Aptiv ADAS Roundtable Discussion Transcript

September 30, 2024

Prepared Remarks:

Chris McNally | Head of Global Auto & Mobility Research at Evercore ISI

Hello, everyone and our sincere apologies. Unfortunately, we had some tech issues, but we got through them. And I'm really really glad that we did, because I'm so pleased to welcome you the Aptiv virtual ADAS Roundtable. I'm your host, Chris McNally, Head of Global Auto and Mobility Evercore ISI, and on the heels of returning from our 7th Annual ADAS AV and AI forum.

It could not be a better compliment than hosting this ADAS Roundtable with the leading supplier, Aptiv. We are going to begin a presentation from Aptiv shortly, and then we'll come back for a fireside chat. And finally, I'm going to open up to you, the investors, for a Q&A towards the end of the hour. So write in your questions.

And with us today Kevin Clark, Chairman and CEO, Anant Thaker, Chief Strategy Officer and Senior Vice President of Product, Benjamin Lyon, Aptiv's SVP and CTO, as well as Simon Yang, President of Aptiv China and Asia Pacific. What a panel, team! Thank you so much in advance for putting this together. And again, I think, because we had such a great panel -- maybe that's why we had so many tech issues. But we got there!

And so, with no further ado. I'm going to hand it over and welcome team Aptiv, and hand the floor over to Kevin. As I know you have some bespoke ADAS material prepped for the event. Team and Kevin, thank you so much.

Kevin Clark | President and Chief Executive Officer

Thanks very much. Thanks for thanks for having us. We really appreciate it, and we welcome the opportunity to talk about Aptiv. On Slide 2, everyone's familiar with the safe harbor related to forward looking statements, so I'll not read through the document through that page.

If we go to the next slide, Chris mentioned those of us from Aptiv who are participating in this presentation. I won't go through and reintroduce everyone. I would say that we have strong capabilities here from a technology, from our product and from a regional standpoint that we thought would make the conversation today really interesting. So you'll hear from each one of us during the presentation.

So on Slide 4, just an overview to provide some context. Aptiv has roughly 3 decades of experience providing what have become increasingly complex end-to-end ADAS solutions. And we have a number of firsts -- 1st radar in the car, 1st sensor fusion of radar and vision systems, 1st radar and camera in a single unit, 1st multi-domain controller. And then a number of firsts, including the 1st supplier to deliver a hands-free L2+ system and awarded a full system L2+ award with Geely last year that includes parking. And then, earlier this year, we announced our 1st full system Gen 6 ADAS award - that we're going to talk a lot about today - with an emerging EV partner.

Now, all that capability is translated into technology on over 55 million vehicles to date. We've shipped over 3 million full L2+ systems across 55 nameplates that are equipped with our L2+ solution. This is translated into over 3 billion dollars in revenues in terms of outlook for 2024 – a 20% growth rate. And, as you all know, strong customer awards or bookings over the last few years.

If you go to the next slide, our view on the ADAS market. ADAS growth has gone from 15 billion in 2020 to our forecast or estimate of 27 billion in 2025 to 45 billion in 2030. And a lot of this, roughly 50% of this will be driven by L2 and above ADAS penetration by 2030.

Now that represents mass democratization of L2, L2+, L3 solutions. And in order to do that, you need to spread advanced ADAS technologies across a broader portfolio of vehicles, including mass market vehicles. So the ability to deliver a high performing technology at very competitive cost is very important to drive market growth. And we're going to talk about during our presentation.

Not only the technology, but how are we taking the cost out of the system? How are we making it easier for our OEMs to adopt the technology? To bring it on vehicles at lower cost and provide them flexibility to get to where they want to be, as it relates to their overall ADAS solution and a big part of the overall content. And we'll talk about growth in software, which we estimate will be 9 billion dollars by 2030. So an important part of the value proposition that we offer.

If you go to the next slide, having been in the business for 30 years, we're very, very familiar with the challenges that our OEM customers have, especially within the next generation of ADAS. And our real focus - again, just reiterating what I said - is how do we deliver better performance at lower cost. While at the same time, supporting our customers' strategies and their capabilities -- giving them choice.

That's really important in terms of what we deliver. So you'll hear us talk about an open platform, a flexible system that's vision agnostic or perception system agnostic, as well as SoC agnostic. And that's one of the big value propositions that we think our solution, our Gen 6 ADAS solution, delivers.

So with that I'll turn it over to Anant and he's going to talk about how our system - how it's designed and architected and how we actually do that.

Anant Thaker| Chief Strategy Officer and Senior Vice President, Product

Thanks, Kevin. Kevin really hit those customer needs and pain points quite well. Just quite simply, our customers are looking for really strong and improved performance at a lower cost, and then flexibility and choice across the technology stack in delivering that. So how do we do that with our Gen 6 platform?

The left side of the screen here really shows the key elements of the Gen 6 platform, which spans from the sensors at the bottom all the way up to the cloud. But there's really three key elements that I'd like to focus on, and that we're going to zoom in on here.

First, our software architecture. That's where everything really starts and specifically how we use a cloud native software architecture. I'll talk a little bit about what that means in a minute. And a container driven approach that allows us to really modularize our software stack and abstract that from the underlying hardware. And if you pair that with a modern end-to-end DevOps platform that's hosted in any cloud environment, this allows us and our customers to speed development of the ADAS software stack, to streamline deployment onto vehicles through OTA, and to really optimize the lifecycle management and the cost of that lifecycle management which ends up being a very substantial cost driver for all of our customers.

So, we really start with having the right software architecture. And then this enables us to really optimize how we leverage AI/ML in enhancing system performance and applying advancements in capabilities everywhere throughout our stack -- to perception, to behavior, to path planning. And we're able to do so in a way that's as compute efficient as possible. Again, with an eye on cost.

And these things together allow us to have a platform solution that for our customers really scales efficiently from lower levels of compliance ADAS all the way up to L2++ and L3, while driving significant reuse in the hardware and software components, as well as in the testing and validation for that entire system and stack, which drives favorable economics for us and for our customers.

So really digging into each of these one by one. As I mentioned, we really focused first on just starting with having the right software architecture. And if you look at the ADAS software features and building blocks, they really follow what we call a ‘services based architecture’. And that means we've broken the stack into logical containers that can be independent and interact with each other through open APIs.

And because of that separation, we're able to update the software at a container level. So any of these blocks that you see here, as containers with the dotted lines around it, we can update without really affecting the rest of the stack. That allows us to make those updates and refinements more easily and seamlessly and importantly, more frequently, which is really important for the end customers.

And then, we can also spin up these containers in the system only when we need it for specific feature applications. That allows you to really optimize and utilize just the right amount of compute resources, which can be more optimal than if it was all one large stack.

And then, finally, that modularity gives our customers more choice - allows them to have more choice with partners that we can work with in every one of those containers. OEMs can own certain parts of it. Partners can own certain parts of that. It allows for really flexible collaboration models.

And so I've really focused on the containers at the top level of this stack. It's really only possible because of what we're showing here at that lower level in the operating system. We're using a RTOS VxWorks, which is really the only real-time operating system that supports these types of containers. It's a specific open container initiative that's a very well-known standard format, again, that drives our customers a lot of flexibility higher up in the stack, because anyone can adhere to this format.

It's not proprietary, and because you pair that operating system and the open container format with our middleware capability, that abstracts the hardware from the software below to different types of SoCs. This gives our customers a lot of choice in SoCs that we're porting our software stack on.

That openness is particularly relevant in China, for example. We're increasingly seeing customers that are looking for localized SoC solutions, localized vision solutions, localized map providers, localized cloud providers. So that openness is going to be really important in China, and Simon is going to talk about that later.

But because this is really so fundamental, I figured we can just walk through it because I want to do a comparison of how this compares to typical legacy systems that you see in the market today. It is kind of a complicated architecture diagram here, but for really the vast majority of Level 2 systems on the road today, this is what the system stack looks like.

On the far left, here you have a vision SoC. You can see these lock symbols because the vision software is really tied to the underlying silicon. It really can't be separated, and that silicon can't be used to host any other software functionality.

And then oftentimes, if there's a parking feature on the stack. You have another Soc, that's running the parking perception and the parking features, because that's fairly compute intensive. And then you often have a microcontroller, which needs to operate in a real time environment, because that's running your ADAS software stack.

You can see all these different features kind of listed at the top, right? Like radar perception and vision perception and the highway stack and motion control. These are all your underlying software features, but they're all tightly integrated into what's called a monolithic architecture. And that means it's all one large binary of code, in which all of these individual components are highly dependent on each other. They're tightly coupled, so if you change one thing, you really have to change all the other things.

So the issue, because you have this type of an architecture, you see the following is monolithic. All of these things because of their interdependencies, they're quite challenged and hard to update. So you can't update the stack as frequently and when you have to test and validate each time you build up a long sort of train of changes before you actually would flash this to a new vehicle.

Because you have that software tightly coupled to the hardware that reduces your SoC flexibility and drives vendor lock-in for several of the customers. And because I have to split that across multiple units and multiple SoCs, it drives up the overlying and the underlying cost of the system.

So, if we can break apart that monolithic stack, which is what we're really focused on, it allows us to take all these components and organize them into individual containers. If we have those containers, as I mentioned before, it allows us to update at an individual level and refine at an individual level. If you really pair this with Wind River Studio, which is our end-to-end cloud native DevOps platform, you can leverage that platform to develop your code, deploy that onto vehicles and then manage it over the full life cycle, and then, importantly, really improve these individual components.

For example, if we're bringing machine learning to our perception capabilities, behavior, or path planner, I can update those individual components, as I've highlighted on the screen, without having to touch the rest of the stack. As you can imagine, with machine learning, these features continuously

improve, so it allows me to continuously make those updates in a seamless way to the vehicles I have on the road. If I'm working with partners, in many cases we might be working with OEMs, who want to own a certain number of the features, bring their own flavor to a certain number of the features, or who may want us to work with a particular vision provider, each party can really work within its individual container. It leads to a much more seamless and efficient collaboration model.

We've seen from the past that trying to do exactly what we're showing here, and just highlighting these different ownership pieces, in a monolithic software architecture is incredibly difficult, and it really drives up the overall cost, leads to a lot of delays, and can cause all kinds of challenges for our customers. So, this is really what we've learned from, and what we want to do differently. I mentioned Wind River Studio, a DevOps environment. I think what's quite important is that it's not linked to any one cloud environment, so this can be deployed onto any public cloud environment or an on premise cloud environment.

We meet our customers where they are. We see some of our customers work with one hyperscaler, some with another, some that need to work in on-prem. Again, in China this could have unique characteristics. You need to work with certain cloud providers in China. So the flexibility here, from the software up into the cloud, is quite important and just as important, since I'm running it on Aptiv's Middleware as well as the Wind River software stack, from a platform standpoint.

It is actually quite flexible with the SoCs on which it can operate, as well as with various sensor types and stacks that can operate with. So we're driving really the flexibility up into the cloud and down into the Soc level, because of this Middleware and because of this software architecture. If you think about cloud and SoCs, these are 2 of the most expensive parts of the technology stack. That's where we're driving the most choice for our customers.

So ultimately, it really comes back to the 3 points that that Kevin had mentioned. That because we're allowing more frequent updates to the stack and more refinements to stack, we're driving better performance because we can speed up development times, deploy container size updates to the vehicles, manage the full lifecycle, and identify issues and update those more frequently.

We're lowering the overall cost significantly for our customers. Because we're driving that openness up to the cloud and down at the Soc level, and throughout the stack with open APIs, we're giving our customers a lot of flexibility and choice. That software architecture is really what allows us to deploy AI/ML in a really optimized way, and efficiently with our Gen 6 platform. This drives significant performance benefits, and how the system performs and operates.

As an example of the perception capabilities, the way we deploy AI/ML allows us to really see significant improvements in our object detection and size, determination, and position estimations. These are all things that are going to reduce your overall takeover rate. They're going to drive more operational design domains. So where does the vehicle operate just with radar, for example. So, you can imagine a low visibility environment solely with radar, we're able to identify vulnerable road users with a 90% identification rate, and more accurately detect stationary vehicles and objects because of how we're deploying AI/ML. This is something that's very challenging to do with vision alone. It really improves our overall system, performance and availability.

Then, importantly, when and you get into things like behavior and path planning, we leverage AI/ML to drive context awareness, you know, more naturalistic humanistic driving, and how we do path planning

and how the vehicle operates on the road. So not only does it sort of feel more normal and how you typically are driving in these types of environments, it also enhances how it deals with certain situations like tight curves or roads without lane markers. It's able to do that leveraging multiple sensor inputs, it's not tied to any one specific sensor configuration. Again, because we start with a software architecture, it allows us to deploy AI/ML in a highly optimized way.

It comes back to performance. The vehicle has higher availability, and it feels much more naturalistic in how it's driving. It lowers the cost, because we can really leverage AI/ML in what are even lower, less expensive sensors, like radar, so we can really get the most out of it. It drives down our overall compute usage, and that drives down the cost, and allows this openness because we can work with multiple vision suppliers. We're decoupling the software stack from the underlying Soc, so it meets all of those 3 key customer needs.

All of these things really come together for Level 2++, Level 3, or Level 2+, as Kevin mentioned, and we showed that growing market demand. We're seeing it across all levels of ADAS. So for us, and for our customers, it's really important that we can drive a scalable solution, scalable architecture, and reusable components that can meet their requirements all the way from compliance vehicles, very low cost vehicles that are just trying to be GSR requirements or basic NCAP requirements, all the way up to higher levels like Level 2++ and Level 3.

And I'll kind of walk through this step-by-step, but the key takeaway is that when customers are investing in elements of Gen 6, or the full Gen 6 ADAS platform, they have that reusability and scalability all the way across all of these different use cases. For us, that's what really enables true democratization of the technology or OEMs to deploy across all different types of vehicles within their lineup.

So to walk through what this looks like, if I start with compliance, it's really feature driven. It starts with what features are you trying to deliver at a software level, then what is the sensor and compute functionality that you need to enable for compliance features. Our Gen 6 can start with a simple smart camera and an optional front radar depending on what the customers need, and what level of robustness they're trying to drive, and think of this as like GSR 2, just your basic kind of compliance capabilities.

When you move up into Core, this is like core Level 2, hands on the wheel, eyes on the road for lane keeping, and ACC, this is where we're adding the corner radar, the front radar, as well as the optional front corner radar that enables that type of capability. I'm reusing the assets, and I'm using the smart camera that I just deployed in my compliance configuration.

As I move up into Level 2+ hands-off highway capabilities, I'm reusing that same vision capability. I'd be reusing that same perception stack. I'm reusing all the same sensors. But, now I'm bringing in much more machine learning into how I do perception, behavior, path planning, and even crowdsourced localization to truly unlock that hands-free capability.

We've already, as Kevin mentioned, deployed this to several customers and have over 3 million units shipped that are hands-free highway systems. We won our 1st Gen 6 ADAS award, that is now moving off of highway into all roads, so moving beyond highway. Again, we can scale quite a bit here, so everything that I have from a software stack I'm able to reuse. I'm bringing in a redundant computing platform. So, I have a smart camera as well as my central domain controller for compute, but I'm able

to really reuse all of my same sensor set, and all my same software stack. I'm really just adding that redundant compute.

So if you think about how we approach our customers if they want to have a Level 2+ system and ultimately scale that up to Level 2++, we're giving the ability to reuse all of the testing, validation, and assets that they had just for highway as they expand it to a broader ODD. Ultimately, even when you move up into L3, you have to add more sensing, and more compute, because now you're getting into much more complex scenarios and highly complex redundancy requirements. But, the same perception capabilities, underlying software stack, and compute that I just used for Level 2 become my redundancy case in Level 3.

All of that reusability is quite important. If you look at this stack, I've focused on sensors, the software stack, the software platform, which is the middleware on top of which all of this is built, and the DevOps environment that I'm using to again develop the software, deploy it to vehicles, and manage the entire lifecycle that is reusable across all levels. So we're using that everywhere from compliance all the way up to level 3, and that drives a lot of scale for us, and a lot of improved cost effectiveness for our customers.

So, if I really tie this back to "what is the point of all this scalability?" Ultimately, it's driving performance, because it's the same assets that are being used across multiple levels of ADAS, they're mature, and they're tested. We have significant testing and validation that our customers can benefit from. They invest in in one level and they get the benefit in the other, because they're only making that investment once. They get to scale that cost across multiple levels of ADAS as they grow across their vehicle lineups. That drives down their overall cost for deploying, maintaining, and updating this over their full lifecycle.

Because we're allowing them to sort of pick the best system that meets their vehicle needs drives a lot of choice, and we can again engage with our customers at just one level of this. We could provide just the perception capabilities, or we can provide the full system. So we're giving them choice across the ADAS levels as well as across the entire technology stack. Having that choice, flexibility, and openness is relevant globally, across all markets based on what we're seeing from our customers. It's particularly relevant in the China market, and I think that's really a perfect segue to Simon, who's going to talk about what we're seeing in China.

Simon Yang | President, China and Asia Pacific

Yes, thanks. Let's talk about China.

As we are showing here, China is driving ADAS adoption, including 3 major drivers. One is increasing consumer demand with high expectations on functionality, particularly hands-free functions. OEMs, especially the Chinese local OEMs, are using ADAS to win share in a highly competitive Chinese market, as you are all aware. And a very strong government promoting innovation. L2 and above adoption is expected to increase to 60% by 2030.

For suppliers, it is very important to differentiate and win in China. At Aptiv, we are focused on positioning ourselves to be successful in the China market, which is the largest globally. Our ADAS strategy allows us to adapt effectively to specific regional needs.

As Anant just showed you, the key product characteristics are the same - including scalable modular solutions, modern software architecture, and optimized AI machine learning deployment. We then tailor our solutions specifically for China. We have a fully in-region, for-region team from a manufacturing and engineering perspective.

Because local OEMs move very fast, as you know, they are more open to full system solutions. It is also important to be flexible and hardware agnostic. So, we work closely with local SoC, vision, and mapping providers to deliver a full China-based system.

Our strategy has allowed us to win several key awards, including for Changan, where we're using a smart camera on both local SoC and local perception algorithms provided by Horizon Robotics. For a Geely project we just won, we're using a smart camera based on a local SoC, provided by Axera, and a local perception algorithm provided by Maxieye.

Actually, Maxieye is a Chinese vision supplier, in which we have just completed an equity investment to accelerate deployment of a local solution for the China market. We believe our strategy is what China OEMs need, and we are focused on working with the top players who will drive volume over the longterm.

With that, now let me turn it over to Kevin.

Kevin Clark | Chairman and Chief Executive Officer

Thanks, Simon. Thanks, Anant.

In closing, hopefully the presentation made it very clear that we believe we're perfectly positioned to capture a significant amount of value from the innovative solutions we've developed in and around ADAS. Clearly, the market is growing. It's growing rapidly. As I mentioned earlier, nearly 50% of the global automotive market will be Level 2 or above by 2030. So, there's a tremendous amount of content opportunity there.

Our approach is what our customers are looking for in terms of scalability, openness, and ability to drive down cost, while at the same time increasing performance. The architecture of our Gen 6 ADAS solution not only provides flexibility and optionality for Western OEMs, but it also has been designed to operate in the context of the specific needs that the China market has today, and we believe will continue to evolve. So with that, Chris, we'll turn it over to you.

Q&A Session:

Chris McNally | Head of Global Auto & Mobility Research at Evercore ISI

Well, thanks so much, Kevin, Anant, and Simon. That was a fantastic tech overview, but also a great one on how to think about modular and evolutionary ADAS systems. What I wanted to do was maybe address some of the numbers and the market drivers, particularly from the moving OEM pieces, which I know investors will ask if I don't come for it in the Q&A. So trying to think about how that $3 Billion roughly in ADAS revenue, how we can grow that when we look at legacy versus sort of this new OEM, and a lot is going to fall into Simon's realm.

So the first question is, however the best way to think about it, percentage of your ADAS book, whether it's on an orders basis or revenue, that I can think about, US, Europe and China split. And then, sort of forward that through to kind of, you know, win business. I know you have a large percentage in your overall Aptiv where it's domestically Chinese exposed. But we're trying to hone in on that same sort of question for ADAS. So, however, is the best way to answer the geographic, or the legacy versus new question.

Kevin Clark | President and Chief Executive Officer

So Chris, I'll take the initial shot. So, just given our history in ADAS, and you think about the evolution of ADAS, it's probably no surprise to you that the majority of our revenues sit within North America and Europe, with the Asia Pacific region, accounting for, I think, just north of 20%, and a big piece of that being China. When you look at our mix of ADAS solutions for the China market today, from a revenue and bookings standpoint, roughly 2/3 of that is with the local OEMs, 1/3 with the multinationals.

I would say, with a tremendous amount of opportunity, opportunities that are in front of with the Chinese locals, both for the China market, as well as opportunities with those who are currently exporting and are looking at manufacturing outside of China. Just given our supply chain outside of China, our knowledge of the regulatory requirements, the quality requirements that are necessary to be successful in that market. So, we feel like that's a very big opportunity, and we have a very strong funnel.

Having said that, and we've talked about it in the past, when you look at our legacy OEM customers that we have large ADAS programs with today, I would say, virtually all of them were working on extensions of those programs or expansions of those programs. And you know there are a number of Western OEMs that we're working with now, or in discussions, about additional opportunities beyond what we historically had.

So big opportunity in China, I guess, just to cut to the chase. But listen, significant opportunity in the West, and probably over a period of time you'll see more of a balancing between China, principally with the locals, as well as Europe and North America.

Chris McNally | Head of Global Auto & Mobility Research at Evercore ISI

Yeah, I would love to get Simon's take. I mean, Simon, the way I think about it is, you know, 2/3, 1/3, approaching pretty much where the market, depending upon which month which numbers, you're seeing almost a 70 /30 split. There's very little indication that that number is going to change, if not grow. So would love your take on how you're trying to get ahead of future market share changes for the next couple of years.

Simon Yang | President, China and Asia Pacific

So as you just mentioned, 70/30 split, right? The locals are really gaining shares. This is where also our system and our team is focused. Kevin, already mentioned, 2/3 of today's booking is with local OEMs, leading local OEMs. So we're working with many folks, 10 to 15 major OEMs, who can drive the volume. Also, at the same time, those top 10, 15 local OEMs have plan to expanding outside China. This is where our advantage is compared to the local pure local competitors, because we can really bring in know-how of regulatory requirements, how those sets meet that globally.

Obviously, the system we developed as we just mentioned, scalable, modular, because China market is also that way. From your entry level to L2, you see a lot of competition. But we use our platform developed to the higher-end which is an end-to-end system. So, with local ecosystem, we're developing the local SoCs that give us not only just the China-based system service that 70% which may go even higher than their portion. At the same time, actually, providing us with competitiveness in the market. So we'll say, from entry level to the whole full system, we're evolving, engaging with the local ecosystem with very competitive products.

Chris McNally | Head of Global Auto & Mobility Research at Evercore ISI

Yeah, no, I would say, I think for most investors, the idea that Aptiv, I've used the word, you know is sort of the Switzerland of ADAS. And that flexible approach that Anant talked about - working with Horizon Robotics is the example you gave. Axera, which is an even, sort of more low-end, cheaper chip for the mass market in China.

Simon, if you could just expand, who is your primary competitor when you're in these RFPs, RFQs for Tier 1s in China? Do you see, obviously, the global players? But I think what we're all curious about is the size of this world. ECARX, you know many examples, and you mentioned there's also some perception players. So maybe a little bit about who you're competing against in China at the Tier 1 level.

Simon Yang | President, China and Asia Pacific

Okay. So actually, as I mentioned, because Aptiv does cover from entry-level to L2++ right. So, from the whole full-scale system competition standpoint, the only player we view locally probably is Huawei. And the remaining local players, you mentioned a couple of them right? It's many in the different segment. Some of them competing with entry-level. The L2 level, there are several local players like a Freetech, you got NavInfo and some of our global peers competing with the L2. That segment, but not full system. But really, to answer your question, there's no single player other than Huawei able to do what Aptiv is able to do locally in China.

Chris McNally | Head of Global Auto & Mobility Research at Evercore ISI

And I remember we did many, many years back. I remember. Kevin, you probably remember you talked about like the percentage of RFQs that you were winning. That Aptiv was sort of, in select number for prime business, and it was a very high percentage of RFQs that that you were winning. Is that the same case in China? Or, naturally, should we think about China, even though you're so well positioned, as a more competitive market than what you had in Europe or the US?

Kevin Clark | President and Chief Executive Officer

Simon, let me start. I think, and I don't have our percentage win rate in China in front of me right now. I would say, Chris, we're really focused on a subset of the broader base of OEMs there. So, Simon mentioned the top 10 tend to, sometimes we go down to 15. They're those who are focused on quality and performance, as well as cost, and ideally, not all of them, but ideally they have plans to take their vehicles overseas. So, there's an incremental value that we bring from an overall system standpoint. So I'd say that which you know, those opportunities that we're pursuing, the award weight is relatively high.

Chris McNally | Head of Global Auto & Mobility Research at Evercore ISI

Perfect.

Kevin Clark | President and Chief Executive Officer

Anything you want to add to that, Simon?

Simon Yang | President, China and Asia Pacific

Yeah, at what Kevin just mentioned here, right? Actually, our winning rate is similar on the global basis. Also, globally, I mean, locally with the market mix, right? The reason I mentioned this with the market mix and what our winning rate also, as we just mentioned, you know before this, 2/3 locals, almost matching the market percentage. Our winning rate is similar. It's just we got definitely because it is a large market. A lot of players sit there. We do get that the number of RFQs numbers are higher, but the percentage wise, I would say similar with our global winning.

Chris McNally | Head of Global Auto & Mobility Research at Evercore ISI

That's really impressive.

Anant Thaker| Chief Strategy Officer and Senior Vice President, Product

Sorry. Just one more thing I would just add to that to the win rate. Especially once we get anchored, I mentioned the flexibility. Sometimes we start out with just perception, then we build our way up. Once we're an incumbent with an OEM, our win rate exceeds 70%, if I look at all Active Safety over the last 4 years. So, we see that in China, we see that globally. I mean, it's certainly lower when we're conquest and when we're getting in there, but especially once we're anchored, we see very high win rates.

Chris McNally | Head of Global Auto & Mobility Research at Evercore ISI

That's fantastic. I mean, those are sort of like you can imagine my check the boxes for China, which is obviously even more rapid deployment cycles. But Anant, you touched on where I was going next about this idea of incremental content as you move up with the same OEMs.

Can you, however you want to describe, what an advanced Level 2+ or Level 2++, however, we want to describe, what are the incremental levels of content per vehicle for Aptiv versus an average today? Given you provided all those stats on the extra, radar sort of the 5 camera 5 radar configuration, which is becoming increasingly a standard for higher levels of Level 2+.

Anant Thaker| Chief Strategy Officer and Senior Vice President, Product

Yeah. So, showing that chart right, as we sort of walked up. So, if you're starting with your L0, L1 that can go up to around $350 type of price point. Our L2 systems, we can go sub $500 if we're really optimizing it to drive cost benefit to our customers, depending on how they want to deploy it. When we get into hands-free it can vary if you're including parking and these other capabilities. But it can get into the I'd say, around $1,200 CPV price point range. And then, maybe get into around $1,500 when we're getting into L2++.

And if I looked at any of those numbers, and you compare that to a lot of our peers set I would say we typically have found, and this is in competitive RFQs, that we can bring the same type of capability with anywhere from 15 to 25% savings, relative to those alternative solutions. So, we drive high CPVs for us, but we can also drive value and savings to our customers.

Chris McNally | Head of Global Auto & Mobility Research at Evercore ISI

That's great. So basically, you think when you go into a competitive RFQ, because of your scale, and also that you have all these capabilities in-house, that you can basically win that same business, same performance at 15 to 25% lower to the OEM.

Anant Thaker| Chief Strategy Officer and Senior Vice President, Product

Right. That's right.

Chris McNally | Head of Global Auto & Mobility Research at Evercore ISI

Wow. Fantastic. Maybe we could dive in a little bit on the tech, because I think it's really important for the Gen 6, where obviously you spoke about it, and there's a lot of excitement. Can we talk about the radar capabilities? You know how you think about legacy radar versus 4D imaging radar, which allows for so much more performance. There's only a couple of products out there competitively doing 4D imaging radar. So would love to know, just an update, when that's coming to market, how that will play into Gen 6. And then, if you can give a little bit more detail on the roadmap for Gen. 6 after these first initial wins.

Anant Thaker| Chief Strategy Officer and Senior Vice President, Product

Sure, I can start. So, I mean, we're actually going into production with a customer on L2+/L3 system that they wanted to deploy an imaging radar into that system. It's going to go into production i think end of this year, early next year. So, I mean, we're already going into production with that type of imaging radar in those deployments.

But the only thing I'd mentioned Chris is we actually see, relative to past generations where you had a different architecture sometimes for the front radar versus corner radar. Now we're driving much more commonality in that platform. So, we actually can use the same radar for the front and the corner, which drives much more scalability for us. We found that the performance requirements we can get for that, even when I get into Level 2+ or what was our first Gen 6 award Level 2++ that's getting into off-highway in those urban environments, we actually don't need an imaging radar. We're able to do it with just the rest of our radar platform. With just our perception capabilities and the ML that we can apply to that radar.

So, we actually are seeing that all the way up to L2+ and even L2++, we don't necessarily need to deploy imaging radar. We can get really good performance with the rest of our perception stack. And then when you get into, L3, I think that's where you might start to see more of those deployments.

Chris McNally | Head of Global Auto & Mobility Research at Evercore ISI

That's great. And then Anant, just from a a tech perspective, what type of channel by channel performance is the imaging radar? When we think about specs?

Anant Thaker| Chief Strategy Officer and Senior Vice President, Product

Yeah, Benjamin, maybe. Do you want cover this one, too?

Benjamin Lyon | Senior Vice President and Chief Technology Officer

We can provide you kind of more details offline, but I think the short version is that it's actually not about number of channels. It's about how clean a signal to noise ratio you can get, and balancing between those channels in order to be able to see a really big object, like a truck, with a small object, like a pedestrian or a motorcycle, right next to it.

So, one of the things that's really awesome about the machine learning that we're doing inside of our radar is that we're able to achieve the same discrimination between those kinds of objects using a much smaller channel count, physical channel count, than you would be on some of our competitors radars, and so that allows us to drive the cost down of the hardware and the radar SoC by turning a hardware problem into a software problem using ML at the radar level.

Anant Thaker| Chief Strategy Officer and Senior Vice President, Product

We've seen we can get a lot of performance from just 16 by 16, relative to 48 by 48. Just to make it specific.

Chris McNally | Head of Global Auto & Mobility Research at Evercore ISI

Perfect, amazing, Benjamin.

Maybe we can stay on you and talk about some of the strategic partners. We talked in China, where obviously it's quite cost competitive. Maybe eventually you could talk a little bit about some of the relationships with some of the larger compute players, your Qualcomms, your Nvidia's, where we're seeing work being done at the OEM level, particularly on drive policy by the likes of Daimler or BMW, where they still want to control drive policy, but they're going to need a lot of help from players like yourself. So, relationships on the on the larger compute side as we start to think about Level 3 programs, if maybe you could just expand upon that.

Benjamin Lyon | Senior Vice President and Chief Technology Officer

Well, a couple of things. First off, I think part of what you're touching on is actually two things. One, how modular do we need to be? And second, is that abstraction of the hardware from the software?

Because we're actually commercializing autonomous driving at all levels of the stack all the way from just compliance all the way over to L2++ and L3. It's actually important that our stack, while leveraging end-to-end in key areas like perception, for example, or in policy making and decision making or in mapping and world modeling, that we have natural break points in the stack that allow us to meet our customers where they're at. So, that's kind of piece one.

Piece two is we've actually invested significantly in our middleware stack so that we can work with all the various different major SoC players, and we do. That's not just the major ones that you see here, coming out of the United States or globally, but also in China. A huge piece of our ability to accelerate in the China market is the fact that we can work with the Horizons, Axeras, and Black Sesames, etc., of the world. That's through that abstraction layer. So we actually really focus on an open platform with

standard APIs, as opposed to getting locked into a specific proprietary neural processing unit or GPU type architecture that doesn't allow having a global application that really meets the needs for the region.

Chris McNally | Head of Global Auto & Mobility Research at Evercore ISI

Perfect. I see some questions from the investors coming in, so please continue to write in. I'm just going to finish up with one or two here, then I'll address the investor questions.

Benjamin, maybe the last one on the sensor set that you laid out. You seem to have extreme confidence in radar. From what I can tell from the slides, LiDAR really only needs to be involved at that Level 3 and above with the flexibility and agnostic nature. Could you work with any external provider of Lidar? If you can go through that same sort of logic on the sensor set.

Benjamin Lyon | Senior Vice President and Chief Technology Officer

Well, one of the things that's interesting about LiDAR is that it's a direct depth sensor, whereas with camera you have to infer from video what is actually where in the world. Now, the nice thing about radar is that it's completely solid state, and it's also a direct depth sensor.

So, one of the things that we will see as we go forward into the future is the combination of radar plus camera for a multimodal system which you really need for L3 and above. How that evolves, because currently that's not static, it's getting better and better and better, which keeps eating into the LiDAR use cases. It used to be, if you rewind the clock 5 years ago or 6 years ago, folks thought you need the LiDAR for all these different scenarios, especially detecting pedestrians near large objects.

With the introduction of ML into radar, and then fusing radar together with camera in more effective ways, the number of use cases that LiDAR has really has shrunk. So, we'll see as we go forward and L3 and L3+ systems come to market, because right now it's very narrow, whether there's really a need for LiDAR, and whether there's a need for LiDAR at the kind of spec that you see really on research prototypes, like a couple of $100,000 vehicles that a prototyping company is doing, like a Waymo or something like that.

At the end of the day, we have to develop for things that work at scale, and Lidar at scale is something that is still not proven. That said, we've developed our architecture to be truly multimodal, and to be able to link in with whoever's LiDAR in the event that we need LiDAR.

Chris McNally | Head of Global Auto & Mobility Research at Evercore ISI

Exactly, only practical at future kind of content per vehicle for LiDAR, or maybe under $500. You know something along those lines. Kevin, it's always my responsibility to come back to the to the numbers. I could see some of those questions coming in. So, what I really appreciated was the market outlook slide. Which very simply, if you think about it every 5 years, the ADAS market is almost roughly doubling, give or take.

If I look at your $3 billion of revenue, and I grow it to next year, I come to sort of a mid-teens market share. A question that comes without getting you to commit to 2030 guidance is, is that a good way to think about it? That maintaining market share, or growing it, would give you that CAGR. You know,

looking out to 2030. So just something to help us with framing the revenue opportunity over the next 5, 6 years.

Kevin Clark | President and Chief Executive Officer

Yeah, Chris, listen. I think over the last several years, right? Our revenue growth has exceeded market growth for ADAS. I think, given the investments we've made, given the solutions we've developed, I would expect that that above market rate would continue.

That may not be perfect quarter by quarter, as you know. But just given the solution that we've developed, the flexibility it provides our OEM customers, the lower cost, the ability to take a platform and sell big portions of it in China as well as in the West, given all the geopolitics, that is a competitive factor that should position us well for the future. So I think the way you framed it up, we're confident.

Chris McNally | Head of Global Auto & Mobility Research at Evercore ISI

That's fantastic. Because if I think about the market growing 15%, you grow something a little bit better, you know, the rough math is that alone is basically 3 points of content per vehicle growth to Aptiv as a total company, forgetting the other 80% of the of the business. So that's really exciting.

And then, you don't break out ADAS margins. But obviously it's becoming a material part of the overall margin framework. Joe, long, long time ago used to use this double digit EBITDA margins. Once we sort of scale past 750 million, a lot has changed. Again, not looking for anything specific year over year, but can you talk about how to think about the margin where we are and where we could be going, as that software component which obviously is going to have a high incremental margins grows?

Kevin Clark | President and Chief Executive Officer

So, our ADAS business today, roughly, 3 billion in revenues. That's our outlook for 2024. We would say that margin rate is roughly in-line to slightly higher than our ASUX segment margin rates. You've seen a significant improvement there over the last couple of years for a couple reasons.

One, when we went through the supply chain crisis and inflation on semiconductor chips, as you know, significant impact on our on our material cost that seems to have stabilized. We're not seeing the same levels of inflation that we've seen in the past two years.

Part of what we've talked about, what we're enabling here is productizing our ADAS solution. So we get far more reuse today on everything that we've done in the past, software as well as hardware, than the traditional business model, where oftentimes customers were trying to pull us into a customized ADAS solution for a given OEM. Now we're really forcing it into a high level of reuse. I'm really utilizing our Gen 6 ADAS platform with some amount of flexibility, and I think, to be honest, doing a better job presenting to them the value proposition of the cost of customization, the cost of change and what it means for them, let alone us. So we've seen engineering costs come down significantly. I think we've talked about that on some of our engineering calls.

So, this is an area, given what we've developed from a product standpoint, what we're doing from an engineering productivity standpoint, given software being a bigger part of the value prop, we'd expect the margins to continue to increase. And, I think in the past we talked about kind of high-teens levels, and that would be what continues to be our expectations.

Chris McNally | Head of Global Auto & Mobility Research at Evercore ISI

That's great.

Kevin, I could kind of think of this, when I modeled it myself, as sort of typical, because you put the investment in, this could also be a low-to-mid 20 sort of incremental margin business, whatever that percentage growth is next year. So, I can sort of get a sense for the pace to the high-teens that you mentioned in 2030. Is that still a good rule of thumb?

Kevin Clark | President and Chief Executive Officer

Yep, that's a good rule of thumb.

Chris McNally | Head of Global Auto & Mobility Research at Evercore ISI

Fantastic. Let me hit some of the questions that are in the queue.

Benjamin, this is probably for you. Can we talk more specifically about the Gen 6 program traction with other OEMs and a couple of questions here about the path from Gen 6 – can that grow to a level 3 solution as well?

Benjamin Lyon | Senior Vice President and Chief Technology Officer

Yeah, Anant, you want to jump in on that?

Anant Thaker| Chief Strategy Officer and Senior Vice President, Product

Yeah, maybe I could start with this one.

So, just to give an overview of the solution, the award we have with the OEM, I think that we mentioned in the past, and that's kind of full end-to-end. So, importantly, that's a Level 2 what we'd call ++. I know everyone sort of has their own definitions of that. For us, it means it's hands free, eyes on the road, but it's also moving off-highway. So, kind of everything that we showed in the technology stack is going to be deployed. Importantly, it's going to be leveraging another vision provider that we're bringing into this discussion.

Importantly, it's going to be leveraging the Full Wind River software stack, the containerized ADAS architecture that we described, so all of the ML assets I described going into perception, as well as behavior and path planning. So, it really is bringing the full breadth of our technology and capabilities that's going to go into production at the end of 2026.

And, it does scale, absolutely into Level 3. So, if you think about Level 3, you're bringing a fully redundant architecture that's required for that type of a system capability, and all of those same assets are leveraged when you go up to Level 3. So, you might add, as Benjamin mentioned, potentially a light LiDAR. We're looking at what else we can do with just radar and vision fusion together, but you potentially add some more sensors, you add another high performance compute, but everything that I just used in this Level 2++ I can carry over. I'm really just adding some more sensing and compute redundancy and capabilities around it. So it's that reusability going up. Then, importantly, even if you're going back down to lower levels of ADAS, that's what really drives a lot of value for our customers.

Chris McNally | Head of Global Auto & Mobility Research at Evercore ISI

You mentioned end-to-end. So just my question is, where does that training data sit for something like Gen 6?

Anant Thaker| Chief Strategy Officer and Senior Vice President, Product

So, we have quite a bit of data. You know that we leverage from our existing and prior programs. We've collected millions of miles of data in testing and validating prior systems. We can take all of our new software and test and validate it against that data to identify use cases to do resimulation to really improve the performance of our software stack.

As Benjamin mentioned, we may need some natural break points. If we're just delivering a perception system, and we want to maximize the machine learning capabilities for that, as well as if we want to go full-on from perception all the way into the to the full software and feature stack, we can leverage the data for that. So we have, given how many Level 2 plus deployments we've done in the past, a fairly unmatched data set that we can leverage for those capabilities.

Benjamin Lyon | Senior Vice President and Chief Technology Officer

Just add one thing to what Anant said, there's the feature that you deploy to the customer, but there's actually the AI factory that you use to develop and do the training, and do the testing, because you want to guarantee safety, security, and, of course, increased performance.

That's like the foundation that you build the house on. So, one of the things that's great about what Aptiv is doing is as we invest in ML, we're investing in ML in the DevOps, and the AI factory, not just in the feature development and deployment.

Chris McNally | Head of Global Auto & Mobility Research at Evercore ISI

Great, I'm going to combine a couple of questions here about Wind River. How do we think about any of the challenges of incorporating the Wind River Middleware for traditional OEMs? Do they have to make changes to their software architecture? Do they need Zonal architecture or OTA capabilities? Because we are seeing a slower than expected changeover in the electrical architectures. We see stuff like VW, and Rivian that's been a discussion point for another webinar that would be great to do with Aptiv, but everyone's going slower than expected. Does that Wind River help, or it a reason for a bottleneck with these traditional OEMs?

Anant Thaker| Chief Strategy Officer and Senior Vice President, Product

I can start there, Chris. There's no bottleneck related to deployment of zonal architectures. Even if an OEM is delaying or changing the timing of a Zonal architecture, typically, they are deploying ADAS in some other form. They might want to just use a domain controller within a domain architecture, or in some of these other variants I mentioned.

It may just be a smart camera, so the compute may just be embedded in the camera, and you're surrounded by radars. We can deploy the Wind River operating system, whether it's in a smart camera, domain controller, or even higher performance compute than just an ADAS domain controller. So it has that flexibility.

The porting is actually not terribly difficult. VxWorks is a POSIX operating system. It means it's specifically designed to be able to migrate from any POSIX operating system. That's a standard that is specifically meant to drive that portability.

Wind River also has a Linux stack, so any of our customers who have deployed on Linux environments we can do that porting. And specifically, like our stack, if they're using a container base or services based architecture that's leveraging OCI containers. Whether that's on VxWorks or whether that's on Linux, we basically are deploying to the same type of software architecture. So, we actually think that it can scale across whether they're doing zonal, distributed, or domain architectures, and whether it's low-end variance or high-end variance we don't see a significant porting effort. When we showed the demonstrations at CES, and for other customers, we've been able to port quite easily.

Chris McNally | Head of Global Auto & Mobility Research at Evercore ISI

That's great. And to Kevin's point, I think that gives a little bit extra confidence that we're not going to see these sort of stair steps and volatility on the year-to-year growth. It's not going to be an inhibiting factor. I'm going to be true to time. I see one more question. I'm going to pull it, because it's a good one for me, and it's probably for Simon. But it's around the 800-pound gorilla. We used to always get questions in ADAS around Tesla. We all kind of know their approach. High vertical integration. The question here, or a couple of questions around BYD. Obviously, also using a high amount of vertical integration, 4 million units. It's becoming the de facto sort of leader in China, also uses Horizon and Nvidia. So, Simon, I know it's always hard to talk about a customer, but the approach of highly vertically integrated OEMs in China, and how you see the opportunity for Aptiv.

Simon Yang | President, China and Asia Pacific

Okay. So we heard a lot about being fully integrated/vertically integrated. But actually, if you look at the China market right now, they really try to do things in-house. When talking about ADAS here today, you got Tesla, you got Li auto, Nio, Xiaopeng, maybe Xiaomi is coming along, and BYD actually is not fully in-house from the ADAS standpoint.

So the remaining customers are basically very similar to our current situation, but obviously with more data involved. The second group of the customers, such as Great Wall and Geely, I will use them as an example, they're trying to do a little bit more in-house, because they're still buying, they're still buying the hardware portion of it, they still buy the software stack, the algorithms from the supplier, and they do a little integration in-house, but overall the majority of our customers are still looking for suppliers like Aptiv to provide the turnkey solutions.

So there's a large group, you can name Dongfeng, and BAIC. Those customers tend to rely more on full-service suppliers like us. So we do see the opportunities, even with vertically integrated suppliers like I just mentioned. For L2++, what we talked about, L2++, they tend to be, so far, more in-house, those 5. Tesla is, you guys know Tesla much better than I do, is still doing L2-plus in-house. But, as I mentioned, for the intra level for L2/L2-plus, they already started talking to us, which means us our scalable modular approach, and especially the ability we're able to work with the local ecosystem suppliers, there's another very important element on top of SoC. About we the ones you mentioned, we are working with every one of them, because you know the way we do the architecture.

Another thing is, Kevin mentioned about that is the supplier resilience that actually Aptiv has a huge advantage. We mentioned the Chinese locals exporting outside. There's the opportunity for us. The local SoC is the opportunity also to reduce the overall system cost. So, because when the volume goes up, you're competing with the very competitive, dynamic market over there. So with everything I just mentioned, Aptiv actually is well positioned. We do not see vertical integration preventing us.

Just talking about the Wind River tool chain, actually, we have a real example. We are launching a project right now with Geely. The Wind River edge products are in there, so the customer-side doesn't really see that much change because we have a local capability. We are able to work with SoC suppliers, and I just mentioned Maxieye, it's more integration work we can do with Soc. With vision perception suppliers, rather than the customer side needs to make any changes. So to answer your question, the supplier like us is well positioned over there to win.

Chris McNally | Head of Global Auto & Mobility Research at Evercore ISI

Well, Simon, that's absolutely fantastic to hear. I think the takeaway for me is that if you're able to continue to deliver that 15 to 25% lower BoM cost on a similar solution in China - whether that's the $3,000 Level 2+ solution which everyone's racing to or it's the lower end solutions like the BYDs because they're putting out sub $15,000 EVs. It sounds like Aptiv is really well positioned.

Gentlemen, thank you so much for joining today. I know we went slightly over an hour, but the content was fantastic. And Kevin, really appreciate the numbers that that you shared. Like I said, I think for investors knowing that sort of that 3 points of outgrowth is sort of in safe hands for a very long time in ADAS is going to be really, really important.

So again, thank you so much for joining. For those on the line, if you want to learn more about Aptiv, feel free to email the team. The deck and the replay of this webinar will be up on their site shortly. But for that, Kevin Simon, Anant and Benjamin, thank you so much and hope to see you again soon.

<<TRANSCRIPT END>>