Intel

Integrating Open RAN - Challenges and Approaches Needed

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PRESENTATION

Lilian Veras

Welcome, everyone, to the Intel Network Builders webinar program. Thank you for taking the time to join us today for our presentation titled: “Integrating Open RAN – Challenges and Approaches Needed”.

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Today, we're pleased to welcome Mats Eriksson from Tietoevry. Mats is a telecom veteran with more than 30 years’ experience from the telecoms and cloud sector. His contributions span systems engineering, research, service development, and product and business management. Mats is currently working as Lead Business Developer at Tietoevry with a special focus on mobile networks, radio access, and edge computing.

Welcome Mats, and thank you again for joining us today, and over to you to start off. Thank you.

Mats Eriksson

Thank you, Lilian, for giving me the opportunity to be here, and good morning, good afternoon, and good evening to everybody in the audience, wherever you are. So I will be talking about Open RAN and the integration of that.

But first starting off a little bit with telling you a bit about Tietoevry. Let’s deal with this slide. We are a group of 24,000 employees, headquartered in the Nordics, but have presence across the globe. Essentially, in China, in the US, and in Europe. We are doing quite extensive work with what we call product development. Meaning it’s R&D services for companies that are in telecom, automotive, or electronics and developing products. As such, for the telecom part, we’re working with the leading telecom vendors, as well as some of the emerging ones. We're also working with silicon vendors like Intel, of course, and others, and some of those types of companies, and it's a pretty big business actually.

And a couple of words on our relation with Intel, it's been a long-lasting partnership. It's been there for quite a long time. It goes both ways. So we contribute to Intel's software frameworks, and we use Intel frameworks and software in our products and solutions, towards our customers as well. So, just to let you know.

So the agenda of this webinar is I'm going to talk a little bit about innovation and what was it that took us here, really. And also then talk about software and the need for performance, especially in this domain. I will then go over to talk about integration and try to define that in the scope of Open RAN and different interpretations of integration.

I will talk about or give an overview of Open RAN integration now, and some of the challenges I expect that we will start to see soon. I will deep dive a bit into the integration of the fronthaul array unit to the distributed unit, and why that is difficult at the moment. I will talk quite a lot about integration of operational systems, and why that is important for mobile network operators, and then I will end up with talking about value chains for doing this type of integration. Some of the points that I will be making are not specific to Open RAN, actually. They are more general to radio access networks in general.

So, starting off with innovation, I mean, as always, when we face innovation, we also face denial of innovation. So, there are always people that are skeptical and more or less vocal about that, or taking an active stride against that innovation, and I think Open RAN is about innovation. Maybe it's not so innovative in itself, but it's about enabling innovation, I think. I think that's one of the most important things, and we need to realize that there is a resistance to innovation, and maybe that's good. It's good that we are skeptical to new things as well because otherwise, we will do a lot of mistakes.

And then we can also think about this, I like this, Amara's Law and maybe you've heard about that, and it is that we tend to overestimate the effect of a technology in the short run and underestimate it in the long run, and we can look back and see that maybe we didn't estimate the effect of the CPU when it arrived a long time ago. But based on that evolution, technological change is not linear, it's exponential, and I'm old enough to have been there 30 years ago when we started to develop GSM, and that was really challenging. And today, if we look at what we have today, and what we're doing today, with 5G and AI and those kinds of things, it's definitely something we couldn't even imagine 30 years ago, of course. So I think this is important. We need to look at this in a little bit longer term, and not assess what we have just today.

And an example of that, of course, is Moore's Law. We've all heard about this and seen this, I guess, the number of transistors on a chip is doubling every second year, isn't it, right? Anyhow, it goes exponential, but the point here is that it's more and more difficult to harvest it because we're adding transistors, because we're adding cores, and now we moved some of the problems of harvesting that performance improvement into software, and this is a key point, I think, for this presentation. It's not very easy to make use of that performance.

O-RAN is a very high demanding application, it's very compute-intense, and it needs to make use of every single horsepower you may have on the chip, and the reason for this is because there is a balance between the raw energy efficiency in terms of throughput and energy efficiency, and those kinds of things. There's a dependency to the performance by which the baseband-- meaning the basic packet forwarding you can say if you want to simplify-- in the RAN is taking place, and that needs both knowledge in how the particular CPU is working, and how we can squeeze out every single effect, every horsepower from it, as well as what does it mean, how do we optimize my domain, meaning the RAN application, and this is a difficult software design challenge. We have some 700 people working in that area in optimizing and building baseband applications, which is the central part of a radio access network, or the central part of the digital part at least.

So of course, today, the general-purpose CPU will not be able to deal with all the use cases, with all the challenging use cases when we have higher-order MIMO, or when we have an increased amount of spectrum that we need to deal with, then we're currently facing the need for an accelerator, whether it's a GPU, or an FPGA, or an ASIC, or something like that to enable the needed RAN performance, and this is complicated because it creates a hardware-software coupling issue, and they are complicated to program. But it's important to deal with the raw energy efficiency. Meaning that we can execute the algorithms sufficiently to make use of the radio spectrum in the best possible way, and that's not only about throughput, it's also about energy consumption, which translates to OPEX for an operator.

So, going into integration, so I made these two stereotypes on how you may look upon integration, and these are very different, and they are intentionally made very different, of course. So at the bottom, you can see this thing where you connect your parts, and you basically expect that this will work, and it will work. With reasonably small efforts, you will make it work because it's a highly mature and standardized system, and you're modifying, or you're picking and choosing different components, whilst the upper one is where you have to modify your parts until it works. It's a completely different metaphor of integration, and I think that when we talk about Open RAN, we're in the upper layer, we need to modify until it works currently, and we have to acknowledge that when we're putting together things, components from different vendors, we have to modify something. That may not be the case a couple of years from now, going back again to Amara's Law, right?

So a couple of years from now, we may have more of the PC analogy. We'll see. But I want to make another point here also is that it's easy to integrate, and interoperability is not the same thing, because it depends on what you want to integratetoo, what you want to achieve. So you can have products that are easy to modify, and easy to tailor. Meaning they don't fit together from the start, but you can very easily make them fit together, but you will create different variants, and that's a different target, and I'm not entirely sure whether-- I mean the Open RAN industry today, they are targeting very much interoperability from the start, the PC analogy, and with this slide, I want to question that a little bit. I'm not entirely sure that's the right way to go. But we will need to be aware of the explosion of variants, of course.

So I'll give you a bit of an overview of different areas for Open RAN integration. So if we start off with what did we have up until recently, we had base stations, we had the element management systems and on top of that, operational support systems and so on. Those kinds of things.

The first step we did, or maybe we're in the middle of that when it comes to RAN, is that we're separating the commercial off-the-shelf infrastructure hardware from the software applications. The virtual network functions, if you will. And then we introduced a couple of new boxes here for managing this, and we also introduced the need for what I referred to as vertical integration, making sure that we have the RAN application running with sufficient performance on a particular infrastructure, on a particular server.

The second step is we're now disaggregating this into different components. So O-RAN is now at least three different components. And then we're creating the need for what I call horizontal integration. So if these come from different vendors, or if they come from a single vendor as well, we need to integrate it, so we need to make sure that these components actually work before we ship them to their mobile network operator. But we've also disaggregated the functionality from an operational point of view, so we now need to aggregate it back again into an operational environment. It doesn't necessarily have to be exactly compliant with the previous ones, but probably somewhat like that. So this is interesting. We tend to disaggregate nowadays, and we tend to forget about the aggregation, I think.

The next step is addressing automation or making the systems more autonomous, and then we create this radio intelligent controllers, the two different ones, and now we have created an integration effort around that to make the entire automation system actually work.

And lastly, we may want to share the infrastructure with other types of applications, machine control or AI, or something that is over the top. And now we create a use case integration. This could be a private 5G network running the actual application for which the private 5G was intended.

And then, of course, we need to think about security. So, if this is a multi-vendor integration, someone needs to take care of the security as a result of mixing a particular set of products. So, I will go through these areas a little bit in the coming slides.

So firstly, on virtual integration, a virtual RAN or a RAN is a pipe and filter application, meaning it sends packets East-West, with an algorithm in between, sort of. It does so on very high data rates, and the algorithms, as we talked about, they are very resource demanding and very complex, and the industry is working hard to improve those algorithms and make them more efficient when it comes to how they make use of the available radio spectrum, and create an efficient forwarding of information over the radio. And this is, again-- I've said so a couple of times already, but the balance between CPU performance and the result in terms of RAN performance-- energy efficiency, and throughput, and those kinds of things-- is tricky, and I think we should pay more attention to that,

how we make use, and how we can implement this cycle. And it's about the implementation of the algorithms, but it's also about the algorithms themselves, and how we enable that over a particular CPU architecture with CORS and cache, and those kinds of things. So, we get an efficient system.

We also have the issue of the dependency to various softwares like Linux distributions and their releases, and DPDK and other libraries, upon which we are depending to get this system and this integration efficient. And then also the software that runs on a particular service consists of different components like Layer 1 and Layer 2, and they may come from different vendors, so we may have an integration to be done there as well over the FAPI interface. So this is just to give you a view of this kind of integration.

And we talked about accelerators. So currently, most people are using what is referred to as look-aside acceleration. Meaning the data flow goes through the CPU several times, and it goes over the PCIe bus, which may cause congestion and issues like that. It has its benefits, of course, because it makes the acceleration optional. It's easier to plug it in and take it away in different configurations. So there are a lot of folks talking about what is referred to as inline acceleration. Meaning that we basically don't send the packets up to the CPU. We send them from the NIC to the accelerator, and then onwards, and yes, to control the flow from the CPU. There's also evolution going on to maybe we can make the CPU more specialized for this kind of work tasks. So these are some aspects on how do we make these systems efficient when we're having accelerators.

And all of this requires, of course, a huge domain knowledge, because it's not only about the infrastructure, it's about the infrastructure and the application, and how they are harmonized and optimized.

So, if we go down a bit into the fronthaul interface, which is something that a lot of companies and stakeholders are struggling with, and basically, the idea of having interfaces so that you can use products from different vendors and they will work together, which is the basic open idea.

This is done based on that there is an interface, so there is a transport mechanism based on Ethernet and eCPRI to transfer data between the radio unit and the distributed unit, and of course, this is not enough. This just provides a postal service, if you wish, between these two units, and supporting a topology. Meaning you can have one-to-many relations here, of course, and different ways of interconnecting the radio unit and distributed unit.

And a lot of people talk about these splits.

Most of the industries is kind of converging towards a 7.2 split, which is highlighted by some MNOs as the common denominator problem. Meaning that if everybody uses 7.2, well what happens with the use cases that would have needed a Split 8 or Split 6 or something? There are not so many products available for those. So, I think that's one issue. But currently, most people are working with 7.2. And that's problematic in itself.

So, again, going down into what is carried over this with this fronthaul interface. Well, it's actually multiple logical interfaces for control plane, user plane, sync plane, and management plane. And they have their own particular challenges from timing aspects to the semantics of the management plane. So, very, very different kinds of problems.

And we can try to summarize what we have experienced from being in some of these projects. The first kind of reason for why this is difficult is that the Open RAN specifications, they have optional – they have options, and they give room for interpretation. So, it means that the product can be compliant, but still don't interoperate, they're still not interoperable. And this is because this interpretation is done by each and every vendor.

And then, of course, coming back to this domain expertise, so somebody may work with the distributed unit parts, Layer 1 or Layer 2, and they don’t have so much knowledge about radio aspects and vice versa. And then either operators or MNOs are forced to build their own team of experts for integrating that. And then, of course, we have vendors that want to use components like Intel FlexRAN without modifying it, which then means that it comes with a particular interpretation. And then we're back again that we need to sort out whether there were any differences in interpretations there. And normally it is.

And then there are options. So, some products may support certain options, while other products assume that more options are supported. So, this is kind of on a functional level, differences in what they support. And then, of course, the specifications is under development. So, when something – when new options arise, this gives rise to new integration problems.

And then the last one, area of challenge, is that you need quite an extensive lab to test out all of these things. And also, the equipment in the lab is expensive. So, not everybody has access to all of those things you need in the lab.

So, now switching back – switching over to automation and operational systems. I use this historical look back on automation because I think it's kind of interesting. If you look as far back as this one, everything was kind of management plane. And the semantics of the management plane was transferred by people talking to each other. And then we moved functionality into the control plane, step-by-step over a hundred years.

And that is kind of a long-term trend that is going on all the time. But it's important to understand that we need to have – we need to express the intent, and we need to be sure on the semantics when we're automating this. And I think that's something that is some – we're still struggling with that because it's difficult. But if we want to achieve zero-touch operations, we need to.

Also, I think another interesting observation is if you look at how competition has been kind of moving focus for – mobile network operators and the regulators tend to think that the competition was around performance. And then it kind of shifted towards operators trying to make service, and content of service as the way by which we compete. And I think we're on our way to start to compete on operational costs. Meaning that functionality, by which we can be more efficient as an operator, as an industry, those kinds of functions will be more and more important.

And this is an example of something that is not specific to Open RAN, I think this is general to the industry. And it's, of course, about cost control. But I think it's also about the way to compete, at the end of the day. And thereby the operational processes, the toolchains need to be purpose-built for each and every operator to fit their way, the way they want to operate and run systems. So, there's no standard way of doing this if it's a competitive edge.

And it also means that these operational systems, they are no longer offline batch systems. They are part of the control loop. And kind of an example, again, about functionality moving from the management plane to the control plane, depending on your definition of control plane, of course. But they also require then substantial integration efforts again, because we need to get these semantics and the intent explanations to actually work.

And then talking about OpEx. We all know that radio access networks are costly to operate. And it's a big chunk, the biggest chunk of running mobile networks. And of course, there are parts of the cost split, like energy consumption, site rental, backhauling, people that need to go out and repair broken equipment. This is very hard to kind of take away, and it depends on a lot of other factors than whether the equipment is Open RAN equipment or a traditional RAN.

What is important, I think, is that there are hidden costs or basically costs that you're not using your equipment as efficiently as possible. And this, I think, is the important thing. There are not very many facts – that I've found, at least when I've done my research trying to find these kind of figures – on how much better can you tune your networks. But we all know that the complexity of the networks is growing. So, these hidden costs, if you wish, they will increase. And this is what calls for automation and intelligence. But again, it's not specific for Open RAN.

So, if we now go into a bit about the idea from the Open RAN community to address this by creating these non-real-time or near real-time RICs, which is kind of “Let's have an app concept, whereby we can program these functions”, and they are essentially control loops. And they provide then, of course, an ability for tailoring. So, we can create different apps for different use cases, which is good, because then we separate out that kind of tailoring to a specific part of the system. But we also see currently the diversity of these RIC platforms. So, this is an area that to me needs much more evolution to get it mature.

But I think one thing that I see very little talked about in the industry is about how do we get these apps to work together. Again, they are implementation of control loops, whether they are in the non-real-time RIC or near real-time RIC, it really doesn't matter. They are control loops. And control loops tend to interfere with each other.

So, this is very, very different from the APP concept in your iPhone. The APPs in the iPhone is not the control loop of the iPhone. They are over-the-top.

So, I think we need to address these kinds of conflicts, whether they are – I was trying to create a couple of examples – whether they're on the policy level, or whether they are on the more control... immediate control level. And we need to create conflict resolution mechanisms here whereby we can do this. And we need to integrate these APPs and that is the implication here that each and every collection of these APPs needs to be integrated. And this will end up being in the context of the mobile network operator, I think.

So, I also think – this is an example of the issue of interoperability or standardization versus innovation. Innovation means we compete with something where some things are different. And we want future growth as an industry. We want to have new ideas and new things. And then that means that we need to have parts of the systems where we compete and other parts where we acknowledge this is a common kind of platform. And again, this to me leads back to that we need to establish a way by which we do integration of these products in order to enable both openness and innovation at the same time.

Talking a little bit about – coming into the aspect of the value chain. So, here, I've just outlined a couple of examples how this could work, where we can have a completely independent system integrator. The MNO selects the vendors for the products and assigns to the SI to integrate them. Or the SI is fronting and providing the – taking responsibility for the entire solution. Or the vendor has an independent SI that also creates then a relation to the MNO, and using other vendors. Or the vendor is an SI, as number four, and makes use of other companies' products. Or in number five, one vendor is SI, and he integrates products that is selected by the MNO. Or the last one, number six, the MNO itself is the SI.

And this – we have seen examples that different aspects of... if you remember my picture about the different types or parts of integration, the vertical, horizontal operational integrations where we would see different approaches being done for different aspects of this integration, different value chains chosen. So, it's kind of natural to get the fronthaul – to try to push the fronthaul integration to the vendors of the RU and the DU.

But the conclusion here also is that the integration of Open RAN is essentially not different than integration of a traditional RAN, it's just that it happens in an open environment. So, the MNOs – so the industry has to select how it thinks about going around to do the integration.

And also, the other aspect, the other point here is that integration is a continuous process. It's not something you do once. It's something you do all the time because there are new specifications. There is new software releases/versions. There is feature and function growth. And some people talk about this being very, very difficult. Yes, it is very difficult. But it's perfectly possible because we have been doing this for a long, long time. We just called it traditional, proprietary RAN. So, the industry has been doing this.

Trying to wrap up a bit. So, complexity is still there. But remember, Amara's Law, remember we tried to – we tend to underestimate the effect short-term and underestimate it long-term. So, I've been talking about software and how software is important to unlock performance in the RAN. I've been talking about the integration, the different notions of integration, the "Modify until it works" or the "Put things together and just check that it works". I've been talking about the overview of the RAN integration, the different horizontal, vertical, operational, and those kinds of types of integration, and some of them being more towards the future. I've been talking a bit about fronthaul integration and what is it that makes that difficult today. I've been talking about the operational systems and the importance of doing that right so that there is actually a cost-saving and a more efficient way of operating radio access networks irrespective of Open RAN or not. I've also been talking about value chains.

And we are a company that has more than 2,000 professionals in these areas. So, we think we are well-positioned to do these kinds of assignments.

And again, we're not a products company, we're a service company. So, we work on behalf of our customers. If you want to read more, there is a whitepaper on our website, you can find it in the Resources tab, and the link to it, and the presentation to it in the Resources tab in the BrightTALK tool.

And with that, I think I was aiming for 40 minutes, I did it almost. So, thanks to Grzegorz, Johan, Lars, and Mariusz to contribute to this presentation. And now time for Q&A, I think.

Lilian Veras

Thank you, Mats, for such a great presentation and sharing such great information with us all. We do have a few questions that have come in while you were presenting. So, let's get started on those. First question we have here “What is your view of the long-term effect of Open RAN?”

Mats Eriksson

I think today, a lot of people talk about it in the context of only the RAN sort of. Is this a competitive solution or a revolutionary solution to what we have today? Or is it something else? But I think the long-term effect is probably more around how I can start to make use of 5G technology and integrate that into industrial systems, into different systems in different verticals, in a more kind of off-the-shelf or OEM kind of way than it always has to be like a mobile network operator thing. So, when we start to see the evolution or the emergence of private 5G, for example, this is an interesting thing where – which is probably only the beginning of how we can make 5G in these kinds of technologies being everywhere.

Lilian Veras

Perfect, thank you. Question number two “What is your take on energy efficiency when comparing Open RAN with traditional RAN?”

Mats Eriksson

That's a good question. And one that I cannot answer, I don't think anybody knows really. Because coming back to this, the need for compute horsepower to run these algorithms that make RAN more efficient. And this is something that if I'm running this on a commercial off-the-shelf, I probably – I sacrificed something in terms of that performance compared with an ASIC solution that has an impact on the RAN performance, but I gain some flexibility then. So, it's not – I don't think it's by nature so that an open system has to be worse than a closed system. So, if that answers the question, hopefully. But it's more about comparing different vendors and efficiency in their implementations rather.

Lilian Veras

That's great. Thank you. Another question we have here. A member of the audience is wondering what type of vendors has Tietoevry worked with?

Mats Eriksson

We have worked and we are working with complete – vendors that have everything sort of. We're also working with vendors that provide a particular set of radio units or distributed units. So, it's a mix of vendors in the industry, both Open RAN and proprietary RAN vendors, as well as silicon vendors like Intel, of course, that we’re working with.

Lilian Veras

Awesome, thank you. We have one last question here. A member of the audience is saying that “As RU vendor, they see the largest integration challenges in dealing with highly variable fronthaul data rates. They're often outside of spec, generally arising from virtualized functions higher up the stack. Where do you see the largest real-world issues?”

Mats Eriksson

These are the kinds of issues we're seeing today that it's problematic to integrate the radio unit with a distributed unit. Among other things, this is one thing. Timing of the fronthaul interface is another thing that we often see. Interpretations, bit orders, there are all kinds of misinterpretations that could be done reading the Open RAN fronthaul specifications.

So, these are the real-world issues today. But those are the – if we remember back to the analogy that this integration is the kind of final phase of the R&D work, this kind of "Modify until it works". So, before we start to have the operational issues, when we start to see what does it mean to run this on big scale and upgrade the systems on a regular basis? Those kinds of issues, they haven't happened yet. So, we're still in this – we're knocking on the systems with the hammer and trying to get it to work, right? And those are the real-world issues we see today, but I think we will move onwards and start to see more of these. How do we make a RAN, in terms of a deployment, be more optimized and more efficient?

Lilian Veras

That's great. Thank you, Mats. I would like to thank you again for such an insightful presentation today and ask our audience to please not forget to give our team a rating for the live recording, so that we may continuously improve the quality of our webinars.

Thank you. And please join us next time and this concludes our webcast.

Mats Eriksson

Thank you very much from me as well.

Lilian Veras

Thank you. Bye for now.