Fujitsu:
Building end-to-end support for C-RAN and virtualized RAN

A conversation with Femi Adeyemi, LTE Solutions Architect, Fujitsu

By Monica Paolini
Senza Fili

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C-RAN at Fujitsu

Experienced in providing transport and access solutions, Fujitsu offers a comprehensive set of C-RAN solutions to give operators the flexibility to meet their fronthaul requirements with resources they already have.

At the same time, Fujitsu has been very active on the access side, with its remote radio head and small-cell products. This gives the company an end-to-end perspective in the solutions for C-RAN that are available and being developed.

Fujitsu solutions support multiple interfaces – including CPRI and Ethernet – and transport options: dark fiber, OTN, PON, TWDM, CWDM and microwave. The array of solutions allows operators to balance cost, latency and performance tradeoffs. For instance, dark fiber is preferred where fiber is ubiquitous and affordable. But in many small-cell deployments, fiber is unavailable or too expensive, and operators need a wireless solution that meets fronthaul's requirements for latency and throughput and supports the chosen interface, which today is CPRI in most cases.

Fujitsu's BroadOne GX4000 is a wireless fronthaul solution to connect RRHs to a centralized BBU. This enables operators to include small cells in their C-RAN plans and, thus, more effectively manage interference using the X2 interface through tools like CoMP and eICIC.

The GX4000 uses the e-Band spectrum (71–76 GHz and 81–86 GHz); that spectrum is license-exempt and provides high capacity, at very short distances. This is an advantage for tightly packed small-cell fronthaul, which is typically needed over short distances to bridge the link from an outdoor small cell to the closest fiber aggregation point (often the macro cell). In addition, the use of short, narrow links is conducive to low interference levels. Low power consumption, small footprint and low equipment costs are additional advantages.

Using Fujitsu's Impulse Radio technology, the GX4000 can carry up to 3 Gbps uncompressed per link, with per-link latency lower than 20 ms when using CPRI, according to the company. Operators can use Fujitsu's NETSMART 1500 Management System for provisioning, operating and maintaining the wireless fronthaul links.

The FLASHWAVE® product line provides a set of complementary transport solutions that use packet optical networking, and also support the CPRI and Ethernet interfaces. These products can also be managed by the NETSMART 1500 Management System. The FLASHWAVE platform includes OTN, PON and CWDM, well suited for fronthaul. The choice among these alternatives has to be assessed in light of the impact that the adoption of the CPRI features may have on latency; that, in turn, affects C-RAN performance.

Fujitsu GX4000 E-Band Radio

Source: Fujitsu

Building end-to-end support for C-RAN and virtualized RAN

A conversation with Femi Adeyemi, LTE Solutions Architect, Fujitsu

Monica Paolini: As part of the report on C-RAN, today I'm talking to Femi Adeyemi, LTE Solutions Architect at Fujitsu.

Femi, could you give us an introduction to what you're doing with Fujitsu on the C-RAN front?

Femi Adeyemi: I've spent the greater part of my career in the wireless industry, building base stations and base station routers, and now I'm involved with Fujitsu on defining the next LTE architecture, for both small cells and fixed wireless.

Monica: There's really a lot of work to do there, because often we think of C-RAN as moving the baseband to a remote location, but there is much more to the C-RAN architecture than just having a remote baseband. At Fujitsu, how are you trying to capture the whole change that accompanies C-RAN?

Femi: We're looking at C-RAN as a total solution, both in the present and as we march into the future. For us, like you just described, it's not just remote radio heads and centralized basebands. What we're finding out is that as you add more and more access technology, remote radio heads, small cells, the likelihood that you're going to introduce a lot of data into your core is very high.

We see this as a complete solution, where we understand what is going on at the access, understand the transport (CPRI or other fronthaul transport), understand the core, as well as all the individual chains that you need as you go from that access into the core. So, access, transport, aggregation points, as well as the core.

We're looking at this as a complete solution. For us that's very important, because we don't want to look at it as a disjointed technology on the access or the baseband centralization or virtualization. We see this as a total solution.

Monica: Let's start with the access. What do you see there?

Femi: On the access, we're very active in small-cell deployments. We build our own small cells solutions both in Asia – and deploy them in Asia – as well as in North America, both in the US and Canada.

Fujitsu has been very well renowned for building very reliable remote radio heads that have been deployed in many mobile networks today. On the access site, when we talk about remote radio heads, we are very prominent in that area, as well as small cells for enterprise and residential use. On the access side, we're very, very active.

Monica: That's step number one. The second step is the transport. This becomes more interesting and challenging at the same time, when you talk about having a C-RAN architecture in conjunction with small cells.

Femi: Right.

Monica: Because of the requirements. What's going on there?

Femi: That is very correct. There is a stringent requirement for sending your I/Q samples from the baseband unit to the remote radio head.

In the industry, the technology you will have heard about is CPRI transport. On that fronthaul transport, we want to give operators flexibility and to allow them to choose, depending on cost and depending on deployment scenarios, which technology they want to deploy.

At Fujitsu, we're really looking at three different areas in fronthaul transport. Number one is what we call active CPRI transport – for example, where we are able to monitor what is happening with remote radio heads while we are still in this centralized location, which is a little bit more expensive but gives you visibility into what is happening between your remote radio head and a central location on your fiber.

For operators that are interested in cutting cost or not really concerned about what is happening at the remote radio heads, we have a passive solution as well: CWDM- and TWDM-based passive solutions.

Now, there are instances also where, for example, you have small cells that are outdoors and you

want to transport your data back to a centralized location, and you don't have access to fiber. For this scenario, we have a wireless transport solution that is E-band based.

We covered all the areas that will be very interesting to any operator. If you are interested in cost saving, we have the solutions for you. If you're interested in monitoring what is really happening among your fiber links, it's available from Fujitsu, as well as if you do not have access to fiber and have to transport your data back into the core.

Monica: Basically, an operator can decide how to mix and match. It's not necessary that one operator only have one solution for a whole network depending on where they are. It can get whatever works better for them.

Femi: That is correct. If you go back into what we've been discussing, we look at this as a complete solution. We don't want to limit the operator. We want to give you what is available based on cost, based on fiber availability, as well as based on network topology that the operator may have today.

Monica: Let's go to the next stages: the core and the aggregation. What are you doing in those parts?

Femi: As we look at the deployment that is going on today, going from the distributed RAN into what we call centralized RAN, as well as the next stage of virtualized RAN, we don't want to come into the industry with technologies that will not be deployable. We want to follow what the operators are really interested in.

Today we are moving from the distributed RAN into the centralized RAN. At the centralized RAN port, we have baseband aggregation happening. In the terminology in the industry today, we call that building baseband hotels.

We have a solution in that space, whether it's for small cells or for a macro cell. This will vary in the number of baseband units we are able to aggregate together, whether you want to aggregate a large number of basebands or a small number of basebands.

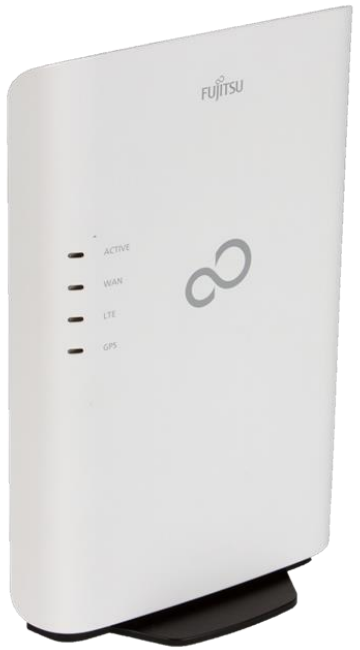
Then the next logical step for us is to virtualize that baseband. We've been able to operate this in the cloud along with some specialized devices, so that we move in these three steps that I'm describing: moving from the distributed RAN to a centralized RAN, and then into the terminology that I would call a cloud RAN, which will essentially virtualize the baseband hotels that you have.

With the baseband hotel, it's now easy to deploy logically, adaptively, sharing resources between the different baseband units that you have in the hotel.

Monica: So it's more than just a one-step process here. How do you see operators moving across this transition, especially those that already have a network and have to deal with legacy deployments? They have to look backward and forward. They need to look forward, but they also need to take into account what they already have.

Femi: That's a very good question, in the sense that we're running into scenarios – particularly

Fujitsu in-building LTE small cell



Source: Fujitsu

with established operators – where they already have a topology for their RAN architecture today.

Now, you can go in and ask them, "Oh, you want to deploy C-RAN architecture; let's pull apart what you already have and just start building from scratch." But that would lead to disruption in their service. What we're finding is that we have two layers that we're looking at, where we start with the existing architecture today, and when they plan for an expansion of the current topology, we build that out as cloud RAN, or C-RAN.

We keep what they already have in their network RAN architecture, but extend out our C-RAN to their new deployment or attachments to their existing architecture. That's one scenario.

Another scenario is when they have a fresh greenfield deployment. Now we begin to think about complete C-RAN architecture for such greenfield deployment.

We want to make sure we work with the operator and get the best out of existing technology while we introduce this C-RAN architecture. There are issues that we come across as we do this. They have an existing transport layer. We want to make sure that the new C-RAN architecture works with the transport that they already have in place.

It's a two-stage process. We are not going in to break apart what they already have; we're building C-RAN on top of existing architecture and then, in the future, also think about pulling out what they have today, so that we can completely make it into C-RAN architecture.

Monica: How long will all this take?

Femi: It's ongoing, even as we are having this discussion. We are working through all these issues of transport. I can give you an example. We talk about CPRI fronthaul transport, which we are now going to integrate with, in most cases, fiber transport, as well as with Ethernet transport.

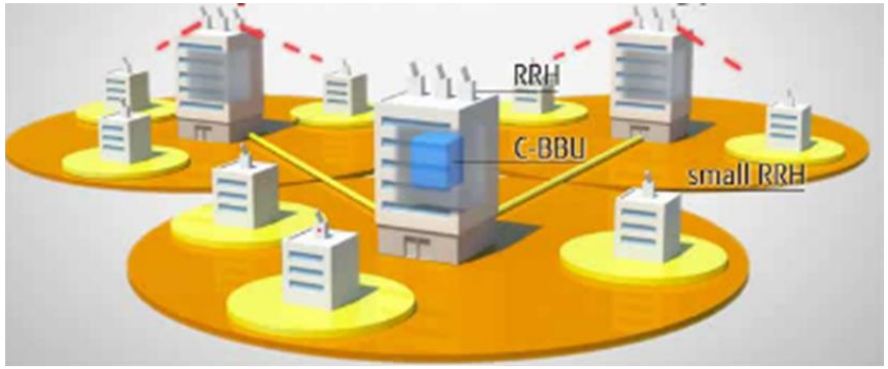
We are working through those issues, and within the next 12 to 18 months we are getting very, very close to fully deploying C-RAN architecture with most, if not all, operators in North America.

Monica: What about the rest of the world?

Femi: Well, C-RAN is actually very, very prominent today in Asia-Pacific, in South Korea, in Japan. Because of the dense population that we have in Tokyo, for example, C-RAN is already being deployed.

C-RAN is nothing new to the rest of the world, it's new to North America. But we are also finding that in our metropolitan areas, we can replicate what we are currently doing with C-RAN in Far Asia in the US, for example.

Centralized BBU and distributed RRH via CPRI interface over fiber and wireless links



Source: Fujitsu

Monica: In terms of the virtualization, the end target is to have all the network virtualized, and use generic hardware that can help support any processing.

Do you think it's possible to have COTS hardware for all the RAN functionality? There is a lot of debate as to whether we can go all the way there or at some point we need to keep specialized hardware. You still may need specialized hardware for some of the RAN functionality. What is your view on that?

Femi: You're absolutely right. Using generic servers to virtualize baseband functionality will not be completely possible, because of the kinds of data that need to be transported between the baseband and the remote radio heads.

My view is that we can virtualize much of the baseband, but we will still need specialized hardware when it comes to switching, for example, so that we can do high-speed switching of the I/Q samples that are going from the baseband into the remote radio heads.

It is not completely possible to virtualize the baseband without some form of specialized hardware. We will still need a little bit of specialized hardware to accomplish this.

Monica: Now, we talked a little bit about small cells before. Some people think that small cells and C-RAN don't mix very well. Others think that C-RAN is actually what small cells need to succeed. Where you do stand on that?

Femi: What is very important about small cells is that we are able to do away with all the large-scale network planning that needs to happen, which is what we have today in our current RAN deployment.

Today, in your RAN deployment, we do what we call network planning. You have to know where this RAN equipment is located, what it is doing, before you can introduce new equipment. If you don't do that planning properly, there will be all kinds of interference.

Now, with small cells and the way SON has been defined, the SON capability that small cells have is really going to help a lot. Because with SON, we arbitrarily place small cells anywhere we want to, and that can be managed from a centralized port.

My view is that C-RAN really needs a small cell to be more effective, because we can introduce remote radio heads, we can introduce small cells, such that they can work together interchangeably without having to worry about network planning as well as interference.

So you're right. A small cell is needed for effective C-RAN deployment as we go forward.

Monica: Let's go back to the operators. Short- to medium-term, what do you see that they're mostly focused on?

Femi: Operators today, they're mostly focused on integration. We know that C-RAN works. It has been deployed effectively in Asia Pacific. But the topology that we have in North America has a unique mix of metropolitan areas as well as rural areas.

That integration of bringing in C-RAN into this topology that is peculiar to North America, where the challenge is, how do we migrate from what we have today into becoming C-RAN? Do we do it gradually, or go on and break what we have today and just start from a clear playing field? And the latter is not possible, by the way.

The third and final challenge that I see is, how much do we currently have in our transport to support what we are bringing in? A lot of studies have been done in terms of how do we do this for a new greenfield deployment. Do we marry it with our existing RAN architecture or RAN deployment, and is our core ready to support the kind of data that we're going to bring in?

Those are the things that the operators today are going through, fleshing them out as we get ready for the full-blown deployment within the next 18 months.

Monica: Then, as you say, transport is going to be a crucial part, because that's what enables C-RAN. If you don't have the fronthaul that performs at the right level, then everything else becomes a moot point. In that respect, there has been some debate in terms of using the CPRI interface: is it really necessary or not? What are your thoughts on that?

Femi: In depends on what is really good for the operator. In many of our metropolitan areas, even when fiber is available, it's very difficult to deploy – whether it's a function of breaking new ground to allow this fiber to be placed or, in other areas, fiber is just not even available.

CPRI for transport is going to be very prominent in C-RAN. That's why, at Fujitsu, we don't want to limit the operator in terms of what can be used. In cases where fiber is not available, we have the option of either wireless transport, which is still CPRI based, and in places where fiber is available, the choice is whether you want to use active or passive fiber. For us, CPRI transport is crucial and is going to be an integral part of C-RAN deployment.

Monica: Now, in closing, may I ask you what you will be busy working on in the next two, three years at Fujitsu?

Femi: The future of C-RAN, as we go forward, is to allow resources to be shared among baseband units – shared effectively, and shared very intelligently. So, for us, the next logical step will be: how do we deploy software onto that baseband hotel effectively?

SDN will be very crucial, and NFV will be very crucial, because that will enable us to deploy access technology, aggregation technology, aggregation applications, that will really blow our minds as we look at the terrain of C-RAN going forward.

You can look for us to be very engaged in SDN and NFV, as well as the 5G technology as we go forward.

Glossary

5G	Fifth generation
COTS	Commercial off-the-shelf
CPRI	Common public radio interface
C-RAN	Cloud RAN
CWDM	Code Wavelength Division Multiplexing
I/Q	In phase / quadrature
LTE	Long Term Evolution
NFV	Network Functions Virtualization
RAN	Radio access network
SDN	Software-defined networking
SON	Self-organizing network
TWDM	Time and Wavelength Division Multiplexing

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 and www.senzafiliconsulting.com

About Fujitsu

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About Femi Adeyemi

Dr. Femi Adeyemi is the Lead LTE Solutions Architect at Fujitsu. In this role, he is responsible for engaging wireless operators and partners in the Wireless and Small Cells Ecosystem. He is a 3GPP expert with design, development and deployment experience.

Femi has over 20 years of experience in the wireless and communications industry. Prior to working with Fujitsu, he led technology and product strategy for LTE and Voice in 3G/4G Macro and Femto product lines at Airvana Inc. He has also held various senior technical and management roles at Motorola, Engim and Elbera (a company he founded). Femi holds BS, MS, and Ph.D. degrees in Electrical Engineering.

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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.