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**OVERVIEW:**

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## CORPORATE PARTICIPANTS

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## CONFERENCE CALL PARTICIPANTS

**Tal Liani** BofA Securities, Research Division - MD, Head of Technology Supersector & Senior Analyst

## PRESENTATION

**Tal Liani** - BofA Securities, Research Division - MD, Head of Technology Supersector & Senior Analyst

Okay. Thank you very much all for joining us. We put the best to the last, as we say, and we wanted to dig very deep into Qualcomm's auto business, and I'm very pleased to host Nakul Duggal from Qualcomm. I'm going to let -- I'm going to ask you to introduce yourself and your background and what you're doing because I'm sure you're going to do a better job than me introducing yourself.

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**Nakul Duggal** - QUALCOMM Incorporated - Senior VP & GM of Automotive of Qualcomm Technologies, Inc.

Thank you, Tal, and thank you everybody for being here. I've been with Qualcomm since '95. Today is actually 28 years on the date. And I've been doing automotive for about a decade, just over a decade. Engineering background, moved over to the business about a decade ago. And so I've been involved with building this business for quite some time. And it really is about how do we take our technology, our platforms, our ecosystems and address a brand-new end market, which it was many years ago and obviously, very exciting, very compelling market from many different vantage points today.

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## QUESTIONS AND ANSWERS

**Tal Liani** - BofA Securities, Research Division - MD, Head of Technology Supersector & Senior Analyst

Got it. How do you define the automotive business? Just give us the high level of what are the target markets you're going after.

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**Nakul Duggal** - QUALCOMM Incorporated - Senior VP & GM of Automotive of Qualcomm Technologies, Inc.

So what we started off in the business was to take technologies that we were building for the mobile business and their applicability into automotive, so wireless technologies, cockpit technology that came from Snapdragon. But over the years, we've actually moved over to become very focused on driver assistance, automated driving. We've made a few acquisitions.

And today, we look at ourselves really as 3 major areas: the central compute transition that is going on in automotive, where there's a lot of integration of compute that is getting centralized. We are going from dozens of microcontroller or smaller application processor type architectures to a few larger ones, and we are right in the middle of that. We've been moving that forward.

Everything that is about connectivity, mostly wireless connectivity. And then really all the software that builds up the plumbing for the vehicle. That would be maybe at a high level, how we describe it, which is a pretty large part in terms of where the transition in the market is happening.

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**Tal Liani** - BofA Securities, Research Division - MD, Head of Technology Supersector & Senior Analyst

So you're selling various products, and we're going to talk about digital cockpit, we're going to talk about ADAS. And is there synergy between one and another? And is there synergy between all of this and smartphones?

**Nakul Duggal** - QUALCOMM Incorporated - Senior VP & GM of Automotive of Qualcomm Technologies, Inc.

So the one big advantage that we have, and this is what allowed us to move into the market very quickly is that there is a lot of technology that the car is consuming today. And that technology isn't necessarily available, certainly not in the traditional semiconductor players that have served automotive typically. There are only a few companies who are mostly like us, the Samsungs and the MediaTek of the world who have similar technologies.

But it is really about the application of the technology as the car as a platform is evolving. So the way we started off was what could you reuse? But very quickly, it became obvious that the platforms are so different that you actually have to change the technology and then you have to position it, you have to situate it inside products that are very different from smartphone products. And that's kind of what's happened over the last decade or so.

And obviously, there is a lot that you have to learn in terms of what the auto business needs. The software is different. The value chain is different. The reliability and quality requirements are different. The scalability, the cost sensitivity. So it has become now a completely dedicated road map but it takes from the underlying technology road map that we built. And we are now -- we have been influencing the company's technology road map over the last 5, 6 years or so.

**Tal Liani** - BofA Securities, Research Division - MD, Head of Technology Supersector & Senior Analyst

So before we go into the technologies and the product, I want to ask a question at the high level, which is where are we in the deployment? What are the biggest challenges in your growth and the biggest opportunities you have in your growth? What drives your growth? Can you talk about kind of the next 5 years, what needs to happen for this business to continue and grow?

**Nakul Duggal** - QUALCOMM Incorporated - Senior VP & GM of Automotive of Qualcomm Technologies, Inc.

There are many facets about automotive that, I think, are not obvious when you look at it from the outside. And -- first of all, there is, today, a tremendous amount of competition in this industry, especially with electrification. What you're seeing is the barrier to entry to build an EV has actually gone down drastically. And for traditional automakers, that is a bit of a challenge as well because there are a lot of new entrants. And you have to be able to come up with what your new architecture is going to look like relative to what it used to be.

Time lines in a traditional automotive setting are not very aggressive. But if you, for example, go to China, you will see that a lot of newcomers that are coming in don't really have any background in building cars. But there is a tremendous amount of infrastructure available to be able to get into the market, and they come from the tech space, they come from software. So the barrier to building a software-defined vehicle product is actually reduced.

It is a business that requires a tremendous amount of energy because it is not like a smartphone where you have a very fixed amount of time within which you can launch it and you know kind of what you're doing. It is a much more complex product. And so you need to be able to operate the business at scale. We have a large sized team that is working on automotive. This is not a team that is -- I mean -- many years ago, when we were reusing products, it was simpler. Today, we have large dedicated teams that are working on this.

And that scale is -- actually, you can't really be in this business without operating at that scale. So you need enough escape velocity. You have to be able to be very sensitive to every tier of the market because automakers are going through this motion of in-sourcing a lot of the areas that they were previously dependent on Tier 1s. Everybody is investing heavily in building software teams. Some are better than others, faster than others. You can imagine kind of what that starts to go look like.

But you really have to be able to service and support everyone because the volumes are unpredictable, right? The volumes are very regionally centered. What will happen in the U.S. will not change very likely in terms of the mix. What will happen in China is highly unpredictable. So you have to spread your bets very widely.

And then when it starts to come down to the technology, it really comes down to what is the expanse of your product portfolio, how many different ways can you actually address the customer base that exists because it is actually not straightforward to be able to manage. We will launch -- in the next 6 quarters, we will launch 150 programs. That's the scale at which the business is operating. So this isn't something that you can enter in and say, okay, let's experiment. You really have to do it at scale.

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**Tal Liani** - *BofA Securities, Research Division - MD, Head of Technology Supersector & Senior Analyst*

How do you define a program?

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**Nakul Duggal** - *QUALCOMM Incorporated - Senior VP & GM of Automotive of Qualcomm Technologies, Inc.*

So for us, a typical program would be from when the business is acquired to launching it, which is between, I would say, 18 and 30 months, depending upon the automaker. And it really is to the start of production. So a car is actually in a dealer's lot available for sale. And the complexity of the program, nowadays, there is very little reuse in terms of the program from one generation to the next, a lot changes because there's a lot of competition.

Connectivity programs are by definition simpler, but as you go 4G, 5G, there is a lot of change. But if you start to look at the cockpit space, extremely competitive because everybody wants to be able to do something slightly different there. There's a lot of energy being focused on how does the automaker bring their own brand in the middle of all of it. They also vary depending upon the region you're deploying in.

And then as you start to move to driver assistance and automated driving, that is even more complex because it comes down to what is the level of automation you're targeting, what is the budget available for the program, which part of the world you're launching in. So that would probably be 18 to 30 months, 36 months in some cases.

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**Tal Liani** - *BofA Securities, Research Division - MD, Head of Technology Supersector & Senior Analyst*

Are the programs -- the launch date, are they sensitive to economic cycle? Meaning what we're seeing today, does it cause auto companies to push out deployment or push out kind of program dates?

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**Nakul Duggal** - *QUALCOMM Incorporated - Senior VP & GM of Automotive of Qualcomm Technologies, Inc.*

I think it varies depending upon the market and depending upon the automaker. I think one thing that has been an opportunity, but also complexity is the transition to EV, which has been pulled in pretty much by every automaker, which forces the car architecture to now change. You have to start to move to a different car architecture.

And those that are mature or those that have less complexity can embrace that much faster. Like, you will see, for example, Volvo is a big customer of ours, and they're launching many different types of vehicles, a lot of shared architecture between Geely, Polestar, et cetera. But if you look at something like GM, much higher levels of complexity in terms of what all you have to go touch.

So this varies quite a bit depending upon the OEM. But I think it also depends upon how familiar you are with software as an automaker. How much capability you have insourced, where do you have dependencies, where you are in the learning cycle. Some are able to manage certain things very well themselves. Other areas that are dependent on our customers.

Launching the car is fairly, fairly complex effort from a program perspective. And so we get to see what the struggles and trials and tribulations are of various automakers.

**Tal Liani** - *BofA Securities, Research Division - MD, Head of Technology Supersector & Senior Analyst*

Got it. Without getting into numbers, I just want to understand how this market is going to evolve over the next few years. Do you envision a J-curve kind of growth? Do you envision a steady and slow growth in the industry? Is there a critical mass that you need to pass through and then suddenly growth accelerates? How is this industry going to grow?

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**Nakul Duggal** - *QUALCOMM Incorporated - Senior VP & GM of Automotive of Qualcomm Technologies, Inc.*

One thing that has certainly happened is after Tesla, a lot of other smaller players, especially in China, have actually moved very quickly. BYD is an exception, another large player that has moved quickly that is starting to get the attention of the traditional automakers in terms of the need to move to a newer architecture.

The change to a newer architecture changes the silicon content in the car completely. So where you might have thought you have time, you could push these things out actually is not possible anymore because if you want to have a footprint that is competitive in a market like China, why would you think that you would not need the same thing in other parts of the world.

And so a lot of a lot of conservatism is being looked at again. And automakers that have actually bitten the bullet and are moving forward are now trying to understand what the execution complexity is. For us, we have been well prepared for this because we've been actually pushing in this direction for 5-plus years. So our investments, the road map that we are building is all getting ready for bigger chips, more complex software, much higher levels of integration. And then it really is a question of how quickly can the industry absorb that level of complexity.

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**Tal Liani** - *BofA Securities, Research Division - MD, Head of Technology Supersector & Senior Analyst*

Got it. I want to maybe go kind of into segment by segment and speak about your growth, and the first one is connectivity. Can you take us through the journey of connectivity. First of all, what is the -- it's obvious what's the expertise you are bringing you, but can you take -- talk to us what is the expertise you are bringing in from smartphones? How much adaptation do you have to make into the car environment? And who is the -- who are the competitors in this space?

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**Nakul Duggal** - *QUALCOMM Incorporated - Senior VP & GM of Automotive of Qualcomm Technologies, Inc.*

Let me start with the competitors. I think MediaTek is really the only viable competitor when it comes to modems. The one thing that, I think, has served us very well is that we started to actually do connectivity in cars back in 2002. So we started working with GM with OnStar when they had a choice between GSM and CDMA. Management at that point in time pushed very hard for them to embrace CDMA and they did. We are now in our 11th generation of modems at GM.

And that has actually served us really well because at the end of the day all things being equal, automakers will choose to go with us. And the reason is there is just a tremendous amount of experience. It is actually one of the businesses where the complexity is much higher than the smartphone because you have to live with your product for a very long period of time globally. And we, I think, have done a pretty reasonable job in that, yes, you may lose a deal here or there on pricing, et cetera. But it is a business where if you don't have the scale, it's actually very difficult to be able to go support this business.

We've tried many different things in this business. We have done unique features like duals and dual active. You have 2 subscriptions of the car at the same time. We integrated V2X inside the modem because that's something we are pushing for. We have now announced the acquisition of Autotalks that is still underway. So it's a space where we understand the surface area pretty well. We understand all of the various technologies, products that are required, we understand competition. And we are building a platform that continues to keep getting richer and richer. For example, most recently, satellite communications, there has been a lot of interest in that. So we will evolve the platform to be able to support that.

WiFi was the other area that we were not as focused on 6, 7 years ago, but we have a very broad WiFi portfolio, discrete WiFi products that we now design to work together with our telematics portfolio. So that also actually gets a lot of lift with the overall solution. And the WiFi use case in the car is quite different.

GPS has become a very important use case in the car for a variety of different reasons, from precise positioning to ADAS, et cetera. That's integrated. Powerline Communications was a business that we acquired about 10 years ago, actually for the home. And back then, the team actually started to look into what the application was in the car. We now have -- we have fairly decent market share for both charging station technology and the in-car technology and power line.

So the connectivity business is actually -- there are many independent businesses. They work together. They also work independently. And they are very broadly distributed across the ecosystem, and there is a lot of history with each customer. So I consider that a pretty stable and reliable franchise.

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**Tal Liani** - *BofA Securities, Research Division - MD, Head of Technology Supersector & Senior Analyst*

And how is this segment going to grow? Is it just about penetration, meaning, okay, I got into this car or that car at GM? Or even once you penetrate, is there an opportunity to grow within the same platform?

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**Nakul Duggal** - *QUALCOMM Incorporated - Senior VP & GM of Automotive of Qualcomm Technologies, Inc.*

Yes, we -- so this is an area where we are kind of trying to look for expansion of the SAM itself. So we have efforts around the 2-wheeler space and the 3-wheeler space because as -- so when you start to go into an electrified platform, it has to be connected. You cannot have a platform that will not be connected. So that increases the SAM. And that is something that we have kicked off. We had some early success. I think we'll share more later this year.

But from micro mobility to 2-wheelers to 3-wheelers, that's certainly an expansion. The other area is services, which is something that we've been dabbling in and trying -- so we built a services platform, and we are trying to figure out what type of services make sense where. There is always obviously the complexity where you end up competing sometimes with what your customer is also trying to go do.

But because we are building a platform versus selling components, we have a very good understanding as to what our customers are doing with that platform. And that's where we are looking for opportunities both before market and aftermarket to actually be able to remain connected to the platform we're selling over its life.

And as you -- because the life of these platforms are 10 to 15 years, and there is a lot of value to be extracted by a variety of different people. So that's kind of our focus in terms of build services on top.

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**Tal Liani** - *BofA Securities, Research Division - MD, Head of Technology Supersector & Senior Analyst*

Is the majority of automotive revenues today coming from connectivity?

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**Nakul Duggal** - *QUALCOMM Incorporated - Senior VP & GM of Automotive of Qualcomm Technologies, Inc.*

I wouldn't say majority. I would say probably half and half.

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**Tal Liani** - *BofA Securities, Research Division - MD, Head of Technology Supersector & Senior Analyst*

Got it. Now another segment that you have is Car-to-Cloud. What -- first of all, what is it? And what's the difference between this and connectivity?

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**Nakul Duggal** - QUALCOMM Incorporated - Senior VP & GM of Automotive of Qualcomm Technologies, Inc.

So Car-to-Cloud is a services platform, so it serves all of the hardware that we -- the hardware and the software that we deploy in the vehicle is served through the Car-to-Cloud platform. And think of Car-to-Cloud really as a services platform that has APIs that are available in the edge that you can essentially call from the cloud. We can call them directly. We can build our own solutions. We can partner with companies who we can extend those solutions too.

So we support everything from fleet management solutions, OTA solutions. We are able to manage the configuration of the hardware. So if you don't want to buy the fully dimensioned platform, if you want to buy a certain portion now and you want to pay for that later, that is something that Car-to-Cloud would support.

We've announced partnerships with Salesforce, for example, where if you want to actually be able to look into what is going to bring CRM all the way down to the Edge, what does that look like? So it's basically a services platform that gives you a tremendous amount of visibility into the Edge.

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**Tal Liani** - BofA Securities, Research Division - MD, Head of Technology Supersector & Senior Analyst

Is -- within the context of what we spoke so far, before we continue into the other parts, is there an opportunity for Qualcomm to have recurring revenues? Or is it still about the old model of smartphones, here is a chip, put it in, it works? Or maybe there is a software piece that goes with it?

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**Nakul Duggal** - QUALCOMM Incorporated - Senior VP & GM of Automotive of Qualcomm Technologies, Inc.

So there is always an opportunity for recurring revenue. And I would say the way that we think about it is, first of all, because the life of the platform is much longer than, say, a typical consumer device, we always look for over-dimensioning the platform because we know that the customer is going to need more over the life of the platform.

So for example, we have the ability to be able to sell you 60% of the capability today, knowing that you will come back for more. That is something that is supported, and that's part of the business model. We have the ability to add software capability on top post the sale of the hardware. So the capability is built in, but if it is needed because some kind of regulation kicks in or like in ADAS, this is fairly common where you need to be able to meet with a certain level of compliance today but over time, that compliance requirement may increase, I can push more software for you because I have additional hardware capability built in. So these are all software based.

And then the services and recurring revenue, those are very -- so for example, in the 2-wheeler space. that actually, in those cases, we lead with the services model. We'll actually package the solution as an end-to-end service where the hardware is built in as part of the service. But it depends upon the specific opportunities.

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**Tal Liani** - BofA Securities, Research Division - MD, Head of Technology Supersector & Senior Analyst

Every company that buys -- every car manufacturer that buys connectivity from you will also buy Car-to-Cloud or can it be unbundled, meaning to buy from your connectivity and buy from another software company, the ability to provision the car.

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**Nakul Duggal** - QUALCOMM Incorporated - Senior VP & GM of Automotive of Qualcomm Technologies, Inc.

It is unbundled. They have the ability to buy it any which way. And maybe I'll be a bit specific there. Car-to-Cloud provides a wide variety of capabilities. For example, if you want to be able to control the configuration of our hardware, you obviously have to be able to get Car-to-Cloud access. But if you want to run your own OTA solution versus ours, you're free to go do that. So it is highly flexible in terms of what the business model is, which you have to be because this isn't a space that -- car is a space that we're still building.

**Tal Liani** - *BofA Securities, Research Division - MD, Head of Technology Supersector & Senior Analyst*

So the question also is we are saying that in the future, very far future, probably, but automakers will make as much money from upselling software and services than making the car. Is Qualcomm benefiting from any upsell? You spoke about to sell various levels. But -- or are you now selling the full-fledged hardware to the company with the software capabilities to the automaker, they pay full price, and then it's up to them to price it differently and upsell in the future, different software packages? So how do you participate in, if at all, you participate in the upsell opportunity later on?

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**Nakul Duggal** - *QUALCOMM Incorporated - Senior VP & GM of Automotive of Qualcomm Technologies, Inc.*

So we would participate definitely, first of all, at the hardware level. If I sell you a configuration that has additional room to grow and for you to be able to get access to that, you have to pay. That would be one way to go to participate, which we do. So that is a fairly standard configuration.

So if you want to, for example, have a standard configuration that you want to deploy across all of your vehicles but you don't need the full performance on day 1 for every single SKU, and we can come up with an arrangement that allows you to be able to pay for when you actually go use, right? That allows us to be able to participate.

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**Tal Liani** - *BofA Securities, Research Division - MD, Head of Technology Supersector & Senior Analyst*

Let me define that question a little bit different because I'm referring more to Tesla, for example. Tesla sells you a basic software for -- with the car. But if you want the autonomous driving, whatever, it's not autonomous, but if you want the autonomous driving, it's another \$13,000.

The question is, you provide the same capabilities to companies. Are they -- I want to understand if the carmakers put the initial hardware already fully fledged so they can upgrade the software in the future or that they put basic hardware today, then you go to the mechanic. They upgrade hardware so they can -- how does it work from the car manufacturer and does it work from a Qualcomm perspective?

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**Nakul Duggal** - *QUALCOMM Incorporated - Senior VP & GM of Automotive of Qualcomm Technologies, Inc.*

From the reset, think of it like this. If we provide a product that is going to go into a premium tier vehicle, that is not fully equipped when it is sold. The hardware has to be made available by the automaker, but not all of the functionality is actually needed to be sold. So we would essentially, at that point in time, come up with an arrangement that would say, you are buying this kind of capability over a period of time, you will pay when you upgrade.

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**Tal Liani** - *BofA Securities, Research Division - MD, Head of Technology Supersector & Senior Analyst*

And that's software, right?

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**Nakul Duggal** - *QUALCOMM Incorporated - Senior VP & GM of Automotive of Qualcomm Technologies, Inc.*

That's software. Software. Software. So the hardware -- so you get paid for a certain amount of hardware and then the rest of the capability, hardware plus software is unlocked over time.

Another way to think about the same thing is automakers do not want to have too many platforms. So they would pick one standard platform and use it across all tiers. Now they know already that for the lower tier, for example, you don't need all of that functionality. How do you go pay for that? So there are plenty of opportunities to be able to say, the software allows me to be able to unlock more capability that allows me to be able to monetize over the life of [the car].



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**Tal Liani** - *BofA Securities, Research Division - MD, Head of Technology Supersector & Senior Analyst*

Got it. We didn't speak yet about digital cockpit. Can you take us through it, number one. And what are the products that are involved? And again, same question as I asked you before, how did Qualcomm come to this market? What are the -- what's the strength that you brought from the other world into this market?

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**Nakul Duggal** - *QUALCOMM Incorporated - Senior VP & GM of Automotive of Qualcomm Technologies, Inc.*

So back in 2012, we had -- we were focusing on our connectivity business. And Audi, who had been a customer, they were doing 4G with us at that point in time. They asked us to look into -- explore with them if we would be interested in getting into the cockpit business. And we took them up on it.

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**Tal Liani** - *BofA Securities, Research Division - MD, Head of Technology Supersector & Senior Analyst*

Just for those who don't know, cockpit is...

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**Nakul Duggal** - *QUALCOMM Incorporated - Senior VP & GM of Automotive of Qualcomm Technologies, Inc.*

Cockpit is instrument cluster and the screen where you have your maps and your other controls. So usually, today, if you think about a typical vehicle, you will have 4 displays. You will have the instrument cluster. You will have your infotainment system, maps, et cetera. You have a passenger display and you will have an augmented reality heads-up display. Those are the 4 things that you might have in a mid- to high-tier vehicle.

So back then, they actually were using NVIDIA for -- I think it was an NVIDIA graphics product that they were using for the infotainment business, and they invited us to say, hey, we would like to start to see what kind of technology you can bring. And it was a great opportunity because it wasn't something that we knew really anything about. It was back in 2013 or so.

But we learned how to do automotive quality and we learned how to do automotive software. The realization was that if we made enough changes to the technology that we are developing in smartphones, the application of the platforms that we build in a car are actually very rich. If you think about our standard products that we sell today, we are driving 8 displays of 1 SoC, various resolutions for various things. Mirrors are going away for various aerodynamic type use cases and they're getting converted into displays.

You have all kinds of cameras inside and outside, all kind of visualization is going on. It's all running off of the same technology foundation that we have created. So there is a tremendous amount of synergy between what we are building for the smartphone space, not to a point where what we are doing in the car, especially in the cockpit has far exceeded what we are doing in the high end of the phone. And the concurrencies are extremely complex because you are actually serving 3 customers. You're serving the car, you are serving the real-time nature of how you are engaging with the driver and you are serving an external application ecosystem that is coming in.

So we've been at this for now close to a decade. And what -- the one big advantage that we had was that we were able to look at our smartphone road map, pick the right parts, make the right changes and make available very quickly solutions that serve the needs of every tier. And over time, we were able to influence the direction of how do you actually design this cockpit because it is really about integration, reducing the total cost of ownership, bringing down -- bringing more functionality to lower tiers of the vehicle.

And that has made us, obviously, a very strong platform provider. What we also had to do because this is not just hardware, there's a tremendous amount of software that is needed. You have to serve a wide variety of fairly fragmented software ecosystems, which we learned.

So we've actually invested in the software teams that are needed, we have the ecosystem partnerships. And that allows you to be able to have a set of customers that are very comfortable with the platform, the teams, the software that they have built. And then you have a lot of repeatability in terms of how you build the business.

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**Tal Liani** - *BofA Securities, Research Division - MD, Head of Technology Supersector & Senior Analyst*

Got it. What I noticed is that some carmakers make an announcement that their rear infotainment system is Qualcomm, the front is someone else. Are we going to -- is this market now is being defined. So we see multiple vendors in the car, et cetera. And then they're going to choose one? Or we're going to live with this kind of fragmented environment for many years?

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**Nakul Duggal** - *QUALCOMM Incorporated - Senior VP & GM of Automotive of Qualcomm Technologies, Inc.*

That example is happening less and less. I think at large automakers who have a very large difference between the tiers of their vehicles, entry-tier vehicles that need something very basic, versus more advanced systems that need something more capable. We are not focused on the entry tier. But I would say that most automakers are centralizing on really one platform that goes across most of their vehicle lines. And then if they have a second one, it is really for an entry tier that is kind of a (inaudible) affordability level. But you don't see as much of that kind of coming.

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**Tal Liani** - *BofA Securities, Research Division - MD, Head of Technology Supersector & Senior Analyst*

And who are your competitors in digital cockpit?

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**Nakul Duggal** - *QUALCOMM Incorporated - Senior VP & GM of Automotive of Qualcomm Technologies, Inc.*

We have many competitors. We have Samsung. We have -- MediaTek is now starting to play. We have Renesas at a certain level. Not so much NVIDIA anymore.

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**Tal Liani** - *BofA Securities, Research Division - MD, Head of Technology Supersector & Senior Analyst*

They're busy with ChatGPT.

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**Nakul Duggal** - *QUALCOMM Incorporated - Senior VP & GM of Automotive of Qualcomm Technologies, Inc.*

We are -- yes, ChatGPT is a good thing. We have a number of Chinese competitors that are starting to show up now locally. But it is a market where you need to be able to have a lot of different assets to be able to operate at scale. So I think -- so far, I think, we've been able to do a fairly good job in holding.

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**Tal Liani** - *BofA Securities, Research Division - MD, Head of Technology Supersector & Senior Analyst*

So on that, I'll ask you, what's your differentiation? What do you bring to the market that the smaller Chinese don't have or the others don't have?

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**Nakul Duggal** - *QUALCOMM Incorporated - Senior VP & GM of Automotive of Qualcomm Technologies, Inc.*

Well, I think, -- first of all, I think there's a lot of experience. We've kind of taken this market in the direction that it has gone. So we control the set point in terms of what the integration is, how do you do a lot of the currency? How do you actually define a feature set for what the next-generation cockpit looks like. There is a lot of software integration you have to do, so you are running safety software with an Android app side by side.

You have to be able to support this globally because automakers are all developing their solutions all over the world. So you have to be able to have teams that can actually make that happen. You have to work with a large number of ecosystem partners because a cockpit is built by -- between a dozen and 2 dozen different software providers that come together. You have to build a road map that scales.

So one of the reasons why we built the road map that we did is, you can't afford anymore, in my mind, to have a cockpit road map and an ADAS road map separately. There's just not enough -- the size of the opportunity is not big enough. So you have to be able to consolidate those 2. That requires you to make choices. So we -- in this generation that we are in, we actually spun out the road map completely. We no longer use mobile chips. We only use the technology. These are all automotive chips that are built from the ground up just by our business.

So you have to be able to make those kinds of bets. And I think once you go do that, then you're always going to have competition where somebody is going to want to try to do something on the chip or experiment, et cetera. But these are systems that are very complex because you have to be able to keep the software updated over its life. And so you kind of need a customer -- so you need a partner that the automaker is going to say, okay, these guys have a lot of the experience, the people, the understanding. What do I need to go do when I'm making my choice? Well, I think, that -- so it's a number of different there. It's much more than just the product. They have many other things that come into play.

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**Tal Liani** - *BofA Securities, Research Division - MD, Head of Technology Supersector & Senior Analyst*

Okay. From a -- before we -- I touched on 3 areas so far where Qualcomm was able to bring expertise in smartphones into the automotive market. Very clear synergy between the products. The next area is something you had to make an acquisition, which is Snapdragon Ride platform, ADAS, right, autonomous driving, et cetera, for those who don't know. Take us through the journey again of Qualcomm in the space. What did you bring in internally and what did you acquire and where are you today?

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**Nakul Duggal** - *QUALCOMM Incorporated - Senior VP & GM of Automotive of Qualcomm Technologies, Inc.*

So maybe 5 years or so ago, it was pretty clear to us that if we had to be relevant in the automotive space, a reuse strategy, take from mobile use and auto, that got us to where it did, but that was not going to be good enough. If you recall, we were in the middle of the NXP acquisition back then. So the thinking was we will acquire NXP, NXP will bring a lot of the things that we don't know about automotive, and that will kind of complete the picture.

It became clear to us a year or so before we finally parted ways that, that was not going to pan out. So we doubled down and we said we don't need to have silicon that will work in the automotive space from a safety perspective. And at that time, we had to start to think about what kind of road map do we need to build for ADAS. So we started to do what you might normally expect. We took the right chips that made sense, and we started to make sure that they were -- they had the opportunity to play in the ADAS space.

And it was a very good decision because it actually won us the GM business on ADAS. So we won that back in 2019, and we learned a tremendous amount because really, the ADAS use case is about taking a large number of sensors and processing them in a fixed delay budget for a variety of different use cases, whether it is real-time processing, apply AI to it, obviously, based upon the action that you have to go take.

So we have to figure out how we were going to go do this as a road map. It was pretty clear that the road map you would have to build for silicon would have to be a safety-ready road map. So that decision we took fairly early on. Then the question was, do we build our own stack or do we just support other people's stack? And the decision we took there was we had some assets internally that we had been building on the stack side, but nothing that we could get into production with. So we had to acquire a team that had that experience.

And the path that we are now on is that it's a flexible road map, we can host other people's stacks. We're obviously building our own. And what I like about this market is that this is headed towards 100% attach. Every single car is going to have safety software and safety hardware. And it really is going to come down to what -- it is not that different from the cockpit in that to be able to get to where we are is not going to happen in 1 or 2 years. It's going to take a long time and you can be added.

So the more synergies you can create at the product level and the more you focus on creating software that is very tightly coupled with your hardware, we know how to do those things. We've done that for a long time. I think that makes you a very attractive bet for a customer to make. And I think if you spend enough time with automakers, what you will realize is it really comes down to make versus buy decisions where they are concerned about handing over what they might think is a very important part of their differentiation to a supplier.

But then very quickly, the question is, is this expertise that they can have at scale internally? So if they have to make a choice, would they trust a supplier that is going to give them the flexibility that they need to have. So for us, these are all bets that we are making for the long run. But I think so far, I think they are laying out well.

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**Tal Liani** - *BofA Securities, Research Division - MD, Head of Technology Supersector & Senior Analyst*

One of the bigger player in this space is Mobileye. I'm not an expert on Mobileye. I don't cover them, but I know they have north of 60% market share, if not more. But they do have a very proprietary approach where you have to buy their entire -- the entire platform from them, everything from soup to nuts. How are you -- how do you intend to take market share from Mobileye? How are you different from their approach when it comes to modularity of the product, et cetera?

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**Nakul Duggal** - *QUALCOMM Incorporated - Senior VP & GM of Automotive of Qualcomm Technologies, Inc.*

In automotive, once the product goes to 100% attach rate. The only thing that automakers focus on is the cost of ownership and control points. There is nothing else that they focus on. And one of the big challenges that the Mobileye model has is that the system is not programmable. It is designed for Mobileye software. So that will always have -- it's a target that you can aim at because you're always going to get attention.

For us, really, the starting point is very different, right? We are building heterogeneous SoCs. That has been our history. We have proprietary hardware that is highly accelerated. And then we have CPUs and GPUs and DSPs that you can program on. And then we have a very broad ecosystem that can develop on our platform. So the example I gave to you about the SKUs, for example, I can sell you a platform that competes with Mobileye and then I can open it up and charge you a little bit if you want to run a parking stack on it.

And if you want to do something more, I can allow you to do something more as well. So for us, it really is about what are the areas that we want to differentiate on with the hardware and software solution that is ours and allow the ecosystem to be able to go develop on top. And because the platform is highly programmable and we are going to be, for lack of a better word, opportunistic in terms of how we enter the market, we build platforms that are very broad.

We will build certain technology areas that we want to excel in. And then over time, we will figure out which market we want to focus on. But the cost of ownership question is always going to be a better equation with us because it gives the automaker a lot of choices.

Mobileye has done a fantastic job. They're a great company, but I think the kind of the black box part of the solution does, I think, pose some challenges.

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**Tal Liani** - *BofA Securities, Research Division - MD, Head of Technology Supersector & Senior Analyst*

So Nakul, the good thing is that we have a great discussion. The bad thing is that I only covered 3 questions out of 35 questions I prepared. And I know I had a lot of sub-questions. I want to stop for a second to see if there is any question from the audience before I continue. We only have 2 minutes left, but I want to at least have the opportunity of any questions.

**Unidentified Analyst**

If I can just ask, but over time, how should we think about potential content for vehicle reduction? And kind of what have you seen in terms of changing dynamics over the past few years...

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**Nakul Duggal** - QUALCOMM Incorporated - Senior VP & GM of Automotive of Qualcomm Technologies, Inc.

Content per vehicle reduction, could you elaborate that a little bit?

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**Unidentified Analyst**

So we've heard about vehicles and autos moving from decentralized ECUs to more centralized ECUs. So in that context, how should we think about potential content per vehicle reductions and obviously on the semi side with perhaps lower-quality chips and maybe potentially older chips as well?

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**Nakul Duggal** - QUALCOMM Incorporated - Senior VP & GM of Automotive of Qualcomm Technologies, Inc.

I don't know if I can answer it in terms of dollars and cents because there isn't really a way to kind of normalize it. But maybe think of it like this. I think one is -- the example I'd like to use is a BMW 7 Series used to have like 150 different ECUs 5, 6 years ago. Today, it probably has more like 10. Obviously, there is a big difference in terms of what the ASPs are, but you can imagine, all of the peripheral cost of carrying all of those 150 ECUs obviously starts to go away.

So there is certainly a system-level savings that BMW gets benefit from. But the bigger benefit is you can take those same systems and now scale them down to a 5 series and a 3 series. So the overall silicon content across the entire vehicle lineup is going up because you're able to bring functionality to lower tiers.

Is the total amount of electronics content going down? I think it probably is just because you are comparing with something that is fully equipped and perhaps not the norm to something that now becomes the norm. So I do think that the amount of electronics that is going into vehicles is just massively increasing just because so many more cars are getting access to that capability.

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**Tal Liani** - BofA Securities, Research Division - MD, Head of Technology Supersector & Senior Analyst

Great. Any other question? We only have 20 seconds left. I think we better finish it here. Thank you so much.

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**Nakul Duggal** - QUALCOMM Incorporated - Senior VP & GM of Automotive of Qualcomm Technologies, Inc.

Thank you.

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**Tal Liani** - BofA Securities, Research Division - MD, Head of Technology Supersector & Senior Analyst

Really appreciate it. Thank you.

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