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T.N - AT&T Inc at Oppenheimer 5G Summit: The Revolution Begins (Virtual)

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PRESENTATION

Timothy Kelly Horan - *Oppenheimer & Co. Inc., Research Division - MD and Senior Analyst*

Good morning, everybody. I'm Tim Horan, communications analyst here at Oppenheimer. My pleasure to be hosting our first 5G summit of what will hopefully be many. And we have Igal Elbaz from -- the Senior VP from Wireless and Access Technology from AT&T. I'm sure I screwed that up.

But thanks so much, Igal, for joining us. I appreciate the time. I know it's a really, really, really incredibly busy time for you. But I know investors are just kind of dying for an update of kind of what's going on with the networks and new products and services we're kind of seeing out there. So thanks so much.

Igal Elbaz - *AT&T Inc. - SVP of Wireless Technology*

Sure, Tim. Good morning, and thank you for having me.

Timothy Kelly Horan - *Oppenheimer & Co. Inc., Research Division - MD and Senior Analyst*

I think you might have to go through the safe harbor, but I'm not sure.

Igal Elbaz - *AT&T Inc. - SVP of Wireless Technology*

Yes. Just before we get started, I just want to call everyone's attention to our safe harbor statement. It's saying that some of what I'm going to share today is forward-looking and is subject to risks and uncertainties, and the actual results might be different than what I'm saying. If you want some more information, you can check our website or our SEC filing.

In addition to this, I want to remind everyone that we are in the quiet period of Auction 107. And as a result, I won't be able to address that topic.

So with that, Tim, thank you.

QUESTIONS AND ANSWERS

Timothy Kelly Horan - *Oppenheimer & Co. Inc., Research Division - MD and Senior Analyst*

Great. And as everyone knows, you can -- on the chat room, you can ask questions. We had a lot of questions here at the first section.

But Igal, maybe you can just talk about what are you spending most of your time on these days and what is your responsibilities at the firm in a little bit more color.

Igal Elbaz - *AT&T Inc. - SVP of Wireless Technology*

Sure. So clearly, 5G is in the middle of what me and my team are doing. Our team is responsible for the architecture, design and technology road map of our wireless network. In the middle of this is obviously 5G, but we're also helping to build our FirstNet network, continue to build our LTE, anything from the radio access network and mobility core, any devices that get on the network. So a lot of this is happening and got accelerated during COVID. So that's the main responsibilities of the team.

Timothy Kelly Horan - *Oppenheimer & Co. Inc., Research Division - MD and Senior Analyst*

Great. And where are you right now with building out 5G? And can you talk a little bit about what spectrum you're on, how much coverage you have and what -- any other color on 5G would be great.

Igal Elbaz - *AT&T Inc. - SVP of Wireless Technology*

Sure. I think when -- maybe we'll take a minute to summarize. We are now in a global pandemic. And there's no doubt that we are at the end of an incredibly challenging year. In a matter of days and weeks, we all shifted homes. We're now all working from home, studying from home. Hopefully, with the recent news from the last week about the vaccine, we can start seeing the light at the end of the tunnel.

But I can tell you that I'm very proud to report that the network performed extremely well during that time. And there's no doubt that we've seen a lot of surge in demand in different parts of the network. Think about backbone traffic going 20% up. We are now seeing about 400 petabyte of data going through the network on a daily basis. That is equal to a growth of 12 to 18 months.

We are seeing 90% growth in WiFi calling services. We are seeing growing SMS and messaging demand, which is equal to a couple of years of growth. We've seen 16x growth in traffic in SD-WAN services. Clearly, we've seen the wireless traffic shifting from urban into suburban and rural because this is where we are. This is where we are all. And that put some stress on the network. But as I said, the network held up very well.

And I think that if you look back, there's a couple of reasons that I think helped us to go through that challenge. One is our investment. Over the last several years, we invested north of $130 billion in our network, added capacity, added coverage. We put our spectrum to work. We've modernized our network. We build a nationwide 5G network. We build FirstNet. So that investment paid off.

The second part of this, and it's really -- because we had a lot of capacity, but in places where we had stressed our journey virtualization that started 5, 6 years ago, really helped us to have the tools and the capabilities to speed up and add capacity really quickly.

And if you think about it, this is one of the things that come with virtualization that we talked about, the ability to add capacity quickly. But to be honest, we don't use it that much. We are pretty good in our industry in forecast. We typically have the ability to understand the growth and we're building accordingly. But in times like this, this is where we had the opportunity to bring those investments that we've made in virtualization to work.

And going back, I think around March, there's no doubt there was some concern. Can we complete the deal, the aggressive deal that we had ahead of us? But I can tell you that we didn't miss a beat, and we've continued our build, and we build nationwide 5G and we build our FirstNet. We are now at 80% of our first build and several months ahead of the time.

By the way, I think we are all at AT&T feeling privileged we serve first responder and health care professional in such a time. So all in all, that really helped us to go through that time, through that COVID.

Now to your question about 5G. I think when we entered the year, there were a couple of things that we wanted to do in order for us to continue a 5G network build strategy. The first thing is that we wanted to be nationwide. And in July, we reached that milestone. We now have a nationwide 5G, and we continue to build. At this point, now at the end of the year, we're already over 230 million -- covering more than 230 million box.

We knew that we're going to need to have dynamic spectrum sharing working on our network. I know there's a lot of noise about this lately. But I can tell you the dynamic spectrum sharing is an important capability in order for all of us in the industry to scale 5G. Like any other part of the network, it's going to take some time to evolve and get to the level it needs, but it's absolutely an important one. We have a very strong spectrum position, so that allows us to use dynamic spectrum sharing at the time and when we need it.

Our millimeter wave build continued. We are now part of 37 cities. We just announced Chicago yesterday. There's one more city. We knew that there is a strong desire for an upgrade cycle into 5G devices, so we made 22 devices available throughout the year. The enterprise momentum continued. A lot of our enterprise customers are highly interested in our private 5G and edge services that we have available for them.

And we wanted to continue the leadership position that we have when it comes to network recognition. And I can tell you that we are America's best network by GWS now 3 years in a row. We are America fastest network by Ookla's speed test for the last 7 consecutive quarters. We are America's fastest network for iPhone, and we are America's nationwide 5G fastest network.

So -- and what we're seeing is that the reality now is catching up with perception. And if you look at the results of our previous quarter, you can see that customers are buying in into that perception and the goodness that the network is coming. So all in all, very pleased with the network and the 5G build and everything that we've been able to accomplish in 2020.

Timothy Kelly Horan - *Oppenheimer & Co. Inc., Research Division - MD and Senior Analyst*

Great job. And on the -- how did the first responder upgrade of the network tie in with 5G? How do you marry those 2 together in that product?

Igal Elbaz - *AT&T Inc. - SVP of Wireless Technology*

Yes. That's a great question. That -- by the way, this brings a lot of efficiencies to how we build our networks because -- obviously, because we have a FirstNet contract, we had to go and be in the FirstNet network. During that process of building the network, every time we climb the tower, for an example, to deploy our Band 14, the new spectrum that we got for the FirstNet network, that allows us to do additional things while we're doing that build.

One is it helps us to modernize the network, add all of the capabilities, like 4x4 MIMO, 256 QAM, additional spectrum. So that's one. The other thing is we build FirstNet. And the third one is every time we touch the network, we put hardware that is 5G-ready. And we've done this over several years, and while -- when the software became available earlier in 2019, it helped us just to push out software and make sure that we can get to nationwide 5G in a very aggressive time. So this is how those things are coming together.

Again, we had a lot of efficiency, this all notion of one climb where you climb once the tower and you do all of those capabilities that allows you and get you ready into 5G.

Timothy Kelly Horan - *Oppenheimer & Co. Inc., Research Division - MD and Senior Analyst*

And were you also prepared to deploy -- when you deploy that, can you upgrade to CBRS on that same network? Or do you have to do additional climbs?

Igal Elbaz - *AT&T Inc. - SVP of Wireless Technology*

CBRS is a little bit different. It's an unlicensed spectrum. The way we use CBRS today is mainly in part of our fixed wireless in rural America as part of our CAF-II program. We are offering fixed wireless services with CBRS.

So that's our main use. We are now also offering CBRS as part of our enterprise offering on-prem. But we didn't build CBRS on our standard macro.

Timothy Kelly Horan - *Oppenheimer & Co. Inc., Research Division - MD and Senior Analyst*

And if you get further mid-band spectrum, can you easily deploy that on the existing network? Or do you have to do more augmentation?

Igal Elbaz - *AT&T Inc. - SVP of Wireless Technology*

Unfortunately, this is really a quiet period, so I need to be really careful here with that question.

Timothy Kelly Horan - *Oppenheimer & Co. Inc., Research Division - MD and Senior Analyst*

Okay. Yes, yes. Sorry, I totally understand. Can you give us some performance metrics, maybe not exactly qualitatively? All these upgrades you've done in the last 2 to 3 years, I know you gave us quite a few examples of how great the network is. But have you kind of doubled your capacity, cut your latency and improved jitter or consistency? Any other qualitative metrics you can give?

Igal Elbaz - *AT&T Inc. - SVP of Wireless Technology*

Yes, absolutely. We're looking at all of this, and this is part of the 5G story, right? It's not just about incredibly fast speed. It's also about flooring your latency, improving your reliability, which is kind of what jitter can help you think about. And we are absolutely saying, again, we are the fastest network, so we're seeing the results. Our customers are seeing the results. We are seeing improving networks.

On our millimeter wave deployment, we are seeing 1-gig-plus speeds. We are seeing improvement in our latency because part of the architecture is that it allows us to build a distributed architecture. So it helps us to bring the network much closer into the customers. So that helps us to reduce the latency. And as a result of this, we're also seeing improvement in jitters and reliability. So all of the metrics looks really good in 5G now.

Timothy Kelly Horan - *Oppenheimer & Co. Inc., Research Division - MD and Senior Analyst*

And you just touched on it with edge computing here. How does that -- you're thinking about how computing will evolve. How does that shape how you've kind of built the 5G network? And maybe some real-world examples that we could see from 5G at this point.

And I would say, I personally have been writing for over 20 years that we're going to see ultimately virtualized desktops and computers. And I think there's a lot of articles. Microsoft is coming out with a cloud PC product next year, which I think can really revolutionize IT and how we think about technology. And I think having, to your point, a much more robust intelligent edge can enable that to kind of happen. But how have you designed the 5G network to enable that? And maybe any other use cases that you'd like to talk about.

Igal Elbaz - *AT&T Inc. - SVP of Wireless Technology*

Sure, Tim. I think you're bringing one of the most exciting part of the 5G story, which is the edge. And let me provide some perspective on how I think about this.

So most of the upgrades between network, between 2G to 3G and from 3G to 4G, there was mainly linear progress in terms of capabilities. I think what we're seeing now with 5G is not just a network evolution. It's a real paradigm shift. And the reason I'm saying this is because the spectrum of improvement is so wide in so many things.

So we keep thinking about the fact, this is -- oh, it's incredibly faster network, and it's much more responsive because of latency. But it's more than this. We talked about reliability. We talked about the fact that it now supports a massive IoT in terms of how many devices you can support in square miles. But there's a completely another set of improvements that are happening.

First of all, for the first time, this is a network that is built in the cloud. It's cloud native, which will allow us to be much more efficient in how we build and operate our network. There's a much more reliable on software. This is a software-based wireless network. It's much more open and drive a lot of more innovation.

And if you add to this some of the standards advancement that helps us to, for one example, expose some of the capabilities to network APIs, or improve the positioning capabilities of the network, all of this now allow you to think about the network as a real-time network, which is a complete balance sheet because now it allows you to offer fast, very responsive network. And edge starts to be part of this. And why edge is important.

So first of all, what is the edge? The edge at the end of the day, it's a distributed cloud. All right? It's distributed architecture that allows us to do a couple of things. First of all, it allows us to run our network elements or network function in a distributed way much closer to the customer. But it also allows you to run the applications or the intelligence or the machine learning or the data that you need much closer to the customer. And that convergence of network, compute and storage is really unique and really what can unleash a lot of the immersive use cases that you have mentioned and everyone is talking about in the industry, think about driverless cars or AR or you mentioned virtual desktops.

All of those capabilities that are -- either needs to work from the device today because you can't really leverage the cloud and the distance between the application and the cloud because the latency is not there to support the experience. But now with us being able to converge both, this is what allows us to start supporting those experiences.

Now it's very exciting. And the way we think about edge in AT&T is in 2 ways. First of all, what we call AT&T network edge. This is how we bring edge services to the edge of our network. This is where we partner with third-party cloud like Microsoft Azure and Google Cloud and allow build services like mobile gaming and others.

And the second flavor of this is what we call the multi-access edge compute, which is on the enterprise premise. And Tim, this is really, really important, and our customers get really excited about this because now for the first time, they -- because of that architecture I said, I described, this distributed architecture, we can extend our wireless network into the enterprise premise. You don't have to go and build a complete network. You can just extend some of the elements that allow customers now to have 5G services on-prem.

And why this is important? Because those 5G and edge on-prem allow them to have fast speed and low latency for something like robotic use cases. If you need a controller for a robotics in a manufacturing side, a WiFi network is not good enough. You'd need that wireless network there.

And the second thing is because everything is on-prem, from a privacy perspective, they can now keep the data, their application and everything on-prem. So -- and during conversation with many of the customers that we're serving, we're saying many of them in manufacturing, in health care, in retail and others really interested in this, and there's a lot of momentum that we have out there.

So I hope I provided some background both on edge and some of the use cases that we're seeing both on the consumer side and on the enterprise side.

Timothy Kelly Horan - *Oppenheimer & Co. Inc., Research Division - MD and Senior Analyst*

No, that's great. I remember when we spoke in the spring, you were kind of -- gave me a few use cases. I know like Alexa and Siri being able to kind of operate with extremely low latency. Right now, to me, Siri is a little bit frustrating sometimes. But when do you think we'll kind of get -- are you seeing that in your network now that where the latency is kind of good enough that these applications are working much better?

Igal Elbaz - *AT&T Inc. - SVP of Wireless Technology*

Yes. We are definitely seeing. We're continuing to distribute the network. We'll continue to then see it. That's part of 5G. That's -- it's a continuing effort.

Just last week, by the way, Tim, we went public about a 3D concert, a 3D AR concert that we've done with Axel Mansoor, and that was over our 5G+ millimeter wave network using smartphone. We allow Axel to perform a concert and position him in his fans' houses, in their living room, in a real-time experience. So his fans could sit there in the living room and can see the concert placed in the -- they were able to communicate with him with emojis and communications.

So that was really exciting the way it was done. It was leveraging -- what exciting about this because it's why -- it brings different technologies together, not just 5G and millimeter wave, but also the edge, AI and augmented reality, all of these coupled together to create that experience that you couldn't do before.

And if you think about this, you fast-forward that notion of that hologram placed in someone living room, this is the foundation of a future holographic communication. So these are the kind of things that really gets you excited with 5G and the capabilities that we were building.

Timothy Kelly Horan - *Oppenheimer & Co. Inc., Research Division - MD and Senior Analyst*

Yes, that is really exciting. I can think of thousands of use cases. The -- and so this is working on the cellular network, not on a WiFi network. And I guess can you talk about -- there is some thinking, enterprise has a lot of WiFi capacity and WiFi 6 is coming out and WiFi 6E. How would kind of 5G compare to what people can do over WiFi? And why go with -- why else go with 5G?

Igal Elbaz - *AT&T Inc. - SVP of Wireless Technology*

Yes. I think that's -- Tim, I think that's a good question. If you look at some of the use cases that are evolving and developing on the enterprise side, I gave the example of manufacturing robotics that need sub-5 millisecond and sometimes 1-millisecond latency. These are kind of things that you cannot do on a WiFi network. You need the management and the license spectrum and -- in order to be able to provide that capabilities that allows for those use cases.

Now I definitely think that those are going to be complementary capabilities, WiFi and wireless systems in an enterprise board. But I think things like millimeter wave really brings extremely high speed and low latency and combined with meg services, provide capabilities into enterprises that I don't think you can do with WiFi, even if it evolves to 6 gigahertz. But I definitely think that these are complementary technologies and enterprise will look about having both for different use cases.

I think what's interesting is how they coexist and manage in a converged way. And I think that's part of how we should think about those services moving forward.

Timothy Kelly Horan - *Oppenheimer & Co. Inc., Research Division - MD and Senior Analyst*

Great. Can you talk -- you kind of touched on millimeter wave. Can you talk about the right mix of sub-6 gigahertz versus millimeter wave? And what are your real plans for millimeter longer term?

Igal Elbaz - *AT&T Inc. - SVP of Wireless Technology*

Yes, Tim. So again, I talked about our sub-6. This is what allows us to get the nationwide and the coverage and get to over 230 million subs.

On millimeter wave, there's -- before I answer this, there's 2 important things. One is we at AT&T have the experience and understand very well millimeter wave. The years before we launched this, we've done a lot of trials and we have a lot of understanding of the capabilities, how it works, how we propagate. And I remind everyone that we were the first to launch standard-based mobile 5G at the end of 2018. So we have the understanding.

The second thing is that we have the spectrum position in there. We have the right spectrum position that allow us to serve the customers the way we want.

When we think about millimeter wave, at this point of times, in my mind, there's 3 things that comes to mind. One is how do you provide that experience layer, those -- creating those experiences that requires a gig speed, et cetera, low latency. And for that, we're building millimeter wave where we think it matters at this point of time, where you can actually build those experience. So think about entertainment districts, high-dense areas, airports, stadiums, venues, campuses. A great example is the Dallas Cowboys stadium here in Dallas, where there was -- between the ecosystem, they built a complete set of fan experiences that people can consume of the millimeter wave during a game or during the time they are in the stadium. So that's one.

The second one, which we talked in length, is the enterprise use cases. Again, we are seeing this in manufacturing, in health care, in retail, in military. We are seeing the demand for that capabilities that comes with millimeter wave in the enterprise use cases, and we're getting a lot of momentum in this in the marketplace.

The third one is broadband. Now I believe that some of our competitors, this is what they're doing, building millimeter wave for broadband and building this as a stand-alone network. We never seen the economics of building a stand-alone millimeter wave for broadband. When we think about broadband, we think about a set of solutions that help us to serve our customers the way they need it.

So for an example, fiber, we've been very public about our expansion of fiber and of continuing investment into fiber. And what you're seeing is that -- and fiber provides you with a really long-term return on your invested capital. And what's important, and we've seen this in COVID, our customers love of fiber service because, first of all, it's easy to get on board on the platform. The offers are very simple to consume. But then it's fast. It's reliable. It's symmetric. The uplink and downlink symmetrical speed, and this is what we've seen in COVID that people are really interested in. This is what they need for their work and for their studies.

By the way, we're seeing the growth in uplink over twice the growth in downlink. So that symmetrical speed is really important for our customers. So we're seeing a very high customer satisfaction when it comes to our fiber service.

Now I'm mentioning all of this to go back to the broadband, which there's different type of ways of serving customers when it comes to broadband. Millimeter wave and wireless home Internet is one of them. We just think that the good use of your investment is actually build millimeter wave on our C1 deployment. Wherever we build small cells, this is where we want to build millimeter wave. So the same infrastructure serve both mobility and wireless home Internet.

So that's our thinking about millimeter wave. And again, as I said at the beginning, nationwide 5G, this is our sub-6, and millimeter wave just created us experiences and immersive experiences where it matters and where we're seeing the experience is evolving and built.

Timothy Kelly Horan - *Oppenheimer & Co. Inc., Research Division - MD and Senior Analyst*

But it does seem like the 2 networks are converging. You mentioned yourself you're using wireless in some of the rural areas. And it does seem to be maybe some edge of suburban areas where you can maybe use some fixed wireless over time as you get small distances from the fiber you're deploying. But are you designing for a longer-term convergence of the 2 networks to one?

Igal Elbaz - *AT&T Inc. - SVP of Wireless Technology*

Absolutely. This is really one of the exciting things of where we are in terms of the architecture. And I know I'm getting excited about different types, but it's just an exciting time in our industry.

There's different point of convergence, and we're looking at all of them. First of all is fiber. Our integrated fiber build is really efficient in serving both our mobility backhauling and transport, our consumer fiber-to-the-home and our enterprise customers. And our ability to look at all 3 of them and build the fiber accordingly is a great example of that convergence.

There's things in the standards today. You asked about WiFi and wireless in enterprises. There's capabilities today in the standards that are evolving that allows you to build a non-3GPP network or 3GPP network, which means that you can have one mobility code that serves different types of services, and now your managed WiFi can be managed on the same infrastructure.

You mentioned the edge. The fact that we are building a distributed infrastructure and the fact that both wireline and wireless are getting more and more virtualized, we can now build our network function on the same edge infrastructure.

So all of those things are really driving a strong convergence. And to be honest, AT&T is uniquely positioned to take advantage of those capabilities because we're serving wireline and wireless and fixed wireless and enterprises. We're fixing the old spectrum of customers. And at the end of the day, for customer, broadband is broadband. And the fact that we can be efficient and smart in how we build to serve that is really an advantage for us.

Timothy Kelly Horan - *Oppenheimer & Co. Inc., Research Division - MD and Senior Analyst*

And so how long have you been kind of building the fiber to support all 3 use cases?

Igal Elbaz - *AT&T Inc. - SVP of Wireless Technology*

It's been a while now. We already passed 14 million home with our fiber deployment. And -- but for a good portion of time, we have an integrated build -- an integrated fiber build that serve 3 of them. This is not something that is new. Again, we are expanding on our fiber build. So this is -- keeping this in our mind and this is how we think about the future, but this is not something that just started with 5G or just started recently. This is how we were architecting and building for a while because we knew that, that convergence is coming.

Timothy Kelly Horan - *Oppenheimer & Co. Inc., Research Division - MD and Senior Analyst*

Yes. And I just drove -- I was driving on the highway, and I passed a couple of your AT&T trucks with the fiber on the back kind of ready to be installed. So that process is obviously continuing. Have you gotten more...

Igal Elbaz - *AT&T Inc. - SVP of Wireless Technology*

On the way to another happy customer.

Timothy Kelly Horan - *Oppenheimer & Co. Inc., Research Division - MD and Senior Analyst*

Right. Have you gotten more efficient at the point fiber? Or any steps you've taken to lower the cost of that process and improve the time to market?

Igal Elbaz - *AT&T Inc. - SVP of Wireless Technology*

Yes. Again, we've -- there's a lot of automation in the planning. There's a lot of systems that we bring -- brought to life in terms of how we do that planning and how we apply better automation and better optimization in terms of how we're doing this.

So again, it starts from the fact that you have that understanding of that -- the same fiber can serve different use cases, and that goes all the way back, all the way to the system into -- the system and the people that are doing the planning. So obviously, we're seeing improvement in efficiency throughout that chain.

Timothy Kelly Horan - *Oppenheimer & Co. Inc., Research Division - MD and Senior Analyst*

And kind of related to this somewhat, I know it's all converging, but can you talk about -- kind of where are you in the whole virtualization process of your network, both wireline and wireless? And is this kind of where you're seeing that convergence occur?

Igal Elbaz - *AT&T Inc. - SVP of Wireless Technology*

Yes. So Tim, you probably know, virtualization is not new to us. This is a journey we've started 5, 6 years ago. We've been very vocal about it. In fact, we are supposed to complete our public 75% commitment that we have said that 75% of our network was going to be virtualized and software-defined by the end of 2020. And I can -- I'm happy to inform you that we have -- we were 7 months ahead of the schedule in completing this.

So we have the experience and we understand our virtualization. Our mobility core -- our 5G mobility core, it was virtualized. We are virtualizing many elements of the network, both in routing and voice, in mobility core, as I mentioned.

Our cell site routers is another great examples of disaggregation and virtualization. And as I said at the beginning, that was really an essential capability when we went through COVID because, again, there were a point of the network where we needed to add capacity quickly. And the fact that we have the infrastructure and the knowledge of how to use virtualization helped us to bring capacity quickly to serve customers.

Clearly, there's virtualization effort in all parts of the architecture on the wireless network, again, on the core, but it's now going into the RAN. There's virtualization on the wireline side of things. And because everything is moving to a disaggregated software and hardware, you can start building common infrastructure that can run both function and services on the same infrastructure. So that goes back to your convergent question.

Timothy Kelly Horan - *Oppenheimer & Co. Inc., Research Division - MD and Senior Analyst*

And so you touched on Open RAN. Kind of what does Open RAN mean for AT&T? And what are the opportunities from Open RAN?

Igal Elbaz - *AT&T Inc. - SVP of Wireless Technology*

It means a huge opportunity for us. Let me start by saying that AT&T will deploy and implement Open RAN. And first of all, if you look, there's all kind of alliances and communities. Probably the most known one is the Open RAN alliance. AT&T was part of the 5 founding members. By the way, today, there's over 230 operators and vendors and universities all part of the Open RAN alliance. And we have all intention not just to participate but also to contribute and lead that effort.

Now why Open RAN is important? For a couple of reasons. One, if you think about wireless networks today, there's one thing that stands out. It's a very close ecosystem. Wireless networks are very integrated. By the way, there's a great -- and with a very limited number of vendors.

Now those vendors are providing us with great infrastructure to perform very well. But it's still, at the end of the day, this is a limited number of supply chain, and it's closed and integrated. And the fact that we can now working on open specification and open interfaces and interoperability between different box of the wireless networks allows us to have improved TCO for a couple of reasons.

One is, all of a sudden, you foster innovation. Because you are now able to disaggregate or build the -- have more subcomponents of the systems, new entrants can come in without having a high barrier to entrance because they don't have to build a complete full integrated system. They can be very good in one of the subsystems. And that by itself foster a lot of innovation and hopefully drive a better cost over time.

The other part of the TCO is -- look at our network. I don't think we're very unique. We have more than one vendor in our network. And each one of those vendors come with its own management systems, for an example. What if we had those common data model and open interfaces that we don't have to rely on dedicated management system? We can have one management system across the vendors in the network, and on top of this, we can build automation and machine learning and AI that helps us to be much more efficient on the network. So that's one part of why it's important because it drives a much better TCO.

The second one that is really exciting is, as I mentioned, a 5G network compares to previous generation is much more complex. All of a sudden, we have massive IoT. We have massive MIMO. We have new capabilities showing that. We're moving to software.

And each one of us operators, we have a different customer base, different device mix, different spectrum holding. And our ability on a closed system to fine-tune the network, to better serve and customize the network to the benefits of our customers is limited. And the fact that we're moving into an open network allows us to apply intelligence on top of the network to serve better our customers.

Now there's a perception that Open RAN is only good for greenfield networks. I do not agree with that. I think that established network can take great advantage with adopting Open RAN.

First of all, most of us are following this Open RAN alliance architecture. And what that architecture brings is a very modular architecture. And those modular components work very well with the incumbent infrastructure. That's one. And they don't show up at the same time, so we can decide which part of this we can consume.

The second portion is we establish network. We know very well how to build network. This is what we're doing for many years. So we moved from 2G to 3G, from 3G to 4G, now 5G. We are building networks. We are adding capabilities. So I really believe that in AT&T, we have the expertise and we have the knowledge to adopt Open RAN. And as I said at the beginning, we will deploy and implement Open RAN.

I'm just going to say, it's not going to happen overnight. It's going to take some time, but we are absolutely interested and we'll be participating in that effort.

Timothy Kelly Horan - *Oppenheimer & Co. Inc., Research Division - MD and Senior Analyst*

I think we're out of time. I had another 20 questions to you but I really, really, really appreciate the time. And I know you're incredibly busy. And congratulations and good luck with all the great work you have ahead of you. And thank you.

Igal Elbaz - *AT&T Inc. - SVP of Wireless Technology*

Thank you so much for having me, Tim.

Timothy Kelly Horan - *Oppenheimer & Co. Inc., Research Division - MD and Senior Analyst*

Bye-bye.