Needham 4th Annual Automotive Tech Conference

Company Participants

- Danny Shapiro, Senior Director of Marketing
- Kimberly Powell, VP of Healthcare
- Rajvindra Gill, Analyst

Presentation

Rajvindra Gill {BIO 16383656 <GO>}

So welcome, everybody. My name is Raji Gill from Needham & Company.

We're very pleased to have NVIDIA presenting with us at our Fourth Annual Automotive Tech Conference. With us is Danny Shapiro. He's the Senior Director of the Automotive Division at NVIDIA; as well as Stewart Stecker, Director of Investor Relations.

Danny is the Senior Director of Automotive Division at NVIDIA. He's a 25-year veteran of the computer graphics and semiconductor industries and has been with NVIDIA since 2009.

So it's great to get his expertise and insight.

The format of the presentation will be about 20 to 25 minutes or 30 minutes on NVIDIA side, and then we'll open it up to questions, 10 to 15 minutes. I'll kick it off. (Operator Instructions)

So with that, let me hand it over to Danny.

Danny Shapiro {BIO 16651500 <GO>}

Great. Thanks so much. And it's really a pleasure to be with you today. What I wanted to do is spend a little bit of time and just give you some insight into the work that NVIDIA is doing in the automotive industry. And again, everything here is subject to our usual financial disclosures about forward-looking statements.

So NVIDIA, of course started out as a gaming company, and that's still a very big part of what we do, and there's great growth there.

But as you know, AI is transforming every industry. And NVIDIA is sort of at the heart of that AI revolution. There's really two aspects to AI. There's first, the development

of the AI, the training, and we play a very active role in that, and our data center business is innovating in that space. And we just had new announcements with our new Ampere architecture, and data center growth is enormous.

But then there's also the aspect of what we call edge AI or also inference where sensors are taking data in and the AI has to understand the environment, and it's a continuous cycle of reasoning and acting and planning.

In the automotive space, we have solutions that are designed to enable autonomous vehicles and creating the brain of the AI system. And so our DGX systems are used in the data center, and it's the exact same architecture then that goes in the vehicle in a platform specific of what we call NVIDIA DRIVE AGX, our autonomous processing platform for vehicles and robots and even health care. And so again, we have a full end-to-end system that we've developed to enable everything to ultimately be autonomous.

We believe this will be the case. Varying levels of automation and autonomy will be across cars and trucks and all kinds of robots and delivery vehicles and fast transportation as well as specialty vehicles.

So agriculture and mining as well.

The key thing here that we developed is not just about a part that goes in the car, but it's a full end-to-end platform. It starts with data collection, so whether it's NVIDIA or our customers, they are out there with human-driven vehicles and as well as automated vehicles that have sensors on them that are collecting data. It's used for mapping. It's used for training.

There's a massive amount of information that needs to come in for us to then be able to train on how to recognize lane lines, recognize pedestrians, recognize street signs. It all comes down to many different neural nets that are running in the vehicle, and each of those neural nets is very compute-intensive and needs to be trained on a massive amount of data and continually refined and updated.

Before we actually put it on the road, though, we want to test and validate. And this is where simulation plays a very large role.

So we've developed our Constellation platform that allows us to do full hardware in the loop and software in the loop testing and validation before it actually goes on the road. And then we have our platform for inside the vehicle. Again, this is the DRIVE platform that is running different software stacks.

We have our DRIVE AV, which is the autonomous vehicle stack, that's doing all the sensing, perception, mapping, localization and path planning. And then our DRIVE IX software stack, which is our intelligent experience, which will leverage sensors inside the vehicle, maybe a driver or passenger-facing cameras to do driver monitoring,

detecting someone is drowsy or distracted. And with that, we'll integrate with the outside sensors to enable new safety features or convenience features.

So again, this is the industry's only platform that goes from end to end, a single architecture that the software that's been developed and trained on NVIDIA is then running on NVIDIA inside the vehicle.

As I mentioned, then there's a variety of different deep neural networks that need to be running inside the card.

So we've developed dozens of these that we make available to our customers, and our platform is open, so they can build their software on top.

So these different neural networks are taking the camera or the radar, the LiDAR, the ultrasonic data and are trained to detect objects or to then also understand what's free space, which is basically the opposite of detecting objects and where is it safe to drive.

We can then run algorithms on these to understand the distance to detect different weather conditions, different road congestions.

We can do map localization with cameras with LiDAR. We can plan pads.

We can anticipate trajectories of other vehicles. The list goes on and on. And this is really where the crux of the challenges that we're developing software. Our partners are developing software because we want to be able to ensure that these vehicles are safe on the road.

So again, a diversity of different kind of algorithms and redundancy is key to insure safety.

To that end, again, we want to be able to test and validate everything, and so we've developed our DRIVE Constellation. This is a two-server unit. One server is generating the environments in virtual reality. It's generating the synthetic sensor data based on real-world experience. And so we're simulating all those sensors, and then we're feeding that into the second server, which is the DRIVE AGX computer. It's operating the full software stack as if it was driving on the road, but it's in a virtual or simulated environment. And then the commands for driving, the steering, acceleration, breaking are sent back to the simulator. And we're able to do this 30x a second.

So this is a full hardware in the loop simulation that lets us take a vehicle that might only be operating a couple of hours a day and now operated in the cloud 24/7. And so this is a way that we can then rack up all of these servers, and this will be a whole fleet of vehicles that, again, are not just driving on the roads where testing is essential on the roads, of course.

But usually, those are boring tests, meaning nothing happens. A good thing, of course.

But really, what we want to be able to do is test those really dangerous, challenging, hazardous scenarios, and they often won't even occur after days and days or months or years of testing.

And so in simulation, we can have these edge cases or corner cases, as they call it. Kids running out in front of cars, people running red lights, blinding light at sunrise or sunset. The kinds of things you don't encounter very often, we can put them in simulation and test and test over and over. And so the ability to do this enables our partner companies to test and validate and basically, recreate and run regression over time to ensure that the software is catching all these corner cases.

The other thing, of course as part of our end-to-end solution is the software stack.

So we've developed a massive amount of software where the base platform that goes in the car, software applications on top, tools, libraries, deep neural networks and our customers that are able to build their applications.

So we have our DRIVE OS software as the core layer.

We have our DRIVE AV, our autonomous vehicle; and DRIVE IX, intelligent experience, software stacks. And then there's all kinds of libraries in our DRIVE works for the sensor processing for mapping and localization and path planning.

So this full software stack is open to our customers to build their applications on top.

Of course then is the hardware that it runs on. Our DRIVE platform is being used by hundreds of companies from carmakers to truck makers to shuttle companies, robotaxi companies. And it's a single architecture that scales. And each new generation of our technology is backwards compatible.

So it's a seamless transition for the software.

We recently introduced NVIDIA Orin. It's our newest SoC or system on a chip. It's a 17 billion transistor chip. Inside, it has many different processors. There's ARM CPUs. There's a new Ampere GPU. There's programmable vision accelerators. There's deep-learning accelerators. Again, this is a whole computer, a system on a chip designed for autonomous vehicles.

So many different types of algorithms are running simultaneously, providing diversity and redundancy required for safe operation.

It's a 7x performance boost over our previous generation. So again, we've been able to make it more energy-efficient and increase the performance dramatically.

Now with this new architecture, with our Ampere architecture, on the GPU side, it's much more energy-efficient. And now we're able to broaden our offering. Again, the key thing here, it's a single architecture. Our customers that we've been working with on developing higher levels of automation, Level 2+ to Level 4 and Level 5 robotaxis are asking us for help at that entry-level segment. Traditionally, they've been working on a totally different architecture, a different vendor developing front-facing cameras, and it really is too expensive in terms of dollars, in terms of manpower and engineering.

So now with our new Orin and Ampere architecture, we can span the entire range from the entry level, which is the simple ADAS solution, a single camera, front-facing solution. A new Orin entry-level will operate at just five watts.

So energy sipping there, delivering 10 tops of performance.

So 10 trillion operations per second to be able to do front-facing ADAS solution, basically a 5-star end-cap type of offering but based on the same infrastructure training for AI and software stack that will span all the way over to our new 2,000 tops performance at the high end for robotaxis.

So again, for the first time, an automaker has a single architecture, a single software development effort. They can now put this solution in every single vehicle in their lineup and leverage that unified engineering approach. And again, this is software-updatable.

So over time, they can add new features, new capabilities. This opens up new business models for these automakers as well. This is something that's really key and a huge inflection point for the industry.

So at that entry level, again, a single scalable architecture but a small, front-facing camera unit mounted in the windshield with our entry Orin, our ADAS solution, it has the Ampere GPU, and it will deliver an incredible 10 trillion operations per second at just five watts of power. And the other extreme, now we're combining two of the high-end Orin SoCs, each of those able to deliver up to 200 tops with two new Ampere GPUs.

So grand total of 2,000 tops able to run many different applications simultaneously. It delivers now 6x the performance of our current Pegasus offering, which is what is in development for many of the robotaxi companies. And again, greater performance per watt.

So energy consumption has gone down dramatically.

What I want to do is show you a little video clip now. Over the bandwidth there, you might not see full frame rate.

But this is a recent drive in one of our test vehicles.

We have a fleet, a small fleet compared to our customers, but we need to understand the complexity and the full challenge ahead of our customers, and also then, we're able to develop our hardware and software by understanding the full complexity of the problem.

So you can see this is our new headquarters called Endeavor. And I'm going to go ahead and play this video. You can see one of our test vehicles on the road.

(Video Clip)

So again, then there's obviously a safety driver inside the vehicle. But it's doing all of the sensor processing. There's a neural network for detecting lights, for detecting lanes, for detecting other vehicles.

So the driver -- it doesn't touch the steering wheel. And he's there to take over if he needs to, and the system is able to detect everything on the road.

So I'm not going to pay the full video. This goes on for several minutes, but we're able to now be driving all around the roads of Silicon Valley as we do tests. Those tests are currently on hold right now due to the COVID-19 situation.

But the benefit that we have, again, in our whole end-to-end solution is that we've shifted to doing all of our testing in simulation in the cloud.

And so I want to advance to the next clip, and this will show the same kinds of drives but now fully in the simulator.

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So leveraging the technology we have from a graphic standpoint as well as modeling the physics, physical dynamics. And now all the sensor processing were taking simulated inputs into our software we're running, and we're doing all the same kinds of detections on the simulated data and can test and validate that the complete system actually works before it goes on the road. And so our engineers are at home working and being extremely productive, even while in stay-at-home orders.

So our ecosystem that's leveraging our technology is vast. There are hundreds of companies that are building and testing and deploying their vehicles on NVIDIA DRIVE. And so we've made announcements, of course with big OEMs like Mercedes-

Benz and Volvo, Toyota. In China, we have a number of automakers as well. The trucking industry is doing a lot of development work. And in fact, during recent pandemic months, right, we've seen a shift from there's less people out on the road. This ride-sharing has gone down.

So the robotaxi business may look at risk. The reality is it's still very healthy long term.

But we've seen a pull-in of delivery and trucking needs as well.

So a lot of long-haul trucking, a lot of last-mile delivery activity will be going autonomous.

We work with hundreds of start-ups and software companies as well as the mapping companies, the sensor companies, the simulation companies. It's a very complex ecosystem. There's a lot of different players, and they're all developing on the NVIDIA DRIVE platform.

So why do people come to the NVIDIA DRIVE platform? I think there's several key things I talked about. I just want to wrap up here before we go to questions, but some of the key differentiators that we have. The first, again, it's an end-to-end platform. I think that term is used a lot.

But really, there's nobody else in the industry that has the complete breadth that NVIDIA has that starts in the data center with the data coming in, the collection, the archiving, the curating of that data, that's all on NVIDIA. Even our competition is using NVIDIA in their data centers.

So the algorithms are developed on our architecture. There's the testing, validating to simulation on the same architecture, and then it goes in the vehicle.

So it's seamless. There's no porting of code. It's really a huge advantage.

The other thing that is pretty unique to NVIDIA is, again, a single architecture in the vehicle. It's not different chips. It's not some CPUs or some different GPUs or some different deep-learning accelerators. It's a single architecture that spans, again, now from ADAS, a front-facing camera at five watts all the way up to our robotaxi solution.

Another key differentiator is it's open, right? We do not have a closed sort of black box system, but our software platform is open for developers. They can take our DRIVE OS. They can use our libraries. They can use our algorithms. Our DriveWorks are DRIVE AV stack, and they can customize and build their own applications. This is key -- and that no automaker wants to outsource their future, which is AV.

So again this open software-defined, software-updatable architecture is key to the future. Again, we have a vast ecosystem.

So regardless of the kind of sensor they want to use, we work with the Tier 1 suppliers, of course.

We're not competing with them.

But it's a partnership between NVIDIA, the Tier 1 and the OEM to build these systems to integrate different maps because, of course you want to have a global vehicle that can operate on any map.

So the China maps, of course are different than Europe's maps. They're different from United States' maps.

But by having this vast ecosystem of sensors, maps, software, we can all then deliver a global solution to our OEM customers.

So again, from end to end, single scalable and our vast ecosystem, we're seeing great promise. It's a long-term play for us. There's ups and downs. It can be lumpy in terms of the revenue stream.

But NVIDIA is committed. As Jensen has said, we're really excited about the opportunities.

We have many recent design wins that we've announced and many more to come.

And with that, I'll open it up for questions.

Questions And Answers

A - Rajvindra Gill {BIO 16383656 <GO>}

All right. Great. Let me just click on the video. Yes.

So yes, thank you, Danny, for that. That was very informative. Before we get into the technology, I just want to get your thoughts on the market size and your design pipeline.

So you have a single architecture. You have a very -- a breadth of solutions for various products. Most of your engagements -- can you describe your engagements? Have they been on Level 2+ or Level 3, Level 4? We know that Level 4, Level 5 has been pushed out further than what we initially thought because of regulation and liability and uncertainty around the market.

So I wanted to kind of dig deeper in terms of your engagements for Level 2, Level 2+, which seemed to be what the market will be over the next 10 years and how your solution, maybe it's more cost-effective or has lower power than the competition?

A - Danny Shapiro {BIO 16651500 <GO>}

Sure. So you're right. I mean we have a lot of different engagements. There's a lot of different programs in play right now.

Some are going into production, right? We just announced with Xpeng, a Chinese new energy vehicle. They've been taking orders on their P7 sedan, and it actually starts deliveries this month. And so that's based on the NVIDIA DRIVE AGX Xavier.

So that's our current production part. That's what Toyota is using, Volvo is using. And so those -- like you said -- will be kind of Level 2+ and in production starting now over the next several years.

The benefit, of course of this is it's all part of the same software-updatable architecture. And so these cards get better and better over time.

We also, of course have a lot of robotaxi-type engagements. Companies like Zoox, like Aurora and delivery.

So those potentially in large volumes are still years out, but that's really a great development efforts and is still ongoing.

We're not seeing any slowdown in that.

I think what we'll see now, of course is with our new ADAS offering, you said, that's right, that's where that volume number is, and those were -- we're going to be able to start announcing those contracts soon, and then those will be several years to get into production. And so what you see today is from a revenue split, we're kind of 50-50 in terms of our legacy infotainment business and our AV development.

We've announced, of course that, that infotainment business will go down a bit in the next quarter due to the overall state of the auto industry in terms of production, things stopped or slowed and new consumer sales also taking a hit. And then, again, in a few years, so we'll see, I think, a sizable ramp for AV.

A - Rajvindra Gill {BIO 16383656 <GO>}

But would you agree that the market that's available to you or the industry is really kind of Level 2 to Level 3 for the next 10 years or so or longer where we get to a more autonomous vehicle kind of market? And if that is the case, then you -- there's existing kind of competition there, and I'm just wondering how your solution will kind of compete if it's not as advanced requirements that are needed in more Level 2, Level 3 -- versus Level 2, Level 3.

A - Kimberly Powell {BIO 22145194 <GO>}

Sure.

Well I think what we will see is the deployment of higher-end system in more and more vehicles, even if the software isn't activated. And so again, there's one particular company out there in the market that's taken this approach. It has a very high valuation because they're putting an AI computer in the car. They're putting sensors all around the car. And even though it's not a Level 4 car today, it's selling extremely well because it has the potential to get there as soon as the software and the regulation is in place.

So I think other car companies need to adopt this strategy, and they are. And so even if it's not shipping as a Level 4, it has the capability to be upgraded to a Level 4, and that's really the strategy I see happening sooner rather than later.

A - Rajvindra Gill {BIO 16383656 <GO>}

Can you discuss how your automotive SoCs, your DRIVE platform interacts with other technologies and vehicles such as ADAS or the infotainment or the HMI? Particularly around sensor fusion because that's where I think there's a lot of differentiation there in terms of the vehicles are including more higher advanced sensors, a better example will be LiDAR. And the processing is going to be offloaded to your solution, and that's where you can -- NVIDIA can really shine as it always does in that area.

A - Danny Shapiro {BIO 16651500 <GO>}

Again, it's a great question. I think what's key about our platform, again, it's open, it's software-defined. And so we're not locked into a specific camera or specific algorithm because we've tuned the hardware.

We basically bake something in. It's an open platform.

So we have a vast array of different cameras, different sensors.

We're going from 1-megapixel cameras to two to 8 megapixels. And again, it's just a software update to allow that flexibility.

So whether it's different sensors, again, we work closely with the Tier 1s to integrate their sensors, to build the solution for their customers.

So whether it's different maps, whether it's different algorithms, that's the beauty of the NVIDIA platform and the base we have on CUDA and now of our deep-learning stack, we're able to change it over time, right, and with software updates, right, new algorithms. There's going to be apps that come out a year or two from now that haven't even been thought of today.

But because of the software-defined nature of our platform, it's not a problem.

And the thing is, today, everyone has an iPhone, an Android phone. Could you imagine buying a phone that doesn't get software updates? You wouldn't do it,

right? You're not going to have this fixed function device. And virtually, every car on the road today is like that old phone that you can't update.

So once consumers start to see what's available and get used to that, there's no way that anyone is going to buy a non-software defined vehicle in the future.

A - Rajvindra Gill {BIO 16383656 <GO>}

In the past, in your Analyst Days, you've mentioned -- you've quantified the TAM for your opportunity, roughly $25 billion. And you've kind of identified it $25 billion for kind of driving Level 2, Level 3, 4 robotaxis, roughly $3 billion opportunity for training and development and about $2 billion for validation. Just drilling on the testing and validation, to me, that would seem the -- kind of the low-hanging fruit, as these vehicles need to simulate autonomous scenarios, et cetera, versus driving 1 million miles around physically, manually.

So I'm curious to see what the uptake has been for your simulation products, your training products on DGX. Are you seeing more from the ride-sharing, from the OEMS? Describe that on your Constellation product platform.

A - Danny Shapiro {BIO 16651500 <GO>}

So again, you're right, Constellation is the simulation product. It's still in its early days, right? We've basically been shipping that for maybe not even a year, right? And it's a large development effort. It's going well and we see that, again, as a great growth opportunity for us. It's part of this end-to-end flow and gives us the ability, like you said, to test and validate, which is key, and it scales really nicely.

So we see it distributed over.

Some people are doing it on-prem, right? They're buying there, and they maintain themselves. Others are working with cloud service providers, so they can buy time on those simulators, and it's a good way for them to kind of start and scale up, but we see a lot shifting to on-prem. And so we've already announced Toyota and Volvo trucks as some of our big customers using us in the data center for training, for sim and then deploying on the road.

But you're absolutely right, the -- again, if you're looking at this from a revenue perspective, the timing data center is very big for automotive, and simulation is growing. That gets reported in other parts of the company that doesn't flow into that auto number that is reported in our data center business.

A - Rajvindra Gill {BIO 16383656 <GO>}

Right. And I think that's an interesting point.

So data center for automotive is kind of in data center in general, and so you're seeing kind of an uptick based on what you're saying for simulation versus kind of physical, manual –

A - Danny Shapiro {BIO 16651500 <GO>}

It's interesting. And again, even there are some companies that aren't using NVIDIA in their vehicles, they're still very large customers of ours for data center.

A - Rajvindra Gill {BIO 16383656 <GO>}

Yes. Absolutely.

So are there any regulation hurdles? Have they been defined yet to do simulation versus actually manually driving and collecting data miles -- raw miles and the nano taking bikes and whatever objects physically. Is there a regulation standard that's been emerging? Or is it kind of well (inaudible)?

A - Danny Shapiro {BIO 16651500 <GO>}

We're very active in that with standard spot ties with SAE, with others that were focused on ISO 26262. The key thing here has been engagement that we have with the industry, with our partners.

We're working with NITSA.

We're working with the federal highway safety boards and the DoT. And so -- and then also in other parts of the world, we're active. I think it's less about logging miles and the disengagements but more about being able to look at scenarios. And so what we're trying to do is come up with essentially an autonomous vehicle driver's license. The vehicle has to sort of pass all these different tests and all these different scenarios, and you can run this exhaustively in simulation. There's also obviously going to be live on-road testing.

But I think we'll see a shift to a lot more virtual testing because, again, you're not going to be able to effectively test those really dangerous scenarios with a real vehicle.

And another reason why the testing is so important is because even when we have safety drivers in our cars or our partners, again, have safety drivers, those safety drivers are there to make sure nothing bad happens.

So if there's a potential collision impending, that safety driver is going to take over as soon as they feel uncomfortable. And that prevents the AV system from really actually being put through its basis and test would the AV system actually prevent this accident or not. And so again, in simulation, we can let it all play out. And if something happens in sim, we just restart the simulation, and we update the software.

We learned from that. You don't have that luxury in the real world if something bad happens.

A - Rajvindra Gill {BIO 16383656 <GO>}

So just kind of shifting to the technology discussion, which we have about nine or 10 minutes.

So you have migrated your DRIVE platform to your new Ampere architecture, 7-nanometer and for all your upcoming kind of Orin chips. What was the thinking behind that? And is it to really provide this kind of end-to-end single architecture, everything is on 7-nanometer now? And I'm just curious if you could elaborate further on the migration to the Ampere architecture.

A - Danny Shapiro {BIO 16651500 <GO>}

Sure. Well again, as a company, we're constantly innovating, constantly moving forward, right? I mean that's just the nature of the computing industry.

We're always pushing and developing and innovating. Having this single architecture is key, though. It's not like the traditional auto industry where there was something that was developed and it was kind of locked and loaded for five to seven years, and something brand-new was developed and then you had to wait, and we had this continuous flow.

So starting with our early DRIVE PX and PX2 systems, people are developing software and they could migrate them to our current architecture and then moving forward to Orin.

So Orin will start sampling next year. And then all the development work today is still happening on the current generation, but we're able to basically have this time machine to accelerate the developments that when those chips go into production, it's not like you have to wait where the software started development.

They're all developing today. And so again, we've seen the industry, in general, has underestimated the complexity of this challenge, underestimated the amount of compute required. And so we're constantly trying to deliver higher performance, greater energy efficiency to the industry. And so it was a natural move, of course to shift to Orin and Ampere.

Again, there's huge performance gains -- much more so than we've ever seen before in the past in the computing industry.

A - Rajvindra Gill {BIO 16383656 <GO>}

So you talked about kind of 4x the performance and power efficiency over your Xavier solutions. I was wondering if you can go into some details and explain how does Orin do this from a technological point of view. Is it primarily on the process node migration? Is it more on the algorithm side?

A - Danny Shapiro {BIO 16651500 <GO>}

It's a combination of both, really. Yes. So the process node.

But again, we're able to -- I mean it is incredibly complex chips, 17 billion transistors.

But we've essentially built in different parts of the chip to do different types of processing.

We have different types of data coming in, and we have different types of algorithms. And some are serial, some are parallel, some are declining base.

So there's a lot of different parts of the chip that are now tuned, and that gives us the greater performance with consuming less energy.

We've -- as a company, we still call a GPU, right? We've had all these GPUs now. These GPUs are doing different kinds of processing than our gaming GPUs from a decade ago. Still has that same name, but they are -- they're really custom ASICs, and Xavier and Orin are designed as SoCs for AI challenges and specifically autonomous vehicles.

A - Rajvindra Gill {BIO 16383656 <GO>}

And when we look at the -- if we look at kind of on robotics, kind of shifting that and kind of more on the robotaxis -- or I wouldn't say, robotaxi. Let's say trucking -- which seems to be more of the immediate application for AVs.

In robotics, you stated that BMW has selected your Isaac robotics platform to automate a lot of their factories. You're using logistic robots that are built on AI computing individualization. How big -- what percentage of your kind of business, automotive business, do you think that will be on the robotics side? Is this going to be a meaningful kind of growth driver of robotics as well as on kind of on trucking and transportation?

A - Danny Shapiro {BIO 16651500 <GO>}

Yes. I think robotics is really a different segment from automotive. It's part of our OEM business.

But I think there's great potential, right? I mean everything that moves will be automated in some fashion.

So that's passenger vehicles, that's moving of goods, and I think we're going to see a lot more, like you said, from the trucking and last-mile delivery before we're moving people around.

But then there's also these -- whether they're fixed robots and assembly lines, more cobots, right? Instead of robots that have to basically shut down whenever a human gets there or in manufacturing of these big changes around the robots, we're going to see a lot more really smart robots that are able to sense their environments and

be able to work alongside with other humans as well as logistics, whether it's in factories, warehouses. Even in health care, the market opportunity is very large there.

We see great growth potential.

A - Rajvindra Gill {BIO 16383656 <GO>}

Great. And then just last question in terms of your product portfolio. You talked about mounted in the windshield solution that's 10 trillion operations per second at less than five watts all the way to robotaxis. What has been the feedback from the OEMs? I understand the advantage of having a single architecture.

But are you getting any pushback in terms of being a sole supplier? Do they want diversification? Or is it really more ease of use and the ability to kind of update the software as kind of the vehicle life cycle changes from five to seven years and more to kind of a mobile phone life cycle where every six to nine months, it's going to be updated?

There seems to be an underlying shift to that type of manufacturing cycle.

A - Danny Shapiro {BIO 16651500 <GO>}

For sure. Yes. This product expansion is a direct result of customer request, right? I think you probably heard me or others saying that we're not going to go into that commodity smart camera business. That's not where our engineering expertise is going to be leveraged.

We're trying to solve the new problems, the challenges that haven't been solved before.

But the reality is that the complexity of cars is enormous. The amount of investment that carmakers need to make and R&D is just astronomical. And so to maintain development engineering of one front-facing camera architecture and then have something separate, totally different code base, totally different hardware platform or other aspects, it doesn't make sense for them.

So they've come to us and said, hey. We want to leverage what we're doing at the high end and just be able to bring it down into that front-facing camera solution.

So again, we see carmakers adopting our platform across the whole spectrum and seeing huge savings from that as opposed to just saying, okay. I want to take this one part of this one segment.

Again, it's not just about what goes in the car, but training that AI, they don't want to have two totally different systems that they're collecting data, two different initiatives. They're doing different development, different training, different testing, different validation when they can do all this across a single architecture. It's an enormous cost savings.

A - Rajvindra Gill {BIO 16383656 <GO>}
So your ability to kind of train and import that learning from the data center directly into the car, so the car is able to make inference decisions driving software policies is based on the data that you've trained on.

A - Danny Shapiro {BIO 16651500 <GO>}
That's right.

A - Rajvindra Gill {BIO 16383656 <GO>}
Is a fairly big differentiator.

A - Danny Shapiro {BIO 16651500 <GO>}
It's enormous. They got -- again, as you talk to automakers, right, they -- and this is why sometimes you see these partnerships going on because it is an enormous investment. And again, we can take two different investments for the same car company and combine them.

A - Rajvindra Gill {BIO 16383656 <GO>}
Okay. All right. Wonderful. I think we're heating up.

We're about 11:55.

So we'll leave it at there. Thank you so much, Danny. Thank you, Stewart. This is very insightful, and thanks again.

A - Danny Shapiro {BIO 16651500 <GO>}
All right. Thank you, everyone.

A - Rajvindra Gill {BIO 16383656 <GO>}
Thank you.