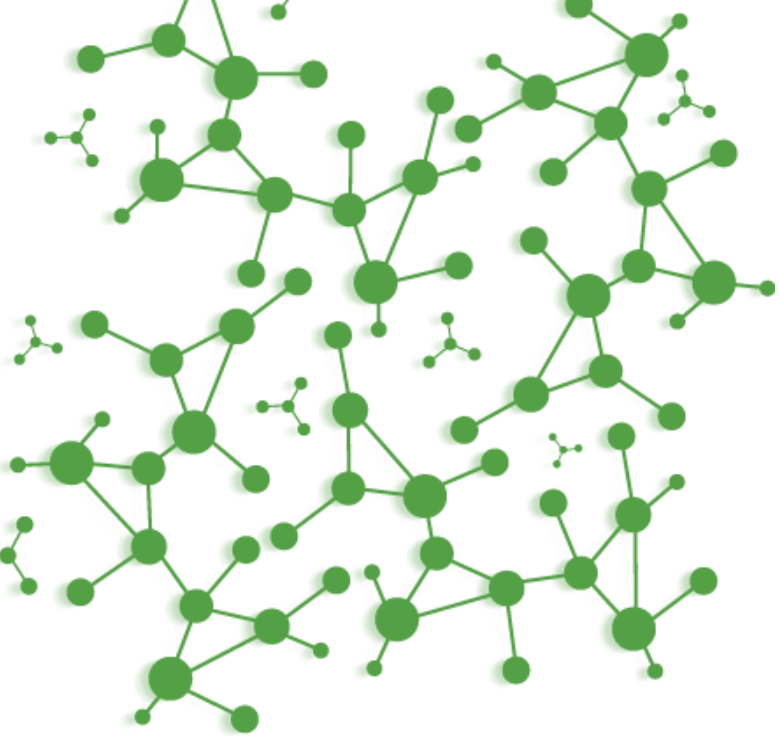

Expanding the utility of fiber in small-cell deployments

A conversation with Saeed Anwar, CTO SOLiD Technologies

By Frank Rayal
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Frank Rayal. Hello and welcome to this conversation with Saeed Anwar of **SOLiD Technologies**. My name is Frank Rayal. This conversation is part of a Senza Fili report on small-cell backhaul that gives an update on the small-cell backhaul solutions and on the evolution of mobile operator requirements for small-cell backhaul. Today we are talking with Saeed Anwar, CTO of SOLiD Technologies. SOLiD is a leading provider of advanced distributed antenna systems, commonly known as DAS. Saeed, welcome to this conversation. Thanks for being with us today.

Saeed Anwar. Good morning. Thank you.

Frank Rayal. I would like to start by asking you for a brief introduction about SOLiD Technologies.

Saeed Anwar. SOLiD is from South Korea. Our R&D and manufacturing is done in Seoul. The US operation is sales, marketing and logistics for distribution of the product into the North American markets. We are primarily selling DAS, both indoor and outdoor DAS, in North America, and we also have fiber optics for fronthaul and backhaul.

Frank Rayal. So the product that you are providing that is specifically targeted at the small-cell solutions, I believe is called Infinity Access.

Saeed Anwar. Yes.

Frank Rayal. Help us position this product. Tell us what it does and some of its features.

Saeed Anwar. The product is a DWDM (dense WDM) technology product. It has the capability of channelizing a single fiber strand into multiple bidirectional channels. The technology itself can handle 32 bidirectional channels. The form factor that we use allows us to do 16 bidirectional channels. With a single fiber strand from the hub site, where all the heavy equipment is, we can take the signaling and transmission over a distance and do 16 linear add/drops off that single fiber to wherever the small cells are, whether they are on a wall or lamppost or street furniture.

Frank Rayal. You mentioned fronthaul. Fronthaul is a relatively new name in the industry. Can you tell us more about what fronthaul is and how you define it?

Saeed Anwar. Let's start off with backhaul first. Backhaul is basically from the base station. The typical protocol that you use is Ethernet, linked back into the port.

For fronthaul, the base station itself is split in two parts. There is the baseband processing and there is the antenna system itself, which we call the remote radio head. The link between those is what is called fronthaul. It is traditionally designed for macro deployment, where you have the baseband unit at the base of the cell tower and the remote radio heads at the top. It is a fiber-based system using a protocol called CPRI, and from there people have learned that you can actually take that remote radio head and

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distribute wider. Some people are deploying it over distances of tens of kilometers, and that is what we refer to as fronthaul in the industry.

Frank Rayal. So how about the applications of the Infinity Access, can you describe a few deployments in areas of how the system can be used?

Saeed Anwar. The small-cell deployment is one scenario. Using a single strand of fiber, you can do 16 linear add/drops on that fiber to street furniture, where the small cells are. That linear add/drop can simultaneously handle both backhaul and fronthaul.

Other deployments on where we use Infinity Access are in what I consider regular telecom and enterprise environments, where you have fiber capacity shortage and you want fast relief without retrenching or bringing more fiber. It is an easy way to add capacity on that fiber run.

Frank Rayal. So in terms of the deployment of your system, let's say I have a base station and I want to cover a certain area, whether it is indoor or outdoor. What are the interfaces, and how do you deploy your solution?

Saeed Anwar. Well, the protocol for that particular scenario, as I said, CPRI. There is another version called OBSAI. The scenario for that is really, at the current time, more outdoors.

Macro cells are split into baseband and remote radio heads. And we are seeing is a new form of micro cell: The one-watt systems that are considered small cell and also have the same fronthaul interface going back into a data center. So those two are the two primary scenarios that we see.

Frank Rayal. Where do you see most of the deployments of your system, the Infinity Access, and what type of environments do you see the operators deploying now?

Saeed Anwar. We see that in metro areas, where micro cells provide coverage in a concentrated area.

From a macro perspective, we also see a deployment scenario where you are deploying macro sites, but for efficiency you are trying to take the baseband processing and centralizing it into a small base-station hotel.

Frank Rayal. When it comes to small-cell backhaul, wireless has been widely promoted because the fiber infrastructure can be not as extensive as to reach every single point where the small cell is going to be deployed.

With your solution, do you see that being deployed mainly in indoor environments or outdoor? And how do you make the business case for it in the outdoor case, where the availability of fiber can be an issue?

Saeed Anwar. Certainly for indoor deployments we can use an Infinity Access.

For outdoors, in metro areas, we see a lot of fiber. Outside of the metro areas, yes, fiber is questionable. Because of the way Infinity Access is designed, it is a very efficient use of the existing fiber, so we can certainly use Infinity Access in a metro environment where the fiber does not exist, in combination with a wireless solution. For example, if you want a small cell on the one side of a street but the fiber is on the other side, then we would use wireless technology to bridge the gap.

Frank Rayal. You mentioned you can add or you can put 16 channels on one fiber strand. Is that the capacity of the card, or is it the hub capacity?

Saeed Anwar. That is the hub capacity.

Frank Rayal. And the 16 channels can be anything ranging from CPRI to Wi-Fi, Ethernet or any other type of channel, is that correct?

Figure 1. Infinity Access Optical Line Terminal (top) and Optical Network Terminal (bottom). Source: SOLiD Technologies.

Saeed Anwar. Yes. The primary channel protocols that we use on fiber are CPRI and Ethernet.

Frank Rayal. What are some of the other main features of your solution, and how do you compare your DAS solution to others?

Saeed Anwar. I think there are several factors. The biggest factor is the use of a single fiber strand for multiple drops. Second, within the Infinity Access, we have linear drops, which provide the capability for passive bypass of the site for maintenance or power outage.

So imagine if you have 16 drops down a street and one of your cell sites there is down because power to the building or lamppost is out. The other sites are totally unaffected because of the passive bypass.

Frank Rayal. When you look at DAS systems, what are some of the key differentiating parameters? Where does your solution differentiate on these parameters?

Saeed Anwar. From a DAS perspective, the parameters you are looking for are, first, the distribution coverage from a single point to a multipoint environment: What is the capability of the system to provide the widest coverage per RF? Efficient fiber usage is a second one. The ability to multiplex both cellular signals and public safety at the same time is a third one.

And then obviously there are several RF KPI metrics that you would have to consider. Another one that is significant is how you roll individual cell providers onto the system, and that is basically what we call our power-level settings for existing carriers after you bring on new carriers. This is a form of protection for existing carriers there.

Frank Rayal. There seems a debate on what is a small cell, and many people also consider remote radio heads as being a small cell, which in the pure definition of LTE-Advanced, it is. Where do you see operators deploying remote radio heads versus compact base stations, and how do you see the backhaul to these two things playing?

Saeed Anwar. Well, there are different scenarios. Obviously SOLiD has a very extensive remote-radio head deployment within South Korea, but in the US what we are seeing is remote radio heads first for hotspots, and others in areas with rapid increase in population like North and South Dakota.

The basic reason for deploying remote radio heads is an easier and a faster way to deploy RF without having the elaborate balancing issues you have with compact base stations. With compact base stations, you still need to make sure that all the interference issues are cleared up. With remote radio heads, you can deploy a lot of remote radio heads, especially if they are in the same baseband, without any interference, so it is an easier technology to deploy from that perspective.

Frank Rayal. In terms of the economics, do remote radio heads have an advantage, in certain types of deployment, over the compact base stations? How does the DAS system itself or the backhaul over fiber play in that type of a scenario?

Saeed Anwar. From an economics perspective, compact base stations would be prevalent from a capex perspective, but, from an opex perspective, the remote radio heads can be easier to manage, even more than compact base stations, primarily because of all the analysis that you would have to do for RF interference issues. For the backhaul, I think the compact base stations would be easier because you have multiple tools in your tool bag for compact base stations because you are carrying Ethernet. But for remote radio heads you will definitely need fiber.

Frank Rayal. I think that is one of the major issues. When it comes to remote radio heads, we are talking about gigabit per second in terms of throughputs, and when we talk about compact base stations, it is tens or hundreds of megabits per second.

In terms of evolution and roadmap of your product, where do you see this product heading?

Saeed Anwar. We certainly believe that Infinity Access is going to be deployed for small cells in high-density metro areas where there are existing fiber providers or a substantial fiber plant. We also plan on evolving the technology for our next-generation digital DAS systems that will combine the ability of carrying compact base stations and remote radio heads into what we call multiband, multiprotocol systems.

Frank Rayal. Can you detail for us the difference between the analog DAS and digital DAS?

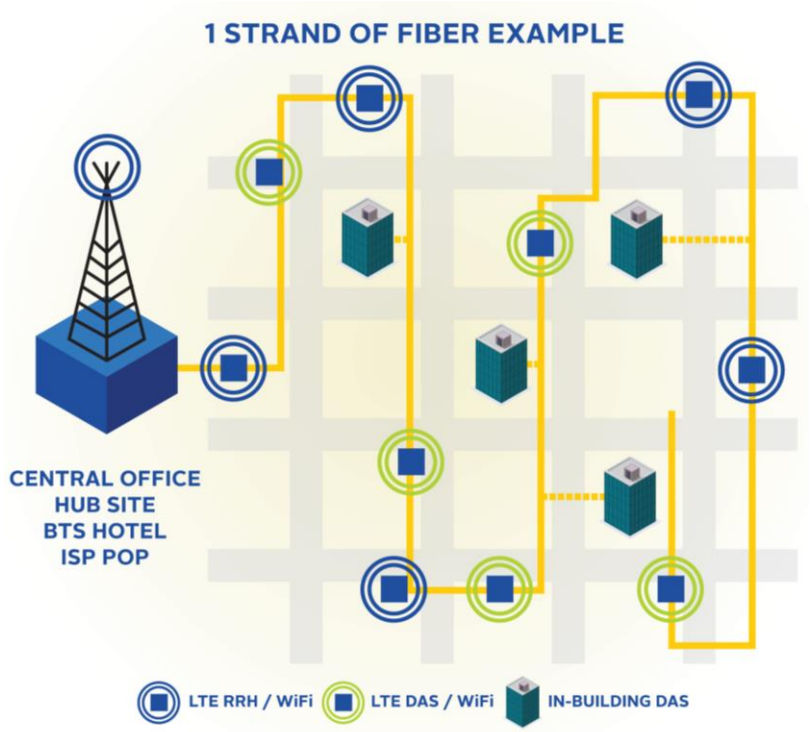

Figure 2. Infinity Access provides up to 16 multi-band, multi-technology add/drop capability over a single strand of fiber. Source: SOLiD Technologies.

Saeed Anwar. In the analog DAS system, we take all the band and protocol feeds from the base station, and combine them in our RF mixer. Then, we translate that RF from coaxial cable to fiber, we place that particular feed, once it hits the fiber, onto a WDM frequency, and finally carry that frequency over a distance. It is very similar to a cable plant. When you are receiving TV signals in your home from the hub site, you are taking fiber first, and then eventually you take coax right in front of your house.

The DAS fiber system is very similar. At the remote node, we convert the fiber to coax, which then goes into the antenna.

On the other hand, in digital DAS systems a remote radio headend is used which is connected to the baseband module through fiber. The interface between the RRH and baseband can be based on CPRI or OBSAI standards.

Frank Rayal. In terms of your view on the small-cell market, whether it is RRH or a compact base station, how do you see that evolving, and where do you see some of the main deployments happening right now?

Saeed Anwar. Obviously in heavier-density areas, the distance between cell sites is much smaller than in rural and suburban areas. With the deployment of LTE-Advanced, we see the distance is shrinking further. The primary reason for that is, if you consider cell sites today, that they do not talk to each other, they are talking back to core. In LTE-Advanced they will be able to talk to each other.

When two cell sites are talking to each other and the system is designed so that the connection goes back to the core and then comes back again, there are going to be substantial latency issues. This is where we see the advantage of our technology, because it is ultra-low latency. From an end-to-end connection basis, our latency, not including the fiber, would be around 120 nanoseconds. Our jitter is also extremely low, 6 nanoseconds. When you total that up, we provide a very good environment for LTE-Advanced compared to other technologies.

Frank Rayal. A low latency and jitter are important for some LTE-Advanced features, like coordinated multipoint, which requires very close synchronization between the different base stations or the transmitters.

Any other thoughts that you would like to add in terms of your product line and where you think you are heading with the solution?

Saeed Anwar. Small cells include Wi-Fi also. We are using the same technology to provide Wi-Fi within the same environment as DAS. For example, if you take a sporting venue deploying enhancements for cellular services, most of the venues are also asking for Wi-Fi. This is not just from an offload perspective, but because they are also providing other services within the venue, like video. There is a lot of traction on video, which is used for things like instant replay to keep the fans within their seats. We are taking Infinity Access as a first stage, even for digital DAS, and moving forward with Wi-Fi within stadiums.

Frank Rayal. And obviously with your type of system, you can put Wi-Fi and LTE, whether it is a remote radio head or a compact base station, and all that can be multiplexed on a single fiber strand and distributed to multiple locations.

Saeed Anwar. Correct, yes.

Frank Rayal. All right, Saeed, I would like to thank you very much for being part of this conversation.

This conversation is part of a Senza Fili report on small-cell backhaul that provides an overview on small-cell backhaul solutions, along with in-depth conversations like this from leading vendors who opted to participate in the report. The report can be downloaded from the Senza Fili website at **www.senza-fili.com**. I would like to thank the audience for joining us today, and Saeed, again, thank you very much for being part of this conversation.

Saeed Anwar. Thank you.

Acronyms

CPRI	Common Public Radio Interface
CTO	Chief technology officer
DAS	Distributed antenna systems
DWDM	Dense WDM
KPI	Key performance indicator
LTE	Long term evolution
NLOS	Non line of sight
OBSAI	Open Base Station Architecture Initiative
R&D	Research and development
RF	Radio frequency
RRH	Remote radio head
WDM	Wavelength division multiplexing

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About the author

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