, that's all helpful. The one point I'd like to maybe follow up on briefly is just how do you see industry structures? Is this a market that you imagine supports two players, three players, five players?

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What does it end up looking like? I guess how three years ago, there were dozens, now there are fewer, but how many tend to succeed in your view?

Scott McFeely

Yes, so I think the way I look at this is each success of generation's technology is getting harder and harder to do and more and more expensive, and you need to have volumes in order to justify the investment, and you need to have, obviously, the key wherewithal and the key component pieces.

We actually believe some of that wherewithal absolutely comes from participating in the network deployments and taking that knowledge back into the design cycle. At the end of the day, I don't think this is an industry structure that can support multiple handful of the players. I think you're going to ultimately talk about a handful of players and how many digits is on that hand. We'll see.

Simon Leopold

Great. Thank you for taking the questions.

Gregg Lampf

Thanks, Simon. Appreciate it. We're ready for the next question, Jenny.

Operator

The next question is from Tim Savageaux with Northland Capital Markets.

Tim Savageaux

My compliments on the disclosure in terms of market size and share across your business, and I had a question about that, which is if you're looking at the Metro DCI market, that represents about 30% of Ciena's cloud revenues last year.

I wonder if you could give us a little more color on how the rest of that cloud revenue is sort of characterized with the further thought that while you don't report Waveserver revenue anymore, when you did, that was around two-thirds of cloud revenue or so, maybe less now, but is there a segment of the market that's point to point DCI just longer distances?

I imagine you've got some subsidy in the long haul in that number as well, but any additional color on the broader picture with the cloud players from a revenue perspective, and maybe relative to Waveserver, in particular, will be appreciated. Thanks.

Scott McFeely

Hi, Tim. Yes, first of all, one of the things to recognize now is with Waveserver actually has—it started out as a pretty good surrogate, I guess, for some of our, I'll just say transponder business into web-scale space. Waveserver deployments now have stretched beyond that and are now getting consumed in service providers and in MSOs as well.

Anybody that's got an application that is much ponder-based and has space constraints in the Waveserver, Waveserver format is very attractive to them. It's not just the web scalers. That's why it's not a great surrogate anymore for a web-scale avenue. Back to your question, if you think about our web-scale business today, we sort of drew out the metro DCI piece of it, as was pretty clear in the

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presentation. The other sources of revenue for us from that customer group is, they have a very big influence on our submarine avenue, both direct and indirect. They have, on the equipment side, also a significant revenue that I'll just say is core backbone networks for them, so think of it as regional to national terrestrial networks.

Those networks, for the most part, also have a fairly sophisticated (inaudible) component to them. It's not just Waveserver and transponders. The other piece of our business with the web-scalers is a growing use of services business with them as well.

If the question was to try to figure out where to rethink the market sizing is for the pluggable optics, as we said, we had thought of that in the past as being the metro DCI opportunity about $500 million in the fullness (phon) of time.

You could see part of that is substituted to our Waveserver metro revenue, and you said, it was about a third of it, we wanted to put absolute numbers on it. Last year that would probably be equated to something like $220 million worth of revenue, Waveserver revenue for that metro DCI application. Not all of that will jump to pluggables. Some of it will, but it also point out as we get in the presentation, there are other non-coherent solutions to that metro DCI use case that are going to move to program pluggables. For us, we see that as opportunity as well.

Tim Savageaux

Great, thanks, and if I could follow up with a technology question, and you guys indicated that while not necessarily revolutionary, this is the first time that we have the client and network side form factors being the same in one of these cycles, and you seem to point to some power challenges in integrating those on the client-side and the line side of the same device. I wonder if you might be able to expand on that.

Dino DiPerna

You want me to take that, Scott?

Scott McFeely

Yes, go ahead.

Dino DiPerna

Yes. Very good point. When we tackle this WaveLogic 5 Nano design, I mean, we have a pedigree, obviously, and coherent decades, and the high-performance, but fitting the power envelope was probably the most critical piece that we focused on and it touches all aspects of the design. Obviously, the VSP plays a role, but the analog and the electro-optics as well.

If you recall, obviously, you've listened to the webinar, the form factor physically is the same, but the power footprint appliances, 12 watts or below, and the coherent needs a bit more than that. The industry benchmark that they were trying to hit is in the order of 15 to 16 watts, and much more than that, and it actually takes away from the density of the router and there's a trade-off there.

Frankly, one of the reasons coherent directly in routers has been around for decades and never really taken off is because that compromise has been just not a good bargain, and so we kept them separate. In our case, we focus very, very, very much so on the power consumption. I'm very pleased to say it's looking excellent on our part, and from what we're getting feedback wise, it does appear to be best-in-class on the power consumption.

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Folks expect we'll get the optical performance there as well, of course, but the power consumption is also very, very important. Only a few watts difference there can really stress the platform, it's plugged in and therefore take away the benefits that anybody is hoping to have with the integrated optics. That's why the power is such a factor.

The other thing I'll add, of course, is as you look at the myriad of capabilities in the pluggable world, it's easy to just cherry-pick some numbers like a plug DD small, 1,000 kilometers. You can't have them all at the same time, of course, because more performance, more reach needs more watts, and so there's trade-offs, which is why we keep emphasizing, it really depends upon the network that you're trying to plug into.

That's why the emphasis on power consumption, the lead application 400ZR has got a very stringent power number in order to not be inefficient on the router platforms. We think we've got what we need in there, and then we've got ways of using more power to get more performance for other applications.

Scott McFeely

Yes. Thanks, Dino. Just a couple of things on the power theme. One is I think there was a narrative in the industry around Ciena that said, hey, these guys are great at coherent, they're great coherent at the high end and they haven't really demonstrated that they can design and deliver it to the lower end or lower—the lower power footprint applications. I know that's something that drove Dino nuts, and as I said, I have been—he and I have been focused on the power here. I'll tell you that we believe we're going to show up with best-in-class power solution on the 400 gigs ZR.

Second thing I'd say is people, I think, take 400 gig ZR and say, oh it's a standard commodity part and can't differentiate yourself. I'd say, well, you can, you can differentiate yourself by actually having, well, first of all, meeting that power spec, but then having a best-in-class solution around that power spec, and as Dino is alluding to, the reach performance within that power envelope as well.

Gregg Lampf

Thank you. I appreciate it. We are ready for the next question, Jenny.

Operator

Your next question is from Paul Silverstein with Cowen.

Paul Silverstein

Thanks, guys. Scott, relative to your last response, given that 400ZR is the spec that there's an opportunity to exceed the fund metrics of this spec, what rough percentage of customer opportunities do you think will simply be meeting a spec that's good enough? We don't care if you exceed the spec and therefore a lot of it becomes about price, and what's the opportunity to extend your differentiator in a positive perspective and technology above and beyond, however you're pricing it for you to gain incremental share versus others? Then I've got some related questions to that.

Scott McFeely

Yes. Okay, Paul. The percentage of the market at the ZR place, first of all, it's going to be difficult for me to give you a number, but I'll give you a sort of a subjective statement. You assume the sort of you're okay in the 15 to 17-watt power zone, and you're okay if you reach at the kilometers. That's good enough and

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then everything else is in a way how are you as a supplier and how are you from a price perspective in the decision making? I think there is certainly a portion of the market that will be in that category.

However, even in that category, if you can shave a watt off, that's real economic value-form, and that will at the end of the day buy you a preference to a point, and that will be a competitive lever.

There was another portion of it where 80 kilometers hits only a portion of their “metro on campus DCI links”, and are they willing to carve off a section of their solution set that meets that, and then have a different solution for the portion of their links that don't meet it. That's still, I think, a journey in front of us. My speculation is that if they can find a solution that covers that full gambit, then that's certainly going to be a preferred part of their solution set and will give us an opportunity to have a preference, if you like. It doesn't mean we aren't going to have to compete from a market price perspective. We have to compete, by the way, from a market price perspective in every application.

You can compete successfully in a quite tough market pricing environment that we've lived in for decades if you do two things. Number one is you have control over your cost base. I'd say from a vertical integration perspective, there's probably nobody out there that has control over more of the components than we do. That puts us in a good stand (phon) from a cost perspective. Then you do have the volumes to drive that cost base. It's drawn I think in the coherent space across all applications. That's why we're one of the ones that drives volumes and allows us to continue to invest.

I hope you would like—without sort of giving you a number, hope I gave you some color.

Paul Silverstein

All right. Well, Scott, I heard your response with respect to power, and I did read the slide deck, but I'm still trying to understand and the question being, what is your technical competitive differentiation? Of course, that begs the question, to what degree you're aware of In-Fi and solutions based on In-Fi's DSP. Similarly, a case of Cisco and solutions based on their DSP and NEL.

Do you have industry insight that informs, to what extent you truly are positively differentiated? The final question being, from the commercial opportunity point, you all have been trying for years in terms of the merchant market. You've had a challenge in that your competitors, I think the target with DT primarily originally in terms of target market, given that most of your Western competitors didn't want to source from you giving that to your competitor. In the ZR market, is rocketry still just selling?

I'll give you some pejorative standpoint, but is it selling through the traditional communication service providers, the hyper-scale owners, and other such customers, or is there an office sharing to also sell to system suppliers, whether an Arista, Juniper, or other? I mean, is there any evidence of success? I know it's very early. I apologize. I know there's a lot there.

Scott McFeely

Yes. There's a few things there, Paul, so let me see if I can unpack it. First of all, on the competitive differentiator piece of it. At the end of the day, I go to three points. Number one, is we think we're going to have best in class from a power perspective. Number two, within that power en bloc, we think we're going to have best in class on our reach differentiation perspective.

Yes, we are aware of the competitive environment as you would expect us to be, which customers actually will value those the most and therefore will give us preferential treatment all within meeting the marketplace. That's still very early days and that's the journey there to see. The other dimension of this, of course, is in your rapid supply chain, can you produce in volumes? Are you a trusted supplier?

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I think in the coherent space, as I said in the past, we've demonstrated that we tick those boxes and one of the questions earlier is we have to convince people that we can also do that in smaller form factors and spaces, and that's certainly in front of us. The other thing over time, of course, is this is a point in time, is the technology and time.

As we all know, that technology moves on if you have the wherewithal financially and capabilities stepwise in keeping it and doing it again because we're on a treadmill and we have to continue to win in this business. The other piece in terms of what you get at the consumption models, as you said, the merchant piece we've been asked for a while. We've said publicly here for some time that they consistently, for the most part, our bet on the table and on the merchant piece has two strategic initiatives for us.

Number one is, we don't participate in China as a system vendor per se. We have some business there with the content providers that are facing the largest part of the China market from the service providers so we don't participate there. We saw the merchant approach, as you called it, Paul, as an opportunity to participate there. Frankly, I think the opportunity is still in front of us. I think it is the timing-wise really required our WaveLogic 5 technology to go play there. I think the time for that is kind of now if you like.

The second strategic piece though, is exactly what we're talking about here, which is the consumption model around, particularly the metro DCI market-moving potentially to a pluggable. That was the reason why we started to exercise that muscle from a merchant perspective. I think it's still an open question around how the content providers will consume this. I mean, procure it, I should say, procure it, whether they will go through a system vendor, and you named a number of them, that participate in their data center solution, or will they buy it directly from "their coherent supplier".

I suspect we'll have both and we are absolutely willing to transact in both ways, and we have, as you have, as you at the QA recall, we do have a team within Ciena we call Ciena Optical Microsystems that is set up to be able to transact with those third parties.

Paul Silverstein

Scott, do you have any systems companies like Juniper or Arista, or merchant transceiver suppliers, the new Photonix and II-VIs, etc., that have committed to you? Could use your DSP at the merchant transceiver level, or to use your full-blown 400ZR transceiver at the systems level?

Scott McFeely

Yes. First of all, we haven't gone down the path of actually composing, if you like, the modem. What we're offering in the marketplace right now is a fully integrated modem. It doesn't tag along in the future, but at this point, that's how we're transacting.

Again, largely the conversations have been around WaveLogic 5 and that's still early days, but we're engaged with a number of them and you named some of them. We're engaged with those folks.

Paul Silverstein

I appreciate it.

Gregg Lampf

Thank you, Paul. We're ready for the next one, Jenny.

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Operator

Your next one is from Fahad Najam with MKM Partners.

Fahad Najam

Thank you for taking my questions. I do have several questions, hopefully, if I can ask most of them. How should we be thinking about your 400 gig ZR opportunity and helping you gain share against Huawei? You mentioned that you're willing to sell your technology on a component basis, but on a module level, do you expect that this is probably going to help you gain share against Huawei outside of China?

Also, if you can help us understand in terms of, both In-Fi and Acacia demonstrated interoperability, we don't know if your modules are interoperable or not. How would that help you gain entree into some of the web-scale, guys like Microsoft, which have been publicly talking about this interoperability between Acacia and In-Fi? Then I have a couple of more questions I'll ask after you've answered this one.

Scott McFeely

Hi, Fahad. Thanks for the question. I'll maybe take the Huawei one and Dino will comment on the interoperability case.

I mean, Huawei, there's lots of dynamics to the competitive aspects of not meeting Huawei in the marketplace. I don't actually think that the pluggable and the ZR one is actually top of that list or anywhere near top of that list as it relates to Huawei right now and where we see them. I would say this, they're more generically, every generation of coherent technology that gets introduced to the marketplace has been an opportunity for us to gain share.

As we move to this generation, our 5th generation of technology across our WaveLogic 5 families, whether that'd be integrated into our systems or as pluggables, we look at it as an opportunity to gain share and we fully expect to gain share as the world moves to that generation of technology. Again, I'll go back to what I said earlier, each of these generations of technology is more and more difficult performance, and there are fewer and fewer folks in the industry that have demonstrated ability to do that.

We think it's a wonderful wedge of opportunity to gain share, both competitively in the application spaces that we're dealing with today, but also there are some new application spaces that have not been coherent in the past. We talked about some of the large web-scalers in the metro DCI applications not being coherent technology today, moving into coherent technology (phon).

That's an opportunity, but also, as you may have seen in the webinar, all of the service provider access networks that are today 1 in 10 gig as they move to be 100 gig and in by 100 gig, that's a new space opportunity for coherent as well. All brand new space, the folks that have the coherent capability can now participate in.

The general statement is a regeneration of coherent technology, a great opportunity to regain share as we have in every other generation. On the interoperability question, I'll pass it off to Dino.

Dino DiPerna

Thanks, Scott, and thanks, Fahad. The 5 Nano has been designed to conform to the OIS inter-op agreement at the 400ZR as well as the open ZR+ NSA, if you will. The design of the structure, the DSP, those are all industry documents and that's what the implementation has been targeted at. In addition, of

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course, per our webinar, you could see, we also have some higher performance private modes to get even more out of the network.

As far as where we're at right now, we're right in the midst of the integration, these production parts, integrating into third-party systems, as well as inter-oping with some of the third-party plugs. There's still weeks and months to go here in front of us, as we start to shift them into different testbeds, but so far so good. Not only was it designed to do that, it is adhering to it.

The other thing I might add is, Scott was listing some of the key points to the previous question, obviously on the optics and the performance, etc., etc., but our system expertise is really helping in this case as well. Like these coherent plugs are more sophisticated than the client gray, if you will, that I mentioned earlier, and the amount of software in there, not only to provision, alarm, diagnostics, performance, all the stuff that matters in real-world applications, our stuff comes with many decades of system experience. So, right out of the gate, the plugs are very rich in feature and robustness and we're seeing that play out as we start integrating in these third-party systems.

Fahad Najam

Okay, I appreciate the answer. Appreciate it. I have a second question. I was reviewing your slide deck earlier today, and I noticed that on Slide 7, you mentioned that there is a two to four-year lag from your high-end systems performance speed to when they get to the pluggables.

Then on your Slide 17, you kind of hint at maybe seeing these pluggables come in the form of 1.6 terabytes in 2025. If I take your three to four-year lead time as indicative of where you would be introducing the 1.6 or 1.2 terabyte solutions, it seems like you might be introducing a 1.2, 1.6 terabyte solution here based on that timing as one can look at Slide 17.

Is that an intent or is some—let me ask you directly, is that an intent you're highlighting that you're going to be introducing a 1.2, 1.6 terabyte solution at a system level this year, and then four years later we can expect a pluggable?

Dino DiPerna

If I may maybe, Scott, and then you can add color after. I'm looking at it now, I'm refreshing my memory. Chart 17 was showing how the dynamics of the data center, certainly the metro DCIs, continue to change what was the Waveserver type appliances, now we're talking ZR. I think what we were trying to show there is there could be a natural path to an 800ZR, but on the fringe here, a lot of activity going on co-packaged optics. That was really the intent.

Then you can say where everybody can place a bet on that, but in some ways, co-packaged optics might actually change what comes out of the router boxes and it won't be plugs anymore. It will be these sort of lower reach, but optical interconnects. This wasn't trying to say that we're going to have 1.6 terabyte coherent plugs, in that timeframe.

What we were saying is in that timeframe, the dynamic inside the data center and especially in the switch chips to try to get the bandwidth out, it could actually change to something like the co-package optics. Still a lot to be debated there, but that was the point there. Hopefully, that's a bit clear. I can see where the confusion would have come from though. Is that helpful?

Fahad Najam

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Got it. Yes, that's qualified. I didn't really cover what pluggables or co-packaged. The slides suggest that we expect, in 2025, 1.6 terabyte solutions at that level, and if your earlier slide is indicative of that, it's usually a three to four year lag between systems, but as far as the co-packaged optics, it would certainly indicate that you might be introducing a 1.2, 1.6 terabyte system...

Dino DiPerna

Yes. Your logic is perfect. Your logic is spot on, but that wasn't the intent, of course. We were talking about the co-packaged optics could change things.

Fahad Najam

Okay. One last question. In terms of the opportunity for ZR, and correct me if I'm mistaken, but outside of Microsoft and maybe Amazon, I haven't really heard of any major, I don't know whether Facebook, which doesn't really you have a metro network, Google, which hasn't really been very aggressive in adopting ZR.

The relative opportunity, primarily means this year to be a Microsoft, maybe even next year, maybe a Microsoft opportunity. I'm still skeptical, but help me understand if I'm correct in understanding the DCI opportunity for the ZR. Does it extend meaningfully beyond this Microsoft? If so, who are the adopters of ZR so far?

Scott McFeely

Yes, again, you sort of find that the fullness of time that application, life opportunity for that application is required to be up to $500 million in the market, but I would suggest over time, it's going to be more than just one of the large content providers. I think you're right. I think the first mover will be Microsoft and we'll see how the others evolve.

I think you've got a fairly good read on the order that they're going to go and just to remind you that Microsoft is not moving from a coherent solution to a coherent pluggable solution. They're moving from a non-coherent solution to a coherent solution. For us, that's part of the opportunity we want to see.

Fahad Najam

I appreciates the answer. Thank you.

Scott McFeely

You had a question on the interoperability, ZR is something that is really important. I just want to make sure that the folks understood here as well. When we talk about interoperability, there's really two parts of it, and there's been press around the optical interoperability between different flood vendors, and we'll see whether or not that's actually a consumption and an operational model that customers actually deploy.

As I think you know, we haven't had (inaudible) interoperability in a WDM perspective everywhere in the industry. Not because it's not technically doable, it's just operationally challenging, but we'll see whether it goes there. It certainly has a capability set in the standards.

The other really important aspect of the interoperability is because these bugs now not coming from the same people necessarily that are providing the help of the host, the system hosts, and these bugs are very sophisticated, is the software interoperability between the plug manufacturer and the system

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provider. We do think that our experience that as a system software provider is going to really benefit us there when it comes to that type of interoperability as well.

Gregg Lampf

Thanks, Fahad. Just so everyone knows, we really do appreciate the engagement. We're going to continue these discussions. We want to make sure everybody gets their opportunity if we can. Jenny, we're ready to go to the next question.

Operator

Your next question is from Rod Hall with Goldman Sachs.

Rod Hall

Hi, thanks for doing this and for fitting me in. I just had two quick questions. One is regarding customers. I know you said you're not yet shipping samples, but I'm wondering how many people are asking you for samples. Can you give us some ideas of how much interest there is in this now?

Then as you ship in volume later in this year, how many good price customers would you expect to have maybe by the end of the year? Are you thinking just a couple of people, or? Just give us an idea of what the interest level, what you think the demand looks like this year.

The other thing is on pricing. It goes back to the competition kind of question, but I think that the specific thing we're interested in is the pricing decline or pricing curve on this technology. Is it typical? In other words, is it down 15%, 20% a year, every year after we have the initial price points getting set? Or, do you think the decline is slower than that because there aren't as many competitors? Just help us understand what the trajectory of that pricing is likely to look like because I think there are a lot of misconceptions about that as they look at these higher speed pluggables

Scott McFeely

Hi, Rod. Thanks for the question. There's two parts to that, I guess, in terms of the market opportunity. Again, if you look at our roadmap, we sort of said the first application is that 400 gig ZR application. That is largely going to be dominant just because of the spec of it, simple point-to-point networks, call it 40 to 100 kilometers kind of reach.

It really is going to be that metro campus DCI and the bulk of the volume is going to be in a couple of little of those that build up those large metro campus data centers, and to a previous question, sort of walkthrough who I think the early movers are going to be on that. I think you're going to see a limited introduction in 2021 and starting to see your volumes drive in 2022 against that application.

In terms of the other pluggable applications, for the most part, we actually see those actually being largely consumed within our system business. The biggest demand for those is actually within our own Ciena product families, particularly in our writing and switching performance.

Rod Hall

I mean, you don't want to answer the question on the customers? I'm asking more like the customer question, not what the—we know the applications, but I'm curious what the actual customer numbers and expectations are as you look to the end of the year.

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Scott McFeely

Sorry, Rod. Maybe I wasn't clear. I actually think the vast majority of the volume in that application with (inaudible) the application because the application space is going to be controlled by a large web scale of all those that we know and love and talk about all the time. Some have an architecture that is more conducive to this than others. The early movers we talked about in the previous question, and I think you'll see Microsoft probably being the early mover on this one.

Rod Hall

Okay. All right.

Scott McFeely

On the pricing question you asked, I kind of look at it this way, and this is sort of our window into what we're seeing in the early days of the market pricing, but we believe in the optical WDM space, we've been for a couple of decades now in an environment that has seen certainly over the last decade capacity demands and our customers' network going up call it 20% to 30% a year.

You guys all know that the market size in optical WDM has been growing at probably on aggregate over that period of time in the low single digits year-on-year. The difference is price erosion. When you're dealing with price erosion year on year in the mid-twenties, probably in that range, if you do the math, if you draw, and that's on a cost per bit basis, so if you draw that curve out and you sort of extrapolate it into sort of 2022, 2023, when these technology starts to hit its stride in those volumes I talked about, it's all on the curve, no different, from our perspective.

You can make a decent business in that curve provided that you've got scale, which we do, and provided that you own a significant portion of the cost of the bill of materials, which we do. That's sort of our perspective on it.

Rod Hall

Okay. Thank you.

Gregg Lampf

Thanks, Rod. Jenny, we're ready for the next question.

Operator

Your next question is from Samik Chatterjee with JP Morgan.

Joe Cardoso

Hey, guys, this is actually Joe Cardoso on for Samik. Just one quick question from me. It seems like most or part of the discussion has been around this implement and total TAM opportunity at the edge where I believe the area that you guys would be displacing is these traditional routers being used today. Some of the incumbent vendors of the world that have been leveraging custom Silicon as opposed to merchant. I just wanted to get your thoughts around why you feel confident that Ciena can displace these incumbents leveraging merchants silicon.

Scott McFeely

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I think, it was Joe, was it?

Joe Cardoso

Yes, it's Joe.

Scott McFeely

Yes. Hi, Joe. I think what you were specifically referring to was where we show the app, the expansion of the TAM, and sort of the access part of the network?

Joe Cardoso

Yes, that's correct.

Scott McFeely

Yes. Okay, so first of all, I guess if I think the access part of the network, today, we do participate in that in our Routing and Switching portfolio, what we historically have called Packet Networking portfolio, and the application use cases there are enterprise business services, wireless backhaul, and sort of the aggregation networks in our service provider domain.

That part of the network largely has been from a packet forwarding perspective, and this is what I think you're referring to when you talk about merchants looking here as opposed to the optics. That part of the network has largely been with the main merchant Silicon for years now. Even if you look at the folks that control, have their own packet-forwarding basics (phon), their portfolio typically bifurcates where that sort of access part of the portfolio largely is done on merchant Silicon chips.

We use the same sources as that and have been in our practice for some time. I don't think that's a lever for differentiation at that part of the network. What has been a lever for differentiation in that part of the network is obviously software fit, operational fit, and the ability to deploy outside plants as an example, and deploy with zero-touch provisioning at mass scale, which we've been doing for years in our Packet Networking portfolio.

What is coming in to play as the Optilink links on these networks move from 1 gig in 10 days to 100 gigs, what's coming into play is an ability to differentiate is your coherent solution. In other words, it's sort of coming into our sweet spot, if you like, and that’s a new opportunity for us again, to use our coherent technology and strength there as a competitive differentiator.

If we go back to the sort of what's the sizing of the coherent market, it's going to be the application space and the coherent technology. I was speculating a bit on what you're getting out of your question, but hopefully, I answered it right.

Joe Cardoso

Yes, you did, and I appreciate the color. Thanks, guys.

Gregg Lampf

Thank you. Jenny, do prompt folks if anyone else wants to ask a question before we go onto the next person.

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Operator

If you have a question, press star, one, on your telephone keypad. Again, star, one, for a question.

Gregg Lampf

We can continue with the next person.

Operator

Your next question is from Meta Marshall with Morgan Stanley.

Meta Marshall

Great, thanks. I wanted to maybe ask a question on the CFP2-DCO, and just get a sense of the interest you're seeing in that today just given kind of a sole DSP provider in the market, and just get a sense of whether you're utilizing other componentry partners, or just your own Silicon Photonix technology given your announcements a couple of years ago about partnerships within the componentry space. Thanks.

Scott McFeely

Yes, good morning, Meta. It's good afternoon on the East Coast right down. I'll take the sort of where we see the application space for CFP2-DCO and the interest, and I'll pass it on to Dino to talk about the technology side and the sources of that. We largely see the CFP2-DCO as an evolution, and I guess the modularity aspects within our system business. That will show up on our Inverse Packet Optical portfolio on products like our 6,500 T-Series, etc., as well as in our Packet Networking, Routing, and Switching portfolio. We largely see the opportunity for us there integrated into our system offers, that's where the pool is. It's sort of an evolution from previous generations. The modularity that we got there was actually separation, if you'd like, the DSP and the electro-optics with the ACOs. That's the opportunity in front of us.

Dino, do you want to maybe double click on what's inside of CFP2-DCO from a technology perspective and the sources of it?

Dino DiPerna

Yes, certainly, Scott, and thanks for the question. The WaveLogic 5 Nano CFP2-DCO obviously leverages that sled I was talking about earlier, the one you would've seen in the chart deck. Our own DSP and the Silicon photonics in there, those are the critical performance defining parts. Of course, there's a laser, and in some cases, there might be other types of optical filters and things like that, depending on the application that we're working into. A good number of those come from our trusted partners in the industry as well. That's the lead.

In general, I would say even where we have our vertical integration and our critical differentiation, and as a strategy, we always look to have a couple of really solid sources just for security of supply. It's just good prudent management to make sure that we have a couple of sources for almost all of the key pieces, which we do, but clearly, the lead technology is our own in the WaveLogic 5 Nano generation.

Meta Marshall

Got it. Thanks.

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Gregg Lampf

Thanks, Meta. Jenny, we're ready for the next question.

Operator

Your next question is from Amit Daryanani with Evercore.

Amit Daryanani

Thanks for taking my question. I have a few, hopefully, quick ones. One, I think you mentioned wanting deployments ZR starting the back half of this year. Do you think you'll be forced to market or are there others that are ahead of you in ZR space?

What do you think you will be in terms of that volume production side or volume deployment? In your meeting the number of players or vendors that your customers want could be higher in ZR versus what you've traditionally seen, either want three suppliers versus two, probably historically, I would love to understand that part of it.

Secondly, I think you've talked a fair bit about vertical integration throughout the slide deck. I'd just love to understand what does that mean and what advantage does that give you in terms of pricing or go to market or something else. Thank you.

Scott McFeely

Hey, Amit, let me take the last one first, which is sort of the vertical integration piece. We pursued vertical integration, and this isn't just related to the pluggable piece. It's related to everything we do on the (inaudible) optics, primarily driven by two motivations.

One is where we believe key capabilities are required in order to drive the innovation to get to the next generation. We want to be in control of our own destiny, and therefore, on the key design aspects of that. That absolutely is probably, at the end of the day, the primary drivers for investing in our R&D businesses to be "vertically integrated." As Dino said, even when we do that, just as a good practice from a security supply perspective, we will bring on other sources in those areas for our security of supply.

Anecdotally, if you remember back in sort of some previous generations when we were talking about our time to market, we got a lot of questions on calls like this where people were basically saying we're scratching our heads because the ecosystem around what you're talking about from a technical capability is insane that they're going to be ready at the same time as you are. We kept saying that, we understand that, but we're telling you what our dates are.

The reason why we were doing that and we were able to do that is that control that I talked about around the innovation engine that was key to the next generation. That's sort of our belief system and the primary drivers for "critical integration." The secondary driver, of course, is the classical model of controlling the key cost drivers within the building materials of the solution. That's an important aspect in terms of being able to thrive as a business with a business model or an economic model that allows you to participate in the market pricing.

We don't necessarily set the market price as long as there's multiple players out there, and typically there is. The market price is going to be a competitive dynamic. How well you can survive and thrive in that market price is dependent on the cost (inaudible) integration piece.

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The first part of your question is sort of time to market. I think we're going to work in a good position to intercept the key build-outs on this application, (inaudible) application. A key part of it is going to be the ability to ramp with production units. You would have seen in the press that a number of folks have been out there talking about where they've been on this journey for a long time. I will point out that we have a different methodology in terms of how we build, develop, and ramp. Coherent technology comes from, multiple generations of doing it. It comes from, I'd say, an angle of BMR, other system providers, and (inaudible) the component providers, if you like. What it does mean is when we come to market with production quality and production map capabilities.

Maybe I'll let Dino talk a little bit about sort of the methodology a bit so you can kind of understand where we're coming up at this time and where we are in that journey right now.

Dino DiPerna

Yes. Thanks, Scott. I mean, you said it again, the key thing, as we talked about, we're providing production units now for the lead customers in this case. They are coming right off a production line. We put a lot of effort, obviously, in the design of the pieces and all that, and that goes through many years and these series of test chips and incremental approach so that we can own in on the final design itself. Even early on some of those prototypes, they're all built by our manufacturing team and our manufacturing process.

While we're developing the design of the actual componentry and the modem, we are designing the manufacturing flow, the test program, the calibration programs, all of these things that we've learned over many generations of coherent and decades of volume production, those things are going hand in hand and it's fully in parallel.

Quote unquote, when someone makes the sample, you can always put one together in a prototype shop. That stuff is coming off the production line right now. That means it's gone through production assembly, production calibration, production test programs, collecting statistics, iterations, etc., and flow through.

That's a big part of what Scott means when he says, our methodology, and that's one that we've honed over many years. It's true. It is a part of our whole system pedigree that causes us to think that way. It's one of the reasons why we still continue to surprise people and they say, well, you've just got your last part and a couple of months later, you're shipping volume and that's because we've spent the last year and a half or so perfecting the manufacturing process and tests. At the same time, we're doing the actual design of the technology.

You can't overstate that because it's really important, but if you haven't lived it, it's not obvious. Again, time and time again, it's served us so well in the ability to ramp the technology as soon as it's ready. That's why we feel pretty good about the timing at this point with the market.

Scott McFeely

Thanks, Dino. That was, folks, a fantastic set of questions and obviously lots of interest and we really appreciate the interest in this. Hopefully, the approach of the WebEx material early and then the Q&A worked for you. I'm sure we'd love to get some feedback on that after the fact but really appreciated the dialogue. Greg, we could hand it back to you to close.

Gregg Lampf

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Yes. Thank you. Thanks, Scott. Thanks, Dino. We appreciate you joining us and we really do appreciate the engagement. We know we went over but we wanted to make sure everybody had an opportunity to ask us their questions.

This is a dynamic topic. We certainly recognize that and we will continue to do so, and so we certainly would encourage everyone to stay in touch with us as they have more questions as things evolve. We're more than willing to continue to engage on this and other topics. Please do, as Scott said, take the time if you haven't to take a look at that recorded webinar and get us some feedback if you can. There's a lot of great information in there and we look forward to getting that feedback and your questions in the future.

Thanks, everybody. Have a great day.

Operator

That concludes today's call. You may now disconnect. Speakers, please hold.

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