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EDITED TRANSCRIPT

MXIM - Maxim Integrated Products Inc Automotive Business Update Call for Investors

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PRESENTATION

Operator

Good day, ladies and gentlemen, and welcome to the Maxim Integrated Automotive business update for investors. (Operator Instructions) As a reminder, today's program is being recorded.

I would now like to introduce your host for today's program, Kathy Ta, Vice President, Investor Relations. Please go ahead, Kathy.

Kathy Ta - *Maxim Integrated Products, Inc. - VP of IR*

Thank you, Jonathan. I would like to welcome everyone to Maxim Integrated's Automotive business update for investors. I'm pleased to introduce Randall Wollschlager, Vice President and General Manager of Maxim's Automotive Business Unit, who will be presenting today. Before I hand over the call to Randall, I'd like to note that the audio in today's webcast will be audible both on the teleconference line as well as through the video feed on our website. Please click on the appropriate links for audio via the teleconference button or the computer speakers only button when joining the slide webcast. This will enable a better synchronization between the audio and slide presentation. However, please expect about 10-second delay for the slides to advance if you're listening via teleconference. For Q&A following our prepared presentation, we will use the phone line per our usual process. I would also like to point out that we will not be updating near-term guidance in our call today, and we request that you limit questions to the content of today's Automotive business update presentation. Once we are done with our slide cast, I will post the final slide deck on our website for your reference. And with that, let me move to our safe harbor statement.

During today's call, we will be making some forward-looking statements. In light of the Private Securities Litigation Reform Act, I'd like to remind you that these statements must be considered in conjunction with the cautionary warnings that appear in our SEC filings. Investors are cautioned that all forward-looking statements in this call involve risks and uncertainties and that future events may differ materially from the statements made. For additional information, please refer to the company's Securities and Exchange Commission filings which are posted on our website.

Now let me turn the call over to Randall.

Randall Wollschlager

Hi, there. Welcome, everyone. Appreciate your interest in Maxim's Automotive business, and it's a pleasure for me to represent that business. I've been with Maxim for over 19 years, and I've been with this automotive group nearly from the very first days to over 11 years, and I've actually spent 20 years of my career developing advanced mixed mode automotive ICs, so I have a long history in automotive. I actually initially started out in

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powertrain and safety applications but when I moved here to Maxim, we actually started out with body electronics and infotainment. So early on, our model was to take our consumer grade products and convert them over to what we call [/v] for vehicle, and we used a lot of that IP to gain traction in the automotive marketplace. And then since then, we've been developing more and more product lines and expanding our fan base as well as our technologies, and we're confident that the run we're on is going to continue for quite a few years for sure.

Yes, so early on our -- we went after infotainment, that's where our strongest growth was and some body electronics, but we see the next wave of growth really coming in electrification, which is a large focus on battery management systems for electric vehicle. There's also some electrification occurring with converting over mechanical systems or hydraulic systems to electrical. We're also participating in those events. And then also ADAS or these advanced driver assistance systems for -- that's safety-related. So electrification's really focused on cleaning up the environment, and the ADAS is really focused on saving lives is how we look at it. I told you a little bit about our early days on infotainment. One of the things is that for 8 years, I ran R&D for our smartphone applications. And it lent -- that experience lent itself well in converting IP over to the infotainment as the vehicle expanded very quickly and providing the smartphone kind of user interface in the standard stack of car. That business is going to continue to grow as well. But in today's call, we will focus more on the electrification and ADAS. So you can see here that over the last 5 years, we've had a 30% CAGR, very strong, actually outgrowing the market. And you can see that most of it actually is in the infotainment area but you can see ADAS and electrical vehicles, electrification there showing up in 2017 forecast. And that's going to continue to grow at a higher rate than some of the other areas that we've been investing in. So that's why we're focusing on ADAS and electrification today. The business is very diversified. I like -- I always like to say that we hit singles and doubles, so we diversified our own product lines as well as customers as well as technology. I feel good about that. You can see here that the electrification or electric vehicles, whether they be -- this includes hybrids as well as full EVs and plug-in EVs. You can see here from 2017 to '22, the steer of the vehicles is growing steadily from 5% to 11%, and actually a tripling of production for electric vehicles. And you can see here by the background, obviously, the air quality is really starting to improve. Some of the success here early on is based on regulation. And so there's a lot of subsidies out there, a lot of governments backing further electrification of the car in order to clean up the environment. But in addition to that, cost of ownership for an electric vehicle is starting to come down and be closer, be competitive with the internal combustion vehicles. So that's also driving some of the demand.

So when you look around at our customer base for electric vehicles, although here in California we see Teslas all the time and Nissan LEAFs all the time, and we participate in those businesses. That's not necessary the read around the rest of the world. But indeed, China has very strong growth in electric vehicles. You can see by the pie chart there that it's more than 50% of our OEM wins on BMS. The pie chart represents the number of OEMs where we have a BMS win. It does not necessarily mean we're in production today, but we're either in production or in development of production vehicles at those OEMs. So -- and in that -- the nature of that -- the pie charts are a little misleading because Korea is actually a fairly strong portion of our BMS business, so it's a little skewed here. We started out in about 10 years ago with our BMS products, mostly in Japan, moved to Korea, sunset moved to China where we have strong traction. But we also have wins in North America and Europe. Many of the countries actually made announcements of phasing out internal combustion engines and most of them see it happening by 2040. If not by 2040, definitely by 2050, and some of them even earlier. India is trying to move that target date up, and that will obviously benefit us because we're in the right place at the right time, and we've been investing in battery management system products for over 10 years now, so we a very experienced development team.

And the slide right here just showing a representation of a lithium ion battery because that's really what our products are focused around managing not the nickel metal hydride, so lithium ion battery stacks. So we're in our fourth generation of BMS products, like I said, 10 years of investment. And our architecture is slightly different than some of the other ones out in the market in that we use a daisy-chain approach for communication, which requires only 1 master control. And so there's fewer parts, fewer components in it, which lowers the bottom cost as well as reduces the chance for failures. So the other advantage that our BMS products have is, is that they have a very, very fast data sampling rate, which -- and a lab isn't necessarily that important, but in a noisy vehicle on the road, it's extremely important to be able to make several measurements very quickly so you can average out the noise. So from a technological standpoint, we are a leader in that area, and we're confident in architectures and our product lines. We continue to invest in the development of these products for BMS.

Now the other thing I should point out, too, is that our products are ASIL D-certified. We're one of the few vendors out there that have third-party certification for ASIL D. And ASIL is associated with the Automotive Safety Integrity Levels, with D being the most stringent, meaning if there's a failure, it's very likely that death could occur. And so when you get an ASIL D certification, it's very difficult to do so and actually took us a couple of generations to be successful at that. There's a lot of documentation required, and it's part of the ISO 26262 functional safety specification. But

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we have achieved that level of safety certification which, in a lot of the customers, they demand ASIL D and then there are some customers that do ASIL D at a system level not at the IP level.

So we actually have solutions for -- whether it's -- I'll try to get this started again, sorry about that. We actually have solutions designed for all the different types of vehicles, whether it be a full EV, a plug-in hybrid. So we're confident in our strategy here going forward. And the only difference there is the amount of content in each of the vehicles. Obviously, the electric bus has the highest content level. Two reasons: the battery stacks are larger and they have higher capacity, which requires more electronics to balance and regulate the voltages. Full EVs also have a solid content for us. As you can see, as it goes down from the different levels of hybrids, our content goes down. So we're positioned to grow in any one of these areas. And actually, the electric bus has an extremely high content, and we have good traction on our electric buses with our high-current capable BMS products.

Moving on to ADAS. Talk about these advanced driver assistance systems and the products we have for GMSL, which is our high-speed digital data products and power management. We bring in power management here because it is a core competency of Maxim, has been part of our history for many years, and it's one of the largest customer bases and product lines that we have here at Maxim, and it also is growing at a very strong rate. Now we've started to include ASIL level -- mostly ASIL C level safety integrity in those power management products, and so they're being designed in. And we've recently won a very large short, medium radar application with our ASIL-related power products. And those power products, they're small, they're efficient. And in the safety applications, it's important to provide clean, reliable power. Even though the electrical systems in these vehicles are extremely noisy, very harsh and very poorly regulated. But we are -- very efficient power conversion and reliable power as well, so we're being designed in, in one of these ASIL applications. When it comes to the GMSL, the Gigabit Multimedia Serial Links, the advantages we have there are very low latency. We do not use compression. There's a latency associated with the compression and also artifacts left in after uncompressing that ruin machine vision. So it really disallows real-time safety applications. Obviously, level 2 cars, level 3 cars going forward can become more and more important, so we have a very strong foothold in that marketplace due to the low latency.

The data rates in these products continue to increase, and we continue to make large investments in this because we see not only the displays requiring high data rates but also the high-resolution cameras and high-speed cameras for the safety-related applications. We also offer future scalability. And really, we provide backward compatibility in our products so you can take one of our GMSL -- one of our early GMSL products, you can take and upgrade that to a more recent GMSL product, and it will still work in that system. So the customers feel very secured designing us in that they're not going to have to do a complete architectural change if they indeed need to do an upgrade. Here, we see the ADAS ECUs more than doubling by 2022. And this is data you can access yourself. The meaningful part of this is that we have good traction in these applications, especially e-call, which is a standard in Europe. Parking systems, a collision warning, adaptive lighting even. We have matrix lighting products but are also focused on expanding into this area of ADAS has become more intelligent lighting in lane departure. So these are all mostly level 2. We know that the endgame is fully autonomous. But in my opinion, the endgame of full autonomous is a little further out than I would like to invest in right now. So we're really focusing on level 2 and level 3 ADAS-type systems, which is a good play for our high-speed serial links and our power management products for sure.

Here, you can see that the ADAS sensor count increases significantly with each level of autonomous driving. Like I said, most of the cars today are participating in the level 2 area, where really level 2 is really more about situational awareness and warning the driver. But there, you have at least 7 sensors, whether they be radar or camera or lidar, whatever it is, there's at least 7 of them in there. Most of those sensors require a serial link to report that data back to the central fusion, the ECU processing the data. When you get to level 3, you can see there's roughly a doubling of sensors to get to level 3 and another level of doubling sensors to get to level 4 and 5. So we see the future being very bright for these GMSL links and our ADAS power supplies.

So here, what I'm trying to make a point is, is that cars really become a data center on wheels. When you look at it, some of these vehicles driving around now, especially with some of these NVIDIA systems in it, they have 2 kilowatts to 3 kilowatts of compute power onboard, and that requires a lot of data transmission. So you can see here on the right of the pie chart, the 20 gigabit per second data rate in 2017, that's really the total data rate. So each one of the links in a vehicle today runs at about 3 gigabit per second. And so your total rolls up -- the total data transmission around the vehicle is about 20 gigabits per second.

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Looking out at 2022, which we can pretty much see the future in automotive. We believe it's going to quadruple the data rate required, it'd be 4x as fast as it is today. I'm in speed talking. So in premium cars today, there's already quite a few links but if you look at a premium car in 2022, the number of links goes up considerably. So we may see as many as 20 links in the year 2022.

We already have traction in moving data around not only video, which is really where we started at in our ADAS, but also we have wins in moving radar data, and we are interfacing with several lidar companies as well to start moving lidar data. So we really do see this GMSL as a multimedia link not just a video link. And most of our business today is actually dominated by display. And interesting enough, as it goes forward, as the number of cameras is increasing, and you think that the business will be taken over by camera business, the number of displays in the vehicles are also going up. The size of the displays, the amount of data they have to push the display, the resolution of the displays is increasing which requires more data. And so actually, our business still continues to be split between these links between displays driving displays and the links sending camera or lidar/radar data back to the central fusion ECUs.

Here, we talk a little bit more in detail about the data rates. You can see that today, our first generation of video links were really sitting at 3 gigabit per second. That's what's in high-volume production today. We're currently sampling our 6 gigabit per second products, which we call GMSL 2. And then, we can see the future out where these 8 megapixel sensors forward-looking for high-speed resolution, these narrow-vision cameras, they're going to require greater than 10 gigabits per second. So we've got products for all of these. We actually have products in the lab working at above 10 gigabit, but we are not sampling customers on those products yet.

We continue to use uncompressed data in most of our applications, but we actually do offer compression in some of our display products now because as the resolution goes up in the displays, you can actually have artifacts left over from compression and uncompressing data. And the artifacts are so small on the HD displays or 4K displays that you can't see, so it's basically lossless -- visibly lossless compression. And so there, we can get up to beyond 18-gigabit type data transmissions today using compression for these 4K displays.

The architectures associated with these systems, they get very expensive with a lot of wiring and a lot of power management, which requires more wires as well. Some of the advantages we have in our products is simplifying the infrastructure, shown on the left side of the slide right here, where we can combine -- there's enough data rate capability in our single coax line that we could actually combine the video with other types of data. For instance, you could have video data bidirectional and also include a gigabit Ethernet communication on the same link. So that simplifies the infrastructure, it eliminates wiring and we also do power over coax. So our products are very low power, and basically there are no power and ground wires required, the power is provided over the coax, so 1 single coax line from the head unit out to the cameras. So on the right side, you can see here where we have products that will take a single video stream and split it. So you can drive 2 displays, for instance, for rear-seat entertainment. Or if you wanted the same display between the front and center stack and a rear-seat entertainment, you could also do that.

Here, just looking at the analog SAM associated with these applications, these particular applications here, right, where it's doubling over the next 5 years. And if you look at the I chart on the right, really, I just wish you'd noticed that there's quite a few that the teal-colored or green boxes are where Maxim currently participates. Some of the boxes that have green wrapped around them are possible future opportunities for us, but we have a very high content in these ECUs, these electronic control units. So it's a very strong portfolio for us, business going forward, not only in the video links themselves but the power management, whether it be LDOs, DC to DCs, step-down converters, boost converters, there's quite a few different products that we participate with in these applications. So really, you look at than, the number of these modules is going up and our content is going up, and so it just makes very good story.

Next, we continue to invest in not only our semiconductor technology but also our mechanical, physical packaging technologies. And we do -- we have everything from a single point of load which would be single power supply rail to power management integrated circuits that have as many as 14 rails, providing power to the SoCs inside these vehicles. As I stated earlier, these rolling data centers that have 2 to 3 kilowatts of CPU power in them, they need very efficient, clean, reliable power to operate. So we have the capability to buy those types of PMICs as well as very, very high-current, single point of load products. And we're showing a little bit of a packaging development here where you can see the areas associated with the package from the left to the right at about -- it's about half the area. And we could actually dissipate twice the power in that package. So it's a 4x improvement, half the area, twice the power. And then we have extremely low-standby power. So basically, these power supplies under no-load conditions when the vehicle's parked in an airport, for instance, they can be there for a couple of weeks before it drains the battery. It's

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very important. As the number of ECUs go up in a car, it's very important that we get the standby current down as low as possible in all these modules. Otherwise, the batteries will run dead in maybe 8 hours that you're parked at work.

So we are making investments in packaging. We're also making investments in internal process development. And on this slide right here, we show one of our current high-volume production, battery management system products in the left, and it's basically in our 450-nanometer process. The purple area represents digital, the digital portion. I think the kind of greenish area is dominated by analog circuitry and high-voltage circuitry. You see as we go to our newest process, just our 90 nanometers, there's a significant die size reduction and a significant digital shrink. And what that allows us to do is actually embed significantly more digital content and offer much more feature content on the products going forward while reducing cost as well, so it's going to improve our profitability. Also, we're making a move from 200-millimeter wafers to 300-millimeter wafers in our 90-nanometer process.

I never give an automotive presentation without mentioning quality because quality, it really is the cost of entry into automotive, and it's a barrier for entry for our competitors. Really, in today's world, you have to be able to ship a complex, mixed voltage, mixed-signal IC at below 1 ppm, so 1 bad part per million. You have to be below that level in order to be a reliable, trusted supplier in the automotive applications. So what we show here is -- on the gold line is the defect rate trend over the past few years being driven down. And it's really been driven down -- starts to all be driven down by our consumer-based products, and then we moved those processes into automotive and we drive it further down, which actually benefits the whole company because these -- even our consumer -- high-volume consumer products will benefit from the improved yields. The other thing here is you could see that our cumulative unit shift by the end of this year will have shifted 1.5 billion fully qualified /v automotive products. And we're quite proud of that because really, when I joined the group about 11 years ago, we were near 0 revenue in automotive. And this is all organically grown. So really what we've done, we built a very talented R&D team that's allowed us to do this that understands part of the culture is a defect-free design, and that goes for everything in the process by the way, so the semiconductor process, the packaging, the design, the testing, the logistics associated with it, et cetera, et cetera. So it's all been organically done, no acquisitions, very talented team.

Content premium cars is debatable numbers depending on, obviously, what options are in the vehicle. Like I said, we're very strong in infotainment and body electronics, some in ADAS. Going forward, that's where we see a lot of our growth. You can see that on the chart on the left going from 2017 to 2022, good strong growth in ADAS. Our content opportunity in the premium car is growing, there's no doubt about that, and in some cases, could be in the $200 range. Especially if you're looking at a premium full EV vehicle, you'll definitely be in the $200 range of possible content. And you can see again here on the right, where we talked about the electric vehicles or our BMS content, is increasing based on the size of the battery pack, whether it be the current capability or the number of cells stacked, both of those will increase our semiconductor content.

To just -- to wrap this up. We see the EV units tripling over the next 5 years. We see ADAS, ECUs doubling over the next 5 years. And the bottom line, the story for Maxim is, is our content is going up as well, and so it's a good story all around. Our BMS designs continue to win. We're not only having strong near-term business but we're definitely in partnerships with many of the OEMs and Tier 1s so that we could see the future further out. So BMS continues to be a strong area and a good investment for Maxim, as is our serial link. Our serial link, we've won several major OEMs with our GMSL 2 products, and we're really in communication with most OEMs and Tier 1s because of the advanced feature sets in our serial links. And so going forward, that's also a large or a high-invest area for us. And then, of course, there's our integrated power management, which really does drive the higher performance. It actually enables higher performance, these 2 to 3 kilowatts that are going around and burning in the trunk. And it does provide safe and reliable clean power that enables these very sensitive and fragile microprocessors to operate reliably long-term in a very harsh automotive environment.

I mentioned the strength of the team, but I'd like to, in closing, just mention that again because without the strength of our R&D team and my product definers, application engineers and logistics supports here at Maxim, the fact that the market's growing would not be very important. But this team is excellent at executing and putting out products in a timely fashion that the customers can trust and depend on us. And so they're willing to design us in before we actually have final silicon. And so it's -- automotive is the fastest-growing business here at Maxim, and it's exciting and glad to be part of it.

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Kathy Ta - *Maxim Integrated Products, Inc. - VP of IR*

Thanks, Randall. At this time, we'd like to open the call for questions. And for your reference, we are posting or we just have posted a copy of the slide deck to our website. So please go ahead and download if you would like. I believe we'll be okay in terms of questions and answers. If you have more than 1 question, please go ahead and ask more than 1 question, and we'll try to get to everyone in the queue. So Jonathan, if you're ready, could we please have our first question?

QUESTIONS AND ANSWERS

Operator

(Operator Instructions) Our first question comes from the line of Vivek Arya from Bank of America Merrill Lynch.

Vivek Arya - *BofA Merrill Lynch, Research Division - Director*

So Randall, for the first question, can you talk about the competitive landscape in these 2 growth areas that you mentioned, ADAS, the serial links and on the BMS side? Who do you usually run into? How's the pricing environment? And how far out is your visibility around the design wins?

Randall Wollschlager

Yes, so let me cover the last question first. Our visibility looking out is about 4 to 5 years as far as new designs go. Typically, the lifetime of our products once they're in production run 5 to 7 years, but if we're talking about new designs, we could see out about 5 years. When it comes to our video links, I think it's pretty clear, it's basically a 2-horse race with TI. And we have a different strategy, so we provide premium products that offer advanced diagnostics and development tools. There's a lot of featured content in a Maxim serial link products, these GMSL products, that really provide a much more reliable link. And that's why we tend to win most of the premium applications. Where sometimes we don't win, it would be in the lower cost, more generic kind of data pushing around. And so it's a less kind of GMSL competitive story. By the way, just in general, automotive is extremely competitive on pricing rate. These -- the guys are used to beating down their semiconductor suppliers very well. But when you have a product that's differentiated and it's niche-y, then that's where Maxim really wins. We do not focus on commodity products. We typically do not win by price. So when it comes to BMS, there's a similar story there, with probably our top competition there being Linear Tech, which is now being acquired by ADI. But they win on precision. They have the most precise products out there, but the reality is, is that our products actually provide a lower BOM cost and a high-functionality in the system, in a vehicle driving down the road. And we win because we're ASIL D. So if you have an electric vehicle and you want the safest vehicle on the road, you're going with Maxim because we're ASIL D third-party certified. And let's just be honest, these large batteries in these electric vehicles, they are dangerous. So a lot of OEMs do require ASIL D. I hope that answers your question.

Vivek Arya - *BofA Merrill Lynch, Research Division - Director*

Yes. So as a follow-up, if you take a step back, you guys have done extremely well in autos in the last 5 years. Do you think being a top 5 supplier in autos is a worthwhile target? And if it is, can Maxim do that organically? Or do you think you will need to acquire other complementary capabilities? Just in general, how do you think about consolidation? Do you need it? Do you not need it? And just when I look at some of the new areas that are coming out, whether it's EVs or ADAS or autonomous, do you think you have the portfolio to address all those opportunities? Or do you need to look outside?

Randall Wollschlager

Certainly, certainly. So right, so I've been in the group for 11 years, and I used to run all the R&D in this organization. And what's percolated to the top over the last decade are the 7 different product areas that we currently provide. So we focus on BMS today and GMSL and some of our power expertise. But there's also other areas over there, LED lighting, that we're investing in. Display is a very strong business for us. USB, USB 2.0, USB

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Type-C, we're very strong in USB and have a strong market share in that product line. So there's other areas that we are investing in. Like I said earlier, we're diversified based on customers, based on technology and based on applications. So -- and I wouldn't want to be leading this business if I didn't want to be in the top 5, okay? Now can we get there organically? It's -- that's how we've been doing it all along. It's taken us a while to gain enough traction to get here, but we are significant now, we continue to grow at a fairly high rate. To stay in the top 5 though as acquisitions and mergers continue to happen, it's going to be harder and harder to be a top 5 type supplier. So really our goal is to continue to -- strong growth with reasonable profitability, meeting Maxim's type standards.

Kathy Ta - *Maxim Integrated Products, Inc. - VP of IR*

And I think I would just add to that, that if you look at the top 5 suppliers in automotive, a lot of them are in the top full position because they serve under the hood content which tends to be lower margin, and it also tends to be incumbent like they've been there for years. So we're not necessarily interested in those internal combustion engine-type sockets that would be required to get just the revenue level up. We're more interested in participating in those parts of the market that are actually growing faster than the average automotive market. So where the content is growing, that's where we're interested in participating. And I think we've done fairly well on those fronts.

Operator

Our next question comes from the line of Harlan Sur from JPMorgan.

Harlan Sur - *JP Morgan Chase & Co, Research Division - Senior Analyst*

As a follow-up to your commentary on the profitability side. I know that the automotive segment drives margin slightly below corporate average given the additional quality and reliability testing that is required, and that is a key differentiator as you pointed out, Randall. The auto team has driven margins into the 60%-plus range. Maybe you can just help us understand outside of mix what are some of the initiatives that you have to potentially drive the growth and operating margins higher from here.

Randall Wollschlager

Yes. So interesting enough is that the margins just naturally improve as we get our newer products designed in. And the reason I say it like that is because initially we started this business, we actually called it kind of a golden retriever model. We go out and find these sockets and convert these consumer-based products into these automotive applications. But they weren't necessarily refined specifically for the automotive environment. And so we're trying to shoehorn kind of IP that Maxim had into these sockets. And I told you these sockets were on -- some of them are running longer than 10 years. And so what happens is I've got a product that's very old on a very old process, in a large die in a larger package, the scale isn't there, the efficiencies aren't there, and so my margins are fairly low on most older products. As you look at our newer products, they're actually targeted and refined for the automotive environment, and we really have optimized kind of our cost performance scenario. And so just naturally over time, even if I did nothing any different, our margins will continue to go up as we start phasing out those older products.

Harlan Sur - *JP Morgan Chase & Co, Research Division - Senior Analyst*

Great. And then just a follow-up, on the serial link technology, you guys have a lot of traction here with some of the leading OEMs like Tesla, for example. How does this complement or compete with gigabit auto-grade Ethernet that we hear some of the other semi guys talking about?

Randall Wollschlager

Yes. So first off, there's already multiple backbones in a vehicle today. There's CAN, right, there's GMSL, there's LVDS out there. There's a lot of different types of data transmission in a vehicle today. That's going to continue. In fact, going forward, there's probably going be more, not less.

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But where we're strong is in point-to-point communication. We can also daisy-chain our products because of the high data rate capability. But one of the strengths where we differ from gigabit is the real time. So Ethernet -- the issue with Ethernet is it's not real time. And it's really not a point-to-point base communication system, it's really for a network. And so it's not real time, it needs to be network. And let's just be honest, a gigabit isn't enough data rate to satisfy the needs of the vehicle. So I really see these LVDS-type GMSL data links remaining around for a long time. One of the reasons, as the data rate continues to change every couple of years, it changes so fast you can't even release a standard. So all of these things, whether it be Maxim or another supplier, we're chasing an ever-moving target, so we don't have a chance to -- we just can't standardize it, and which is good for margins. So right now, it's -- we're very confident that our success in this business is going to continue and will continue in a big way.

Operator

Our next question comes from the line of Ambrish Srivastava from BMO Capital.

Ambrish Srivastava - *BMO Capital Markets Equity Research - MD of Semiconductor Research & Senior Research Analyst*

I had 2 quick ones. Randall, you talked about the BMS side and how -- why Linear-ADI wins on precision versus when you win. Can you talk a little bit about -- so ADI has seen some volatility in the segment. What is your view of the market? Are you seeing any such volatility in -- at end market? And then also related to that, what is your share now versus -- and I guess, this is a brand new opportunity for you. And then I have a quick follow-up.

Kathy Ta - *Maxim Integrated Products, Inc. - VP of IR*

Maybe I can jump in on the -- we have to be careful not to update our guidance. And so we're not doing that on the call today. We -- from a long-term perspective, we don't see any cause for concern. For us, it's basically for a regular combustion engine, we have virtually no content. If it's an EV, we have content. So it's upsize for us. And we do expect that with the nascent nature of this market, especially pure EVs, it's going to have fits and starts. We're going to have lumps, especially as we have government incentives programs come and go. The long-term trajectory looks very bright. So I don't know, Randall, if you wanted to discuss that in terms of just long-term.

Randall Wollschlager

Yes. Long-term, what I could tell you is that we are winning, especially in China. So we're very strong there with several of the battery manufacturers or OEMs. And it is good that there are fits and starts as Kathy pointed out, and we have experienced some of that ourselves in the past quarters. But I don't run this business on a quarter-to-quarter basis, we're really making long-term investments into automotive. We think it's the right place to be at the right time, and we've got the right technologies to continue to win. As far as LTC's and ADI's weakness, I really can't intelligently speak about that.

Ambrish Srivastava - *BMO Capital Markets Equity Research - MD of Semiconductor Research & Senior Research Analyst*

Okay, that's fair. I had a quick on the serial link side. You mentioned the biggest competitor there is Texas. Where -- can you help us understand when or what are the parameters that help you get design wins versus them? Or what are the opportunities? And I think I heard it correct, you said you're targeting more of the high end versus the data-only side, is that right way to think about it?

Randall Wollschlager

Yes. We're definitely -- these systems require more and more reliability as they become not just a video, not just a display. So early ones I'll say was a backup camera, for instance. You might look at that and say it's just a display. It could be slow, it could be fairly unreliable and maybe it's not going to be life-threatening. But as we move forward into level 2 and level 3 autonomous-type driving, there are these advanced driver assistance

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systems, you need a reliable data link. What we provide is, for instance, the ability to set a high-opening threshold on the link that the OEM can set so that if you start seeing degradation in the cabling or the connectors and the system looks like it's headed towards a failure, we could tell the user to see the dealership prior to a complete fail. Today, these links, they just fail and they go black, and then you have no idea that it was going to fail, so you're caught off-guard. With the safety-related systems, you cannot have that occur. That's one big advantage we have is we also provide onboard development tools, actually integrated into the IC itself to make the development of the system easier for the OEMs in the Tier 1s. So that's an advantage we have. The other advantage I was telling you is our real-time, high-speed data rates and our power of our coax requiring fewer wires.

Operator

Our next question comes the line of Tore Svanberg from Stifel.

Jeremy Lobyen Kwan - *Stifel, Nicolaus & Company, Incorporated, Research Division - Associate*

This is Jeremy Kwan calling in for Tore. First question, just looking ahead to the rampage you're seeing in the Automotive business, how are you planning for your capacity requirements? Do you have capacity in place to, say, like the next 2 to 3 years? Or how far out do you look?

Kathy Ta - *Maxim Integrated Products, Inc. - VP of IR*

I'd take the first cut at that?

Randall Wollschlager

Sure, go ahead.

Kathy Ta - *Maxim Integrated Products, Inc. - VP of IR*

So yes, thanks for your question, Jeremy. So that was part of our strategy, in fact -- and we transitioned our manufacturing footprint to more outsourced capacity. That gives us the ability to ramp up quickly without putting any CapEx at work. So it really is an advantage for us. And in part, it may be the reason why we're not seeing that extended lead times on our ability to deliver product to our customers because we're able to dip into that ample capacity that is in place in our foundry partners, and we have a number of them that we can use. And they each have their own capabilities and would usually do or qualify it as well in terms of where we run our products. So we have that flexibility in our manufacturing capacity to be able to dial in what we need. That being said, I don't know if there's any other...

Randall Wollschlager

No, it's pretty good. At our internal processes, we have multiple sites we could fab these products, assemble these products and test these products. So there's pretty much dual site for everything that we do that's internal. And then, some of our products, we do run at TSMC. But the reality is we run -- our products are focused on 1 or 2 process flows, so it's not a very diversified -- from a semiconductor fabrication process, we focus on 1 or 2 processes, and it enables us to really make sure that we have the capacity we need because it's not a very complex system. We don't need to manage 25 different flows in our fabs.

Jeremy Lobyen Kwan - *Stifel, Nicolaus & Company, Incorporated, Research Division - Associate*

Great. And just a quick clarification on that, and then I have a follow-up. So you've mentioned some is internal, some is outsourced. Can you give us a split for what that looks like right now and what it could look like in 2, 3 years? Just within automotive.

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Kathy Ta - *Maxim Integrated Products, Inc. - VP of IR*

So for automotive.

Randall Wollschlager

Dominated by internal, we're about 4 fits internal.

Kathy Ta - *Maxim Integrated Products, Inc. - VP of IR*

Yes. So we do run a lot of our automotive products through our existing fab in Oregon. And what...

Randall Wollschlager

I forgot, I still look at...

Kathy Ta - *Maxim Integrated Products, Inc. - VP of IR*

So Tower is outsourced.

Randall Wollschlager

So yes. So actually, we're probably 70% outsourced now, 30% internal.

Kathy Ta - *Maxim Integrated Products, Inc. - VP of IR*

Okay. So 70-30. Sorry, about that, Jeremy.

Randall Wollschlager

So we -- I still view one of our fabs that we sold to TowerJazz as our internal fab.

Jeremy Lobyen Kwan - *Stifel, Nicolaus & Company, Incorporated, Research Division - Associate*

No, that's helpful. And just in terms of -- you mentioned there is -- some of the future products you're working on is the conversion of mechanical and hydraulic systems. Can you just give us more detail what systems this is affecting in the vehicle and maybe what the dollar content and market opportunity of this could be?

Randall Wollschlager

Yes. A lot of that is fairly new development. So I don't really -- I can't really give you a good read because a lot of those, the market really hasn't developed. So one area that everybody talks a lot about is the 48-volt system, okay, where they're going to start driving turbochargers with electric motors instead of with exhaust gas. So there's one where there's a conversion of a particular application. But the 48-volt has been slow in gaining traction. So there's a lot of hype around it. And we have some 48-volt products for that application. But like I said, the market really hasn't developed yet. So that's just one area. There's a lot of electric power steerings out there. I see electric brakes coming. They're not there yet, but I believe that

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they're headed in that direction. They can solve some of the high-temperature problems and some of the reliability issues. I don't have a feel for the size of the market though.

Operator

Our next question comes from line of Ross Seymore from Deutsche Bank.

Ross Clark Seymore - *Deutsche Bank AG, Research Division - MD*

Just the question on the go-to-market strategy. We hear a bunch of the processor companies, they put out big announcements about wins with the big auto OEMs. So just wondered from your perspective, probably more so on the ADAS side of things, whether it be the power or the serial link side, you have to link up ahead of time and be on design wins with those different processor vendors? Or do you get the design win with the OEM, the Tier 1? Just talk a little bit about the partnerships and how you actually get these design wins.

Randall Wollschlager

Yes, that's -- I'll be honest with you, Ross, that's a little bit like the rest of the business. It's very diverse. So we do have strong partnerships. We have a very strong partnership with NVIDIA, for instance. And that's been announced at CES, and we've had joint displays and stuff like that, both on the power side as well as the data links. And that definitely has helped us gain traction at several large OEMs in Europe especially. We also work closely with Renesas, we work with power management with Freescale, for instance. So we do have those type of relationships, but we also have direct relationships with OEMs, and then we have direct relationships with Tier 1s. So it really is a mix, and we try to cover all of our bases that we can. Although we can't be everything to everybody. So we do not have a partnership with every single SoC manufacturer out there. We picked a few that we think are going to win. I think we've done a very good job with it, especially with NVIDIA. NVIDIA is definitely making a huge investment in fully autonomous going forward, so it's a long-term play for us. That's kind of our go-to-market. And we're a little bit more subtle in our successes, a little bit behind the scenes, not so much out there maybe bragging it up. But I'll tell you, we have had many years a very high growth rate, and we do see us continuing to outgrow the market.

Ross Clark Seymore - *Deutsche Bank AG, Research Division - MD*

And I guess, as my follow-up, a bigger picture question. One thing you said, starting off on your ADAS portion of your slides, is that you're focusing on level 2 and 3 and not really full autonomy, thought that was going to take a little bit longer to come to fruition. That seems to be at odds with some of the hopes that the others, especially in Silicon Valley talk about. So just curious as to why you think it's going to take a little bit longer. And when is a little bit longer in your eyes mean?

Randall Wollschlager

Yes. You got to pin me down with that one. So yes, the reality is that we're in position to support level 2, level 3. We can support all the way to level 5, especially with our ASIL D capabilities with an experienced team. And I've got 125 design engineers. So we're in the right place at the right time. But sometimes, being too early, you end up being a technology leader and a money loser. And I like the balance -- although I come from R&D and I'm an engineer, I do like the balance of the business side with the engineering and the hype. So whenever it does develop, Ross, we'll be there to support it. But in the meantime, we'll make money off of level 2 and level 3. That's really my strategy.

Kathy Ta - *Maxim Integrated Products, Inc. - VP of IR*

And Ross, I'll just add a little bit to that. When you look at market projections for these presentation, we really did take a conservative view. And that does match our view of what we expect. We're Maxim, so we're going to be low key, and we're not going to count on it until it comes kind of

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culture. So it is that kind of perspective that we do have. And so that's why we wanted to mention like in our sizing of this that it really just reflects level 2 coming in. And of course, if we see level 3, 4 and 5 coming in sooner, great, because that will just accelerate the SAM projections that we expect.

Operator

Our next question comes from the line of William Stein from SunTrust.

William Shalom Stein - *SunTrust Robinson Humphrey, Inc., Research Division - MD*

I recall you highlighted a 30% sales CAGR from 2012 through 2017, and I noted the pretty strong visibility having this end market with 5-plus years in production for each win. And I think you said 4 to 5 years of visibility from design win to production, so quite a lot of visibility. I'm wondering if you think that, that 30% sales CAGR will sustain itself, fade meaningfully. Or by a sum of this presentation, I could conclude it might accelerate. Can you share what the company stated on this already?

Kathy Ta - *Maxim Integrated Products, Inc. - VP of IR*

Yes. So Will, maybe I'll just start off an answer to that. So that 30% CAGR is just a reflection of historical actuals of those I described, Maxim revenues historical actuals. And then, we're not changing our long-term view that we're expecting our automotive revenue to grow low teens on a year-over-year basis going forward. We did -- this is classic Maxim perhaps, we're just kind of setting a reasonable target that we expect to be able to hit. So we do see that low-teens growth rate then that does reflect the larger base business that we have today, the business has grown just geometrically that the growth rate will slow down mathematically going forward. So that's basically what we're reflecting here. The faster growth rates that you see in some of our SAM projections are highlighting the EVs and the ADAS content. We do also participate in infotainment content. We expect that to grow around in this low-teens area as well. And then what may be growing slower than all of the above is the auto body electronics. This is our best estimate today on what the future growth rates will be, but we hope to be pleasantly surprised, of course.

William Shalom Stein - *SunTrust Robinson Humphrey, Inc., Research Division - MD*

Got it. And a couple of quick follow-ups if I can. First, back on Slide 11, you highlighted the ADAS ECUs, you expect to more than double by 2022. And this may be another way to look at the prior question that was asked before me. But it reflects an architectural view that treats ADAS as a suite of many discrete functions so that would maybe be more in line with sort of level 2 ADAS that's dominating the market but there are other vendors you highlighted, NVIDIA, in particular, that they proposed a somewhat more centralized view of ADAS features, not just level 5 but a very centralized architecture as well. Is Maxim making a bet here that ADAS gets deployed in this more sort of decentralized manner? And if NVIDIA's architecture winds up gaining more success, would this affect your growth opportunity in that market?

Randall Wollschlager

No. We're actually positioned no matter what direction the market goes, to be honest with you, okay? So yes, currently, these systems are standalone, and they -- actually, the systems currently today do a lot of data processing. For instance, the radar system today does a lot of data processing out at the radar module, at the bumper of the vehicle. If NVIDIA, their architecture wins, we'll be pushing radar data across our GMSL links back to the central fusion module, so which is just good for us. So we currently can do the power management and the data transmission on those radar module today, but the data links don't require much bandwidth today. So if NVIDIA wins and they go to raw data, that's good for our GMSL links, what stood at the power management out there. And as the CPU power goes up to these 2 or 3 kilowatt, there's a lot of power management products in there. And just to give you an idea on some of the more recent NVIDIA board designs, we have in excess of 20 integrated circuits on a board, so we win either way. But historically, in automotive, the way these new systems are combined in the vehicles is they start out as a kind of a standalone module out at the extremes. Whether it's a video camera, radar, ultrasound, whatever it is, it starts out as kind of its own standalone remote module, and then it will be integrated in possibly into an ECU -- central ECU going forward.

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Kathy Ta - *Maxim Integrated Products, Inc. - VP of IR*

And so Jonathan, I think we have time for just one more question, and we actually have a question that came in through our chat facility, and it appears to be from a buy-side investor, so I'm just going to go ahead and read that question here.

So the question is, you've grown this Automotive business from 0% to 20% of revenues using consumer products that have been repurposed for auto. And the question is, have we improved our design win percentages as we've designed, targeted and refined automotive products?

Randall Wollschlager

Yes, absolutely, an excellent question, so I call that our product vitality. And it turns out that our -- at our products, about half of our current revenue is based on products that were introduced in the last 5 years. So really, if you look at our portfolio, we are really designing ourselves out or replacing ourselves or the other parts are dying off and the new parts are gaining traction at a very high rate. So at Maxim here, we flex and dice the data in any which way you think you could look at it, and the automotive unit here is very successful. Almost every single product that we introduce ends up selling and making money for the company. It's a very high success rate business. And it's because we stay very close to the customer, we listen very closely to them, and we could execute very quickly. And so that's really been why Maxim has been picking up market share. That's why Maxim grew so fast during the infotainment expansion is because we have a design team capable of producing products very quickly. So yes, we did start out converting consumer-based products. But now really, our portfolio is being dominated by products designed specifically for the automotive applications.

Kathy Ta - *Maxim Integrated Products, Inc. - VP of IR*

Great. So I think that is our last question that we have time for. So I'd like to thank everyone for their participation. And thank you, Jonathan, for being our operator. This concludes our conference call today, and we like to thank you for your interest in Maxim.

Operator

Thank you, ladies and gentlemen, for your participation in today's conference. This does conclude the program. You may now disconnect. Good day.

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