



# **SOLiD: Optical fronthaul as an enabler of scalability in C-RAN and vRAN architectures**

**A conversation with Ken Sandfeld,  
Executive Vice President,  
SOLiD**

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By Monica Paolini

Senza Fili



## C-RAN at SOLiD

Over the years, SOLiD has developed RF amplifier, RF radio, and optical transport solutions designed to enable the densification of mobile networks and, hence, to support a massive but cost-effective increase in the capacity density through DAS and small-cell deployments.

SOLiD wants to ensure that backhaul and fronthaul do not become the bottlenecks in densification efforts. Instead, SOLiD aims to transform them into a scalable enablers that helps provide the capacity needed, where needed.

SOLiD solutions fit in organically to address the requirements of C-RAN topologies that include DAS and small cells, whether in indoor or outdoor locations. Working with SK Telecom in South Korea on the Smart Cloud Access Network (SCAN), SOLiD

has gained experience in the deployment of a commercial C-RAN deployment in a dense urban environment.

The premise at SOLiD is that densification, with its attendant need for a huge increase in backhaul and fronthaul capacity, requires not only a physical expansion of the optical transport network, but also a boost to its efficiency and a slash to its per-bit costs. Building out fiber is expensive and, as the density of the network infrastructure increases, scalability becomes an issue. As a result, SOLiD argues, a future-proof approach to densification requires operators to make the investment needed to optimize the use of the fiber assets available or being deployed.

SOLiD has been a leading proponent of DWDM, which splits a single fiber strand into multiple bidirectional channels to increase the capacity of fiber, multiplying the capacity of the link. Linear add/drops enable the operator to use the same

strand to serve multiple small cells, and to provide both fronthaul and backhaul.

The DWDM solution, INFINITY ACCESS, supports multiple protocols (e.g., CPRI, OBSAI and Ethernet) and can simultaneously support multiple access technologies (e.g., LTE and Wi-Fi) in the same strand. Operators no longer need to add a new fiber link when they add a new RRH or a small cell. And because DWDM allows operators to gradually add new links to the same strand, they can reduce their deployment and operating costs as they expand their networks.

The SK Telecom network includes 12,000 base stations and 80,000 RRHs, which are connected to BBUs in central offices or data centers. By using DWDM to increase the number of concurrent channels available, SK Telecom was able to increase the capacity of the existing fiber network without having to deploy new fiber where it was already available.

### SOLiD DWDM INFINITY ACCESS



Source: SOLiD

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**Monica Paolini:** Welcome to our conversation on C-RAN and fronthaul with Ken Sandfeld, Executive Vice President at SOLiD.

Ken, can you tell us what SOLiD is doing in the C-RAN and fronthaul space?

**Ken Sandfeld:** SOLiD is focused on the optical infrastructure for C-RAN, so the development and manufacture of unique optical network solutions at the physical layer that solve the problems that operators face when looking to build a C-RAN network topology.

**Monica:** What is it that you see, in terms of the C-RAN and fronthaul deployment? Because the end game is C-RAN. Fronthaul is what you really need to get there. What's the relationship between C-RAN and fronthaul?

**Ken:** The goal of C-RAN is to have the bulk of your processing done in a central location, and thereby increase the performance and the coordination of your assets right at the central office. The optical solutions provide the scale for the network, to be able to grow differently than previously was required.

With a C-RAN architecture, you're trying to push the assets back into the core, which means you have to change the way you deploy the topology on the access side of the network. This requires a different combination of network solutions, with the use of CWDM and DWDM. We have the capability of combining GPON, Ethernet and CPRI, all in the same fibers, thereby increasing the flexibility of the architecture.

We focused on the unique packaging of those solutions so that they better fit the network operators' requirements, because the traditional solutions just were not packaged and were not set up for that type of density. They were set up mostly for point-to-point links. This has enabled the operators to be able to design these networks and deploy them in this fashion. It really has to do with the number and type of services that you're trying to run across the cabling.

**Monica:** Why is it important to be able to mix and match different protocols?

**Ken:** It's very important, because no longer can you lease a dark fiber from point A to point B and say, "Well, that's all I need to do." The reality is there are going to be stops along the way. You might need to drop Ethernet for Wi-Fi. You might

drop Ethernet for a small cell on a pole, and that fiber asset may continue down that street and may also go into a building, where you might need to provide some broadband.

In the case of wireless operators in North America or Europe, that's not typically the case. In Asia, the same operator that supplies broadband to the building is supplying wireless, so it makes sense to have the ability to drop two different types of services.

However, in the end, the ability to mix and match those services on wavelengths is what's proving to be very powerful in the TCO of the solution.

**Monica:** This is a way to leverage your network resources in a more efficient way when it comes to C-RAN. Because what you often hear is that one of the major obstacles to C-RAN is that you're going to have cost savings, but the fronthaul is a big challenge because it's so expensive. How can you help with that part?

**Ken:** The upfront cost of the network – building new topology – is going to be higher than in the way we deploy today.

The reason it's going to be more expensive is that you don't have a ring. You're not trying to build a ring and then just add long access trunks off of that. You're essentially building multiple rings, and then you're building a whole new access network. That's expensive, because you have to put up new fiber in the ground, and you're going to go into locations where you've never been before. That's more expensive.

The benefit of doing so is that you have closer access to the nodes that you're going to use for future densification. You also have the physical-layer infrastructure, which we manufacture, that allows you to continue to add services without any additional fiber requirements.

By adding nodes out there – whether it be a small-cell node or whatever equipment is needed for the type of densification plans you have – the only requirement is a new card or the activation of additional ports into the ring. Wavelength services are what enable you to scale virtually on your fiber, and that's the most important benefit.

Not only can you scale in the quantity of ports, but in the type of service. Ethernet and CPRI are going to be interchangeable. You might even have to run both to a given node. You might have Wi-Fi at that same node as well. You may be supplying a radio head that's supplying service in the city for the Super Bowl, and at the same time, on that same pole, you're going to have Wi-Fi. You're going to need multiple services.

**Monica:** This sounds like a good TCO in the long term, although, on day one, you require substantial investment. Do you see that to be a challenge and something that is slowing down the deployment? Are operators ready to move on with this?

**Ken:** I've been watching this for three years, and it's just a very strategic investment. It's a big investment, and it requires a lot of change in the way things are done from a procedural standpoint.

I think those changes are still being made. Today, the procedures being used or the legacy procedures, legacy documentation, legacy steps for activating that particular device are one of the biggest problems. That's what's really slowing things down.

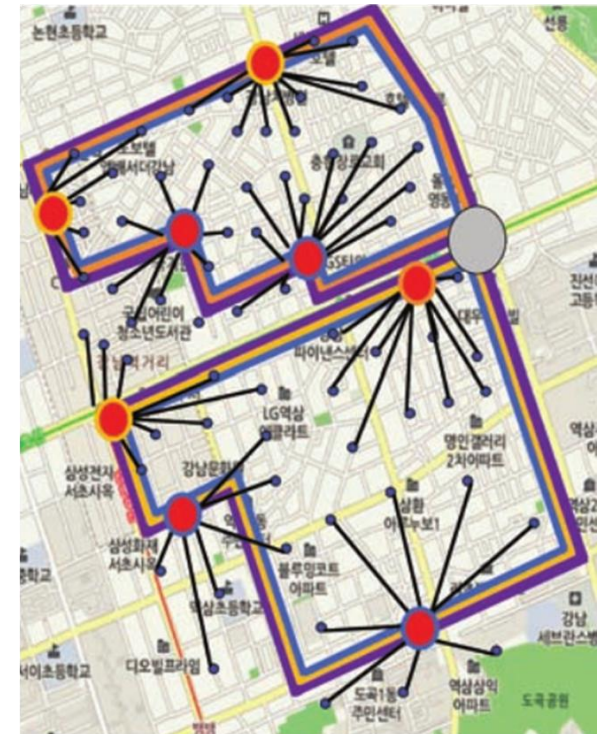
It's going to take some time for that to change, but I believe that this up-front investment is very strategic and requires a mind shift. It's just like the switch from 35-foot macro poles to 20-foot inner city poles. Even just by densification, you're effectively trying to cover less area. It takes time for everyone to learn how to adapt to those changes.

Plus we have a very robust macro network that we have to re-optimize. That's one of the steps in the densification with C-RAN: you have to reappportion the macro network to be able to accommodate all this densification. Actually, some of the macro locations will potentially even go away, because they're not suitable for that environment anymore. You're going to go from a big, tall pole and you're going to need lower locations.

Now, that doesn't mean that that physical location goes away. You may have a 20-foot shelter on it, you might actually repurpose it, and you might actually make that an aggregation point for all your fiber.

**Monica:** I wonder if you can comment on the differences you see in different regions. I know you do a lot of work in Asia, as well. What do you see that is different, in terms of the ability to have the strategic vision to move forward?

### SOLiD deployment with SK Telecom



Source: SOLiD

**Ken:** Well, a lot of people – almost everyone in the US, the North American environment – will tell you, “It's different over there.” Some differences have to do with the rules on fiber and the access to new fiber, as well as the rules associated with that carrier providing multiple types of services on that. We have different rules here, and that causes things to be a little slower.

However, from an LTE deployment perspective, the problems are the same. That means the solutions are going to have to be similar. Regardless of how they deploy, and how hard or



easy it is compared to the North American market, the physical challenges are the same. The topology is the same. It has to go together, physically, the same way.

The investment required is going to be substantial. It may even change the entire model completely. It's like when the carriers started selling assets to the tower companies. They're saying, "You know what? We don't really need all those."

We may be going through a similar revolution with densification, because now you need to put up a 15-foot pole or a light pole on the street, and who wants to own that? Does the city own it? Does a third party own it? Does the carrier own it? Those are things that we're going through right now, but it does come back to the fiber usage. Fiber is going to be a very important commodity as we go here. Usage of the fiber is what we're focused on.

**Monica:** But in North America specifically, isn't there a difference in terms of, in the US, we are more spread out than in Asia and even in Western Europe?

**Ken:** Well, the investment is certainly bigger, because when you're densifying to that level, you have more square miles of coverage to densify. The US has always been your big, NFL cities that you're going to try to serve first. Where is your population? But the reality is the physics.

This isn't the coverage days. This is the capacity days. There is no way to deliver that capacity without having a pole near that user. A lot of my folks from Asia travel to the US, and they're always

amazed that LTE service is a matter of a couple of bars, whereas in Asia, there's five bars everywhere. The reason there's five bars isn't that they have more RF coverage blasting through the window. It's because they have more devices close by to serve the customers. That's why they have such strong RF coverage.

Unfortunately, there's no easy way around it, Monica. The reality is we're going to start at the city cores and we're going to have to build out from there. We first have to make the strategic investment in the cities, city by city, and changing the topology of our network. That's one of the reasons you see so many people trying to do wireless connections to these nodes, because they're like, "Well, jeez. I've got to do a gazillion of these things. I can't afford to run fiber to all these."

I think those solutions are going to be very critical in the build-out of these networks. However, all of these services ultimately have to aggregate to these points in the network. The aggregation points could either be the existing macro-node buildings or they could be the other CO offices in the city, but the reality is it's still going to be a big shift in the topology of the architecture.

There's just no way around it. If we don't, we're going to be here many years from now talking about this. There's just no way around it. You hear people say, "It's a physics exercise," and it really is. It's just like Wi-Fi in that perspective. If you're not close enough, you don't get enough bandwidth. It's the same thing.

**Monica:** With small cells, it becomes more challenging because, as you say, there is already the issue of ownership, and it's also the issue of where you put them. They need to be very close to the users. The closer you get to the users, the more complex it gets to get fiber there. Getting fiber on a lamppost is more difficult than getting it onto a cell tower. What can operators do?

**Ken:** Well, I think that's where in-building coverage is going to come in. Today you have, in the city, down-tilted antennas and all kinds of crazy things to try to provide some coverage inside buildings. This is going to change with in-building solutions coming back.

I believe the enterprise and the building owners are going to take some participation in that. Some buildings are going to utilize their bandwidth there to supply their services to their facility. Just like they supply Wi-Fi today, I believe there are going to be network solutions that allow them to provide future licensed-band coverage.

That's something that we're all working towards in this industry, in addition to the fiber networks. SOLiD is very focused on those solutions as well. The pipes to the buildings may be paid for by that enterprise to supply licensed and unlicensed services. There could be co-participation deals. Once all that IP is controlled by a gateway to the facilities in that building, you can decide who pays for what.

When you get back to the city street, that's when they require more ownership and more planning for the carrier to provide that. That's clearly an

outdoor, public space, but there's going to be fiber down the street. There's no other way around it, whether it's leased, owned, trenched or wireless, that connectivity has to come into play. I believe they're going to do it one block at a time. They're going to do it one building at a time.

Seventy percent of North America's buildings are not covered. The average facility that you and I travel to in North America has no coverage. If it does, it's an old system and it needs upgrades. It's designed for 3G. You may have a little service because they added an eNodeB to it, but there's not enough bandwidth or enough density on the RF to make it even work properly.

Regardless, we're talking about a virtualized core. That's really designed so that we can deploy additional nodes in the densification faster. It's all about lowering the costs and increasing the speeds to deployment. The fiber network equipment is getting cheaper.

If you have to buy the fiber, dark fiber, it'd be nice if you could do not just one thing. Maybe you can do 48 things with that fiber. That's what we're all about, is really trying to make more use of that infrastructure in a more efficient way to lower your TCO, given that, eventually, you're going to have to invest in that infrastructure, so let's make it more efficient.

**Monica:** What is your proposition for C-RAN, to operators going through the transition?

**Ken:** Well, in the beginning, the carriers are going to deploy basebands and radio heads for outdoor

solutions as a migration for the current macro topology. This has been going on for a long time, and it's only recently that the whole C-RAN concept has emerged. But that's already being done, at a more traditional level.

If we need fiber going from point A to B and you have these smart radios on top of the poles – that's not densification. That's just designing a more efficient macro pole. How do you duplicate that times 1,000 in that area? The reality is, you can't. You have to change the way you deploy.

Right now, they're going to continue to try all the electronics to make sure they work. They're going to be testing all the software. I think the software's probably one of the biggest reasons why it's been slow. They're trying to test all the software so that they can deploy these things quickly and have all the interference be managed automatically, so they don't have to do so much planning every time they make a little change. That's going on right now and has been for years.

Once you get to the next step, how we're going to be able to help them is, they're going to say, "Well, jeez. We don't need to deploy 10 sites here. We need to deploy 100 or 1,000. We know we have fiber in these areas." The fiber companies are going to become a real big part of that. They're going to take the carrier-owned fiber assets, they're going to take assets that they can lease or acquire some other way, and they're going to design new topologies from that perspective.

We're going to be able to provide the physical electronics and the optics to utilize all that

infrastructure. But it's not until they make the decision that they need to build their network that way that we really come into play.

One of the reasons we haven't really kicked off in a huge way in the North American market is that we haven't gotten to that problem point yet. Right now, carriers may tell you, "Well, I have enough fiber going to that pole. I have 12 strands going to that pole. What else do I need?" Well, it's not until they need to build 10 poles around that pole that they go, "Oh, my gosh, I don't have enough. I don't have any fiber." But they know they have the 12 strands going to that pole, so once they know they have that, they say, "Well, we know we have 12 strands going to this pole. There's a shelter next to it. We know we have connectivity at that point. Now, how do we get to the other 100 poles that we're going to put up around that?"

That was their way of looking at it. "Let's use what we have from a network. We've been investing in it for years. Let's try to see what we have and then kind of scale around that."

That's where the C-RAN optical network solutions really come into play, because you have 12 strands, so now how do you make better use of those 12 strands? The reality is, right now, those 12 strands are 100% full. Once we go to the C-RAN topology with the optics, we're probably only going to end up using 2 or 3, because we're going to take those 2 or 3 and we're going to create 48 virtual paths or more on every one of those fibers.

Now, all of a sudden, those 12 strands, we've got lots of excess capacity. That's where the TCO

model is just awesome. Because now, when the next year comes 5G and the next year comes whatever, now we have plenty of growth and scalability in our infrastructure to be able to add more channels into this architecture and grow however we need, up to a certain extent – up to the physical assets that you’ve acquired.

**Monica:** Let me ask, in closing, what should we expect from SOLiD over the next few years? What are your directions of development, in terms of products, trials?

**Ken:** As we’ve been working through all of the C-RAN possibilities in the Asia markets and actually learning with the carriers what’s working, what’s not, we’re modifying our products. We have a lot of new patents and new technologies that we’re looking to bring to market.

These aren’t just run-of-the-mill optic solutions. These are new, patented ideas and architectures that are totally different than the way things are deployed today. A lot of people commonly lump optics: “Well, it’s a piece of optic cable and you put stuff on both sides.” Yes, but how you package that and how you put that all together and how much you can do across a fiber is something of an art form and a science.

You’re going to see a lot of new, exciting solutions coming out of our factory. That’s obviously going to be combined with the coverage enhancement solutions on DAS, as well as other radio solutions that come from SOLiD.

We are actively looking at all aspects of the densification of the network. We’re focused on new technology as specifically geared towards making the C-RAN network deployments much more cost effective and much more powerful for the network operator. I think we’re right at the cusp of that starting. I think we’re right at that point.

## Glossary

<b>3G</b>	Third generation
<b>BBU</b>	Baseband unit
<b>CO</b>	Central office
<b>CPRI</b>	Common public radio interface
<b>C-RAN</b>	Cloud RAN
<b>CWDM</b>	Coarse wavelength-division multiplexing
<b>DAS</b>	Distributed antenna system
<b>DWDM</b>	Dense wavelength-division multiplexing
<b>eNodeB</b>	Evolved NodeB
<b>GPON</b>	Gigabit Passive Optical Networks
<b>IP</b>	Internet Protocol
<b>LTE</b>	Long Term Evolution
<b>NFL</b>	National Football League
<b>OBSAI</b>	Open Base Station Architecture Initiative
<b>RAN</b>	Radio access network
<b>RF</b>	Radio frequency
<b>RRH</b>	Remote radio head
<b>SCAN</b>	Smart Cloud Access Network
<b>TCO</b>	Total cost of ownership
<b>vRAN</b>	Virtualized RAN

**This conversation is included in the Senza Fili report  
“Charting the path to RAN virtualization: C-RAN, fronthaul and HetNets,”  
prepared in collaboration with RCR Wireless News and available for download  
from [www.rcrwireless.com](http://www.rcrwireless.com) and [www.senzafiliconsulting.com](http://www.senzafiliconsulting.com).**

## About SOLiD



SOLiD (<http://www.solid.com>) helps keep people stay connected and safe in a rapidly-changing world through a portfolio of RF Amplifier, RF Radio and Optical Transport solutions. SOLiD enables indoor and outdoor cellular and public-safety communications at some of the world's best-known and most challenging venues including leading hospitals; professional, and college sports venues; government, university and Fortune 500 corporate buildings and campuses; international airports and metropolitan subways; and other high-profile sites. For further information on SOLiD DAS, Backhaul and Fronthaul solutions, go to [www.solid.com](http://www.solid.com) or call 888-409-9997.

## About Ken Sandfeld



As Executive Vice President, Ken Sandfeld leads the overall sales and product strategy activities for the SOLiD's portfolio of network densification solutions. Ken possesses over 17 years of experience in the wireless infrastructure industry and is passionate about bringing innovative technologies to market. Prior to his current leadership role, Ken held management positions at MobileAccess, Remec, Spectrian and Zyfer. Today Ken is focused on bringing SOLiD's leapfrog technologies out of incubation and into the market to solve some of the industry's biggest problems. Those areas include high-efficiency amplifiers for indoor and outdoor small cell applications as well as low-cost DWDM tunable optical solutions for the Enterprise and Wireless Operator markets.



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We provide a bridge between technologies and services, helping our clients assess established and emerging technologies, leverage these technologies to support new or existing services, and build solid, profitable business models. Independent advice, a strong quantitative orientation, and an international perspective are the hallmarks of our work. For additional information, visit [www.senzafiliconsulting.com](http://www.senzafiliconsulting.com) or contact us at [info@senzafiliconsulting.com](mailto:info@senzafiliconsulting.com) or +1 425 657 4991.

## About the interviewer



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](mailto:monica.paolini@senzafiliconsulting.com).

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