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## Conference Debate Session II:

## IoT and the Network Edge of Tomorrow

## Introduced and chaired by John Canali,

## Principal Analyst, IoT, Omdia

**Featured Speakers:**

**Analyst chair:** John Canali, Principal Analyst, IoT, Omdia
Anit Lohtia, CTO, 5G Strategy Lead, Dell Technologies
Marc Cohn, Principal Technology Strategist, Spirent Communications
Vikas Tandon, AVP – Product Management & IoT, Tata Communications
Tom Bianculli, CTO, Zebra Technologies

**John Canali, Principal Analyst, IoT, Omdia**
Good morning. Thank you for having me. This is my first NetEvents panel. So appreciate everybody who travelled from near and far to get here. My name is John Canali. I'm an analyst with Omdia. We're a global market research and consulting company. My focus is IoT. I've been working in the space, both as an analyst, but also working in product development and product management. previously to this position, I was with AT&T, working their IoT organization. So I've got a short presentation to take you through, and then we'll get on to the panel. So the IoT landscape, looking back on 2022, it was, in many ways a tough year, especially after coming out of 2021, where IoT had, in many ways, one of its strongest years. One of the key trends that we're seeing recently, is not just consolidation, but market exits within IoT. So particularly looking at the difficulties that many in the service provider space are facing, we've seen recently, Ericsson exit the space selling its IoT Accelerator to Aeris, we've seen Google get getting ready to retire its IoT Core. We've seen other providers, IBM, SAP, looking to exit the space. It's, you know, a tough, tough market for service providers. This partially contrast what we're seeing in the hardware space where many of the components and modules vendors are thriving. Conversely, if we look at some survey data that Omdia has compiled, we run the survey every year, it's a global survey where we speak to enterprises deploying IoT solutions, what we're seeing is enterprises are fairly bullish in IoT we see year over year an increase in spending. So again, you know, where the hardware and components vendors are thriving

enterprises, you know, appear bullish, it's really the service providers that have been struggling to see their position on the IoT value chain. And continuing with some of what we're seeing from our survey work, we're seeing a broad range of applications being deployed within IoT. If we look at what's being used fairly broadly, across many different verticals, we're seeing asset tracking, both stationary and nonstationary. We're seeing connected cameras becoming increasingly more utilized by enterprises. And you know, as we'll speak to later in the panel discussion, obviously, that's an area where edge computing can be very important. We're also seeing fleet management software, predictive analytics, and roll of equipment. So again, going back to our survey work, what are the trends we're seeing in what is actually being deployed? And what do enterprises believe they'll be deploying in the future? Key to their deployments? We're seeing open API's not really, too surprising. They're, surprisingly, enterprises are keen on deploying 5G. I think that goes to a number of different reasons. 5G is still not fully matured as a technology, but many enterprises are looking to it strategically as to what it can bring to their solutions in the future. We're seeing AI and machine learning. But you can also see, within second to last, we're seeing what's going on with Edge processing. Again, enterprises are looking to include this in their solutions. So reasons to be optimistic about IoT and then we'll get on to the panel. Enterprises are exceedingly happy with their results in IoT. We're only seeing a very small proportion of respondents saying that their IoT deployments did not meet expectations. Obviously, there's some level of bias to be honest here. You know, the folks we are asking, are the ones who deployed the solutions. Surely they don't want to supply negative comments about their experience. But, you know, I do think that most of these numbers are quite valid and that enterprises are seeing a nice return on investment. So with that, I will turn to the panel, we've got a very distinguished panel from a variety of different industries. And I will turn it over to the panel to introduce themselves and their companies. Thank you.

**Tom Bianculli, CTO, Zebra Technologies**
Hey, everybody. So Tom Bianculli again, Chief Technology Officer at Zebra Technologies, if it wasn't apparent from some of the examples I gave earlier, we're really focused on providing an advantage to frontline workers by connecting them so connectivity, providing visibility, and then empowering them with mobility. So the way we like to think about it is being able to sense what's happening in real time, across transportation, logistics, manufacturing, retail healthcare, analyze that data in real time. And recently, we've done a string of acquisitions around that from a software perspective, and then be able to drive the right action down to the right person. So using that device in someone's hands, not just as an application platform, but as an alert event and intelligence platform to orchestrate workflows.

**Vikas Tandon, AVP – Product Management & IoT, Tata Communications**
Hi, everyone, Vikas Tandon, I run product for our mobility and IoT, Tata Communications. We are a digital fabric enabler, we also are global IoT connectivity provider across use cases from a connected watch to a connected airplane and everything in between. And across technologies. So whether it's cellular or satellite, or, or Wi Fi, or even (inaudible). So we own and operate a lot of infrastructure ourselves that enables this, we work with partners to bring the IoT connectivity to predict success. And that's one of the key aspects today. We talked about why IoT fail, one of the reasons is choice of technology, putting thinking this all through together. So that's where we come in, and we, in addition to providing the connectivity we enable, or we make sure that these things become success for our customers.

**Marc Cohn, Principal Technology Strategist, Spirent Communications**
I'm Marc Cohn. I'm from Spirent Communications. We're a world leader in communications, testing technology, I actually work in corporate strategy, qualifying new opportunities over the three to five year

timeframe, including how the communications industry is evolving, at least and with regard to private networking, which I think is an integral part of the overall IoT evolution. I also have a background in open networking. And I've been participating in a lot of industry activities over the past number of years, we actually complement both service providers, equipment providers, integrators, the whole ecosystem by providing testing capabilities throughout the entire service and product delivery lifecycle.

**Anit Lohtia, CTO, 5G Strategy Lead, Dell Technologies**
Good morning, I'm Anit Lohtia. I'm with Dell Technologies. I'm focused on 5G technologies, I lead the 5G strategy and wellness strategy for Dell. Most of the folks know Dell as a company for computers and server and storage with this increasing focus from Dell on the network technology to bring edge and wireless technologies and (inaudible) technologies together to deliver the IoT solution and intelligent edge solution. So I look forward to our discussion today.

**John Canali, Principal Analyst, IoT, Omdia**
So you all sit in various positions on the value chain when it comes to edge technology. But I think a good place to start is really getting your definition of the edge. It means different things to different people. So Anit, if I could start with you.

**Anit Lohtia, CTO, 5G Strategy Lead, Dell Technologies**
Sure. I think our definition is rather simple on edge edges, where data is acted on close to the point of creation to create the real time value in the enterprise or enterprises. It has like you can define edge in different parameters like it could be device edge where you're looking at latency of microseconds. Then you have far edge latency on like sub millisecond latency and then you have what we call near edge latency. Hear around five to 10 milliseconds. And then you have a core where you can have can tolerate more latency. And we look at more in terms of when we are talking about latency, why do we need it like sort of an application, you need to take action in real time to be. That's a hard requirement. For example, if you're using it in autonomous vehicle, you have so many microseconds available to act, right. So you have to have the HSP really close, then you have next level of data where you can maybe take a few millisecond delay before you take an action that does where the far edge and so on. So that's how we define edge. And each of these edge have their own characteristics in terms of hardware networking, storage. So each comes with a different set of requirements. But it comes down to what problem are you trying to solve, and why you need to take act in the real time and how quickly is that real time.

**Marc Cohn, Principal Technology Strategist, Spirent Communications**
Since Spirent focuses primarily on telecommunications, service providers and the connectivity that they provide, we look at edge at least more recently as an enabler for new applications that are going to be an extension of what is loosely being called the telco cloud. So we're not really focused on the enterprise technology, per se, but we have to be now that there's sort of a convergence, and that distribute that there is distributed computing and distributed networking, that is going to enable these multi cloud applications that we've been talking about earlier in the morning.

**Vikas Tandon, AVP – Product Management & IoT, Tata Communications**
From our perspective, it's not a communications we've been looking at edge and a library or whatever the customer calls their edge. But it's a combination of doing things on the device on the premise closer to the users, and even somewhere in between up to the cloud. Because every customer really, or their use cases vary a lot in terms of what their requirements are, where do they want to process? Where do they

want to store and where do they want to access from? The way we are looking at it as it is not just about a clear definition of what edge is across the industry. But how do you orchestrate those that compute that storage? That connectivity on demand? How can you scale up and scale down? So that's how we look at edge in today's scenario?

**Tom Bianculli, CTO, Zebra Technologies**
Yeah, so I mean, it's similar to what many the other panelists said. The way that we like to describe it is where you know where the work is getting done. Like if you think that the examples I was using earlier where the package is getting delivered, where the shelf is being restocked, where the patient is being administered the medication, it's that frontline of operations is the edge of, of where work is getting done. And that's the opportunity to, to digitize and help automate those workflows. I think from our customers perspective, they think about it similarly, but maybe as many of you mentioned, within the, there's much more focus from a CIO point of view on the setting in which that edge is occurring, right. So the edge for them may be the store itself, or it might be that warehouse, or it may be the, you know, the healthcare facility. So it's the setting that that's occurring and, and the way they need to think about deploying infrastructure in that setting to support it.

**John Canali, Principal Analyst, IoT, Omdia**
Tom, I know you touched on this earlier but I like to hear you reiterate and hear from the other folks on the panel. Can you discuss a business dynamics that you're seeing in this space? You know, are you seeing a lot of collaboration? Are you seeing any players currently looking like they're really dominating the value chain? And in terms of edge technology?

**Tom Bianculli, CTO, Zebra Technologies**
So yeah, great question, when you were going through your introduction, I think your point around consolidation, but we're the service provider, as you mentioned, several players divesting of platforms in in various types of elements from an IoT point of view. And I think our view on that has been attacking the challenges of IoT and the opportunities before us. Trying to do that in a really horizontal way, when we're still kind of mid inning is tough. And what do I mean, by horizontal way? I mean, saying, Hey, I'm going to create an IoT platform that runs across a myriad of use cases, is not typically the way things get traction, you typically start with, Hey, I found a pocket of value that I can go deploy something into, and I'm gonna go and build that end to end and as you build enough of those pockets of value, then, you know, more horizontal ways and platforms for doing that can be deployed across though so I think that's, you know, certainly something that we've seen in terms of in the value chain. You know, we've got an internal way of thinking about this I mentioned earlier, the three words of sense analyze an act, sensing on this data as you know, acting on it. If you sense the data, and you don't do anything with it, you know, you're never gonna get to an ROI. So one of the ways we think about that is that technologies from left to right, right, the technologies is deployed, since you know, analyze and act, but the return on investment is from right to left, you've got to be, you've got to figure out what are you going to do different in your operate? What action are you going to do different in your operation, that's going to translate into what you need to set. So I think those companies that are investing in software analytics, the AI and machine learning, that are highlighting what specifically you should go to different off of all the state are the ones that are winning. And so I've kind of picked that layer in the value chain is kind of more the application analytics insight layer versus the pure just sense side of things.

**Vikas Tandon, AVP – Product Management & IoT, Tata Communications**
Yeah, Tom brought up a good point, right? the horizontal integration is becoming a challenge. But it is also something that you will see because not everyone is going to come to the same platform. And that's where the common framework that are the enterprise has to start thinking of work, work on a consultative approach, saying, Okay, this is my challenge. I cannot necessarily go and select a vendor based on where they are. But we'll have to find a framework where everyone can interoperate. As they say, it takes a village to deliver an IoT, I think that the village people need to talk to each other more often. That's I think that's the that's the approach we're seeing.

**Marc Cohn, Principal Technology Strategist, Spirent Communications**
The way we look at the IoT being this enabler for the kind of vertical applications that we've been talking about, and I think Tom mentioned in his keynote earlier, or at least at least some are, are going to, in essence, evolve into a more horizontal platform with a set of building blocks, the challenge we have as an industry, and I think that John, your data actually corroborated that is that we're seeing this disaggregated ecosystem, the reason why you're not seeing these large service providers, or the GSI, as the global system integrators just dominated in a particular, you know, across the industry is because this is broken down into many different segments, many different players, many different opportunities to offer value. And as a result, we're seeing a very different type of, of constituents set of companies that are actually participating in the not just IoT, but I think it's a precursor to private networking. And as a result, we really need to start thinking about how we can enable more horizontal technology, but also how we can actually provide a way to allow for multiple companies to collaborate into these broader systems without this huge centralized cost. That is, that usually takes down major projects. And this is going to require some new rethinking of how individual companies can ensure that that each player in the overall ecosystem is delivering what they say they're delivering, and validating that things are secure things perform the way they're expected to and behave the way they're expected to. And that's what I think the new IoT slash Private Networking evolution is going to be all about. And value is going to be delivered up and down that chain.

**Anit Lohtia, CTO, 5G Strategy Lead, Dell Technologies**
Yeah, so I cannot miss the opportunity, you said who is leading the race, obviously, Dell Technologies. So that's my bias. But on a more serious note, I think I agree with Mark. This is the IoT, I would say it's a complex problem to solve. It's been the concept has been around for a long time. And I'm pleasantly surprised you think and so many enterprise think that it's actually delivering value, I think 42 percent meeting the expectation, but if you had to go back and look at the history of the market prediction like there has been very bullish projection whether you call it IoT it was used to call machine to machine communication. Prior to that, industry has under delivered the project projection for the growth and I think one of the reason is that for this to be really successful, there has to be three technologies or three paths or organizations have to come together one is obviously IT, the second one is OT, operational technology people who understand the business processes and third is the networking piece. And all three are fairly complex and generally they do not talk to each other or at least, do not speak the same language, just to overcome the lingo and barrier across these different organization needs to happen. And companies were able to figure out how to do that efficiently and at scale are going to be the winners and our intel, we have focused on dividing the problem into different segments. One is, obviously underlying infrastructure. That's where our core businesses, we're focusing on networking piece, that's where my business unit is focused on private, whether it's a private wireless network where anybody technologies, how do you provide the network fabric, and then there's more importantly, the vertical knowledge, whether it's manufacturing or

retail, each of these verticals have their own processes and on set of business requirements that needs to be met, and bringing those together and providing an efficient solution, I think is the key to be successful in this area.

**John Canali, Principal Analyst, IoT, Omdia**
Forgive me, if this is a little bit of a broad question, but Mark, you'd mentioned private networks. And there are other technologies, I think we see in forming what's going on the edge, whether it's 5G, whether it's the evolution of Wi Fi. So if you all could address how these technologies you think are shaping the edge? Mark, you can start?

**Marc Cohn, Principal Technology Strategist, Spirent Communications**
Certainly, I think there's a number of technologies that are emerging for IoT, and ultimately evolving into private networking. Because these are very use case specific, I mean, it's going to depend on the coverage requirement, the performance requirement, the data requirements, in terms of how data is stored, and also there's going to be regulatory and governance requirements that are going to be required. And this is all going to necessitate that there's different technologies to address these different use cases. Because the when we say IoT, it's so broad. And there's so many use cases, that you really have to, you know, the devil really is in the details, we have to look very specifically. And as a result, we're going to see a need for a methodology that are going to address hybrid architectures, meaning there's not going to be wireless or it's 5G. No, it's going to have 4G For one thing, because we always have, there's always going to be a legacy and a migration. And then secondly, we're going to see a need for other wireless technologies, again, depending on the operational needs.

**Vikas Tandon, AVP – Product Management & IoT, Tata Communications**
Yeah, so in terms of in terms of 5G, the primary use case of private 5G today that is getting implemented, or most of the use cases that are implemented are still broadband. How do I get more connectivity, lower latency by it's not about connecting everything on that private trajectory yet, and that's, that's where the transition will, will definitely bring a lot more value. Because it's more about how do I connect 50 devices, 150 devices that can have unlimited access, or a few 1000 devices, not a million devices yet, which is the promise the private 5G gets. And I think we will see that transition. And like Mark said, but it's not going to be about that island of private 5G It has to inter work. What happens when the asset the people, the devices, they move out of that, that realm. So it is going to be that that overall overarching network architecture, that overarching systems that the enterprise has to look at, because it is it is going to be a multiplication on an explosion on the number of devices now are the number of endpoints that the enterprise has. So it has to be thought through a lot bigger than just the Private 5G? But yeah, so with private 5G, a lot of a lot of value comes to the enterprise in terms of doing things faster, doing things more efficiently, having a real time visibility into the assets into people into the processes and the outputs that they're getting today.

**Tom Bianculli, CTO, Zebra Technologies**
Yeah, just, you know, kind of bring it back around to from a customer's perspective. I mean, our customers are at the end of the day, all of the you know, the technology and the different means is you have a cost and mark which is both describing of connecting is, you know, as a means to an ends at the end of the day, they're trying to get to an outcome, whatever that outcome may be. It's maybe, if I if I stick with the retail vertical for a moment is creating a better, or less friction experience for the shopping journey for that for that shopper or its insurance. I mentioned earlier, we got the exact right inventory on the shelf or I'm

creating a more empowered and engaged associate. Mark, you were saying, there's a lot of different ways of doing this. And so you have to look at the individual use cases. I think if you if you take computer vision being used for perpetual visibility of inventory, for instance, in that retail store, well, there's networks that are already deployed that retail store, from a Wi Fi perspective, there's fiber, maybe more and more increasingly coming into that store. And that's being used as the backhaul, then you look at manufacturing environments where maybe that manufacturing farm has been largely disconnected, historically, because they haven't had the need to, they've kind of running all within that facility, but now to achieve the outcome that they want, which is getting more done, potentially, with less people doing in a more automated fashion. Now, they've got to bring the connectivity in, and why start with legacy connectivity? Why not jump straight to, you know, the 4G, or the 5G network, or maybe even a private network deployment to go and do that, because you're starting with that connectivity today, as opposed to building off of an evolution that you've come from and in deploying the use cases that way. So I think a real important perspective we have is really starting with the outcome you're trying to achieve, and then working your way backward into what does that mean connectivity wise, Data Wise security, which we put to the edge versus the cloud? And what are you starting with? What's the legacy, backbone of your organization, and it varies wildly across the different vertical markets.

**Anit Lohtia, CTO, 5G Strategy Lead, Dell Technologies**
Yeah, I think just to add to what Tom was saying, and in I go to manufacturing, and this is actually real experience, we have a lot of manufacturing sites within Dell. So we're just talking about private mobility, or what can be done. So just visiting factory talking about the range of use cases can vary so much like one was we had an autonomous vehicle, it will get stuck because it was on Wi Fi network, and it would like have some blind spots, and it would not handle properly. The moving to a 5G mobile network, they can have seamless operation of the device, the other and that is fairly required fairly good RF planning coverage, so that there's no coverage gap. So you can do that. The other extreme of the use case was there's a test station, which is multimillion dollars, test station, but it's fixed because it's connected with an ethernet cable, they cannot get a reliable a gigabit connection with the 5G, they can get a secure, reliable gigabit connection. And they can move the test station in different parts of the factory. And that increases the efficiency by 30% of the test equipment. And it's just simple. You don't even need a mobile, but you need a wireless connectivity. So you can actually move the destination. And that actually pays for the system itself within six months. So these are two extreme use cases where you need fairly advanced mobile network to meet your use case. The other one is providing a very basic, secure, reliable RF connectivity and that increased probability. So I think that the point I want to drive is not it shouldn't talk about the technology, whether it's a 4G, 5G, Wi Fi, or Zigbee, or whatever it has to be starting from, what business problem you're trying to solve. And what's the most efficient way of doing that. And all these multiple technologies, as Mark said, would coexist for a long time. And they've continued to evolve.

**John Canali, Principal Analyst, IoT, Omdia**
So given this as the debate, I'm going to turn it over to the audience and see if folks have some contentious questions to sling.

**Kishore Jethanandani, Private LTE & 5G Magazine**
Hi. my name is Kishore Jethanandani, I write for the Private Network Magazine. So my question is around fabrics. The connecting tissue between all of the things that were discussed by the panel today, I think, is the fabric which allows you the flexibility to position networks or devices for use cases. So the question then

is what is the hardest problem with setting up fabrics so they can coexist with 5G, 4G or whatever? Has an attempt being made to leverage fabrics so that you can make the best of even 5G network?

**Vikas Tandon, AVP – Product Management & IoT, Tata Communications**
Yeah, so one of the things that has from a connectivity perspective that we see as a challenge is that all of the networks that we are trying to use today, outside of a Wi Fi that is built into the enterprise, all of the, all the other cellular networks typically are public networks, they were not built for an enterprise use case particularly. So you use the same thing, same network that an IoT device uses, if there's a Super Bowl match, that capacity consumed, because everyone is doing a live stream, sitting there in, in that Super Bowl, you can actually bring down capacity in that area for few hours. So that's the impact that that you're getting today. And coming back to your question, so what is the impact of the fabric that networks have to be now you cannot purpose built legacy networks, so you have to adapt the network or the consumption of that network? Or even the digital fabric in terms of edge? How do you get more compute closer to the enterprise to make sure that the continuity of the enterprise use case is not impacted by how the public networks are getting used. Or if there's a fiber card somewhere, it should not impact the operations of an enterprise because now it's not just in a silo of a private 5G, it is working in the private 5G continuation, it's also interacting with the public network in combination has also taught me to the data center. So the reliability of that network has to be really purposeful, again, going back to the point, which I think everyone is agreeing, we got to start looking at the business output and then start looking downwards in terms of a layer by layer is my is my digital fabric is my network is my infrastructure, all of this capable to deliver it, if not what tweaks I need to make to make sure my use case is getting addressed.

You can invest as much as you want, in that private network, one, it'll still continue to be an island. So how self-sustained will that be? That's one thing. And again, in some cases, it might just be sufficient, because you're just operating that one plant. And you don't worry about what happens to the outside world. But in most cases, you are getting touched by our suppliers, your vendors, your customers, they are also looking into the organized into that private 5G or interacting with that, with that island that you have set up.

**Tom Bianculli, CTO, Zebra Technologies**
Great points for you guys in the developer. And maybe the SLA, if you will, kind of the service level agreement between those islands is one that you know, you want to design from the get go with the with the dynamics, you're gonna have to deal with example, you gave us a, there's a surge in usage, have I designed that system to be able to deal with that. So an example would be, you know, if it's that warehouse, example I was giving earlier, the private network at the warehouse is able to support the data that's being produced and the way that it needs to be consumed at that warehouse level. But if I've got 5000 warehouses across the entire network, well, then they need to share data with each other, and then ultimately back with some kind of corporate office. But the rate, the instantaneous, and the fruit, you know how forgiving that information can be in terms of how it's shared from an integral site back into corporate office, maybe the, maybe a much more slack in that SLA budget than there is in what's happening actually on site. Right. So that's where the private network is doing exactly what you said, it's kind of guaranteeing that service level agreement, and then the network of networks is going to be operating at maybe a little bit more variability, because it may be running a lot more of a public system. But you've designed that from the beginning. In terms of wealth, it arrives 10 minutes later corporate headquarters, the end of the day, that's not going to change.

**Vikas Tandon, AVP – Product Management & IoT, Tata Communications**
Some of them, some of those use cases might be resilient, or maybe agnostic to such issues. But we have seen real time problems where some someone doing a software update on 100,000 connected vehicles in one country started impacting elevator operations in another country. And this is I'm not even making it up. It's a real problem. And the problem is that these are public networks that are not meant for IoT. So we have to be able to bring up the infrastructure on the public network as well as private networks for them to interact.

**Drew Conry-Murray, Packet Pushers**
Hi, I'm Drew Conry-Murray from Packet Pushers here in the United States. I'm starting to hear more about 5G network slicing from the network device manufacturers, which is about delivering differentiated services across 5G. I'm curious when you're talking to customers about their IoT strategies, is differentiated services an issue for them? Are they just more interested in a fast dump pipe? What are folks interested in their IoT 5G network strategy?

**Vikas Tandon, AVP – Product Management & IoT, Tata Communications**
It really depends upon the enterprise. And so it really depends upon the enterprise on what is their understanding. And we are they are in the journey of understanding the private network or even the public 5G requirements. So some, as you rightly said, they're just looking at 5G Just because they want to foster NumPy, some want to make sure that they are, they are making sure they are on the latest technology. So they have a visibility of X number of years going forward. So it really depends on the enterprise.

**Marc Cohn, Principal Technology Strategist, Spirent Communications**
I was going to add that when we talk about network slicing, network slicing is the mobile network operator approach to private networking, where instead of I mean, it's somewhat counter to the objective where instead of going to a private infrastructure, you're actually going to try to adapt the public infrastructure in such a way that it can provide some level of network as a service capability that would enable whatever that I don't even want to call it a performance objective could be a, could be a resiliency or could be security objective as well. And I think that, going back to the previous question a bit where it's a question of what alternate what technology is going to make sense based on the business need? I don't think there's one answer, I think there's going to be multiple answers. And we talked to a number of different service providers and equipment providers and that's, in essence, what we're gearing up for, is this hybrid environment, because there's no one answer.

**Anit Lohtia, CTO, 5G Strategy Lead, Dell Technologies**
Yeah, just to add one more thing, the way I think should think about network slicing is another tool in your toolkit. So whether you use it or is required to be used it or not, right, so that's how I would like to think about things is capability, you can also think about it as a quality of service or security, you want to segregate traffic, and then you have to balance against complexity against what you're trying to achieve. You don't want to over design and think for every possible possibility right? You have to focus and that's where return on investment and efficiency on getting deployed comes into the picture and we can have more discussion I think there's a panel session that you're hosting to talk about 5G and network slicing and we can get into more discussion there.

**Angus Robertson, MC**
Fantastic. Thank you so much, John, and thank you to the panel.