Morgan Stanley Technology, Media & Telecom Conference

Company Participants

- Colette M. Kress, Executive VP & CFO

Other Participants

- Joseph Lawrence Moore, Executive Director, Morgan Stanley, Research Division
- Unidentified Participant, Analyst, Unknown

Presentation

Joseph Lawrence Moore {BIO 17644779 <GO>}

All right. Good morning, everybody. I'm Joe Moore, I'm very happy to have with me here today Colette Kress, the Chief Financial Officer of NVIDIA. Before we start, just let me read the disclosure really quickly. Please note that all important disclosures, including personal holding disclosures and Morgan Stanley disclosures, appear at the Morgan Stanley public website at www.morganstanley.com/researchdisclosures or at the registration desk.

Questions And Answers

Q - Joseph Lawrence Moore {BIO 17644779 <GO>}

So Colette, thank you very much for being here. There's definitely a lot going on with you guys, as always. Maybe we could start with gaming and just kind of go right into that. Gaming, 53% of your revenues. And you've had a pretty exciting product launch with a little bit of an inventory correction around it. You've talked about that business sort of peaked at about $1.8 billion. It was below $1 billion just last quarter. Can you just kind of talk about what's happening there with the -- and maybe if you could frame that in terms of what you said about the consumption levels?

A - Colette M. Kress {BIO 18297352 <GO>}

Sure. We finished our Q4 results and our fiscal year. It probably ended a little bit differently than we hoped to end the overall year. But we took this opportunity to kind of describe the dynamics of what we saw in terms of gaming throughout the year and how to think about this as we move into our new fiscal year. So for one part that we sat back and looked at is essentially past the first cryptocurrency wave that ended in essentially the end of Q1 of last year. And we went and looked at what we saw in our Q2, Q3, Q4 as well as what we're guiding in terms of our Q1 and averaged those over that period of time to take a look at in terms of what we think about the

overall gaming business, the overall gaming demand over that period of time. We probably post-cryptocurrency shipped higher than overall underlying demand in Q2 and Q3 of last year. However, for Q4 and Q1, we're going to do the reverse, which is we're going to say that we're going to ship less than what we believe the overall demand of the end market is happening in terms of gaming. So over that period of time though, if we average it out, we came together with what we considered to be a baseline for our overall gaming business of approximately $1.4 billion that we expect to grow from here on going forward. Over this period of time, over the last 1.5 quarters, there were opportunities to (launch) our new wave of overall Turing architecture. Our Turing architecture is an opportunity for us to bring ray tracing to the overall gaming business. This is an important part for us and making that sure we have a healthy channel, a channel that can absorb our new products well is a very important part of that. We think we are now set to drive that all within our fiscal year '20.

Q - Joseph Lawrence Moore {BIO 17644779 <GO>}

Okay. So $1.4 billion is kind of your trailing rate of consumption and then you grow from there over time as you catch up to that?

A - Colette M. Kress {BIO 18297352 <GO>}

Right.

Q - Joseph Lawrence Moore {BIO 17644779 <GO>}

?Okay, that makes sense. Then can you talk a little bit how there got to be this much inventory? I know you mentioned crypto and there were certainly shortages around that. But it seemed like you guys have described that the OEM business was largely serving crypto. And there wasn't that much gaming. And the numbers actually bore that out. If you look at the hash rates of the cryptocurrencies, it didn't seem like there was that much incremental gaming. So was it just that the shortage itself created some incremental demand for channel fill? Or just how should we think about how this inventory got as big as it did?

A - Colette M. Kress {BIO 18297352 <GO>}

Yes. The cryptocurrency wave ended quite sharply at the end of Q1 a year ago. We had a little bit in our Q2. But what happened after that overall wave is we had extended higher prices in the overall channel, higher than our overall manufacturer's suggested retail prices over that period, which therefore influenced the underlying demand. People had first -- the channel had kept the prices a little bit higher and didn't really bring them back down fast enough for us to track the overall demand for that period. The demand, therefore, was less than what we expected, which led to us having higher overall excess inventory in the channel during that period of time.

Q - Joseph Lawrence Moore {BIO 17644779 <GO>}

Great. And I want to talk about some of the important new products that are maybe just on this inventory discussion. If we can talk about the 1660 that you launched just last week. Pretty compelling kind of mid-range, budget-priced product. How do you

juxtapose that with everything else that's going on with the older 1060 products and the newer 2060 products?

A - Colette M. Kress {BIO 18297352 <GO>}

Yes. So the excess inventory that we had in the channel, we expected to take approximately 1 to 2 quarters to get through it. So we expect by the end of the quarter that we're in today, we will have depleted the overall excess inventory that we have in the channel of our Pascal mid-range that is (inaudible). So what that has enabled us to do is now start new in terms of our Turing architecture at different price points that can attract at those areas as well. So at CES, we announced our 2060. Our 2060 has a price point of $350, a great overall price to realize overall ray tracing for overall gaming. And as we just commented on, we've just announced also our 1660 Ti. This comes out at a price point of $279, which is also a great performance improvement over Pascal of probably 35%. And even widely increased in terms of performance over the Maxwell. Those are very, very key important volume SKUs that we can attract both markets here in North America but also in terms of China. So we're excited to bring Turing now further down the stack to a great price point.

Q - Joseph Lawrence Moore {BIO 17644779 <GO>}

Okay. And I guess when we look at your April quarter guidance, now understanding that, that product is there, I guess some people have asked me, "Is the guidance conservative, given that you now have a product at kind of most of the price points that's Turing-based?" Even (some of which is in development), you have products at every level. So maybe that inventory of 1060 doesn't hurt you as much. So how do you respond to that? You obviously knew about this when you gave guidance.

A - Colette M. Kress {BIO 18297352 <GO>}

Yes. So when we looked at our overall guidance, again, we did need to keep in mind that we still have to work through the overall inventory that is in the channel. And we will again have a slight overlap as we dove into the new Turing products over there. But this is, as we know, still a period of time where we have to allow that overall sell-through to occur before we start selling in more into the overall channel. We believe given our Q1 guidance, it's a little bit lower than that overall base -- that overall run rate, which definitely influences our overall year overall growth. But we think we'll start stepping back up after we finish the Q in terms of growth, in terms of the latter half of the year as well.

Q - Joseph Lawrence Moore {BIO 17644779 <GO>}

Okay. Great. And maybe you can talk a little about Turing, about the new capabilities, real-time ray tracing. For me, kind of the technology there is a really exciting prospect. Can you just talk about the importance of that? Then obviously, when you bring something that's breakthrough capability to the market, it has to really be programmed to optimal usage. What do you see in terms of the enthusiasm for (developers as well)?

A - Colette M. Kress {BIO 18297352 <GO>}

Ray tracing and our overall Turing architecture is a super, super opportunity, what we believe is next-generation gaming, next-generation gaming that was probably not expected to hit for more than 10 years in the future. And we're bringing it now based on the overall performance availability that we've established with our overall platforms now. This is an opportunity to essentially change essentially how people absorb the overall gaming with cinematic types of overall games, to where the pictures are so true and so real in terms of what they're seeing. But you're correct. It's a little bit of a chicken and an egg. The hardware, the overall architecture, the software that you have that enables the overall ray tracing brings the overall content to this area. We have a great set of games that have already come out, including Battlefield V; including Anthem, which is really now using our DLSS; as well as in terms of Metro Exodus, which is also available. We'll see more games in the future come in to take advantage of the overall ray tracing. But it is breakthrough technology, very, very similar to what we see in terms of programmable shading more than 10 years ago. We see this as the future as we go forward.

Q - Joseph Lawrence Moore {BIO 17644779 <GO>}

Great, thank you. I'm getting some signals that people can't hear. If you could turn the mics up a little louder, that would be great. Then the other aspect of Turing, I guess, before you get ray tracing support, you mentioned DLSS, Deep Learning Super-Sampling. Can you talk about what that is? And it seems like that goes a long way to really boosting performance of the higher-end ray tracing products even before they start to implement ray tracing itself.

A - Colette M. Kress {BIO 18297352 <GO>}

Correct. So the overall ray tracing does create overall beautiful pictures but may take the overall frame rate refresh down a little bit lower. So what we established was DLSS, which is essentially bringing AI to the overall gaming piece by overall filling in pixels in between 2 points with the overall use of AI. You can now overall get back to the overall performance level that you would likely have seen if you did not have overall ray tracing. A great piece of technology, taking so much of our learnings that we have in terms of the data center and using AI. We're excited to also bring this now to overall gaming.

Q - Joseph Lawrence Moore {BIO 17644779 <GO>}

And how pervasive do you expect DLSS to be? And how difficult is it? It seems like you guys do a lot of the work of creating those drivers. But it's also -- it's taking a little while to get some of the games out. Just how long does it take? And I guess, as we look to the holiday season this year, how pervasive do you expect DLSS to be?

A - Colette M. Kress {BIO 18297352 <GO>}

So it is a piece of work in terms of working on the overall software thing. The overall software developers are very -- they develop the work that we're doing. They are also helping along with that. So it's actually a bit of a joint work going through that. Again, at any point in time that you bring a new technology, they may be at a certain stage in terms of building out their game. So keep in mind that we are working with them while they're in the middle of that project. As we see newer games come to the

market later, we'll be able to get there at the very beginning of their overall development cycle that we'll probably move it quite faster into this overall market.

Q - Joseph Lawrence Moore {BIO 17644779 <GO>}

Okay. I mean, Turing is out, you've said it, there's a little bit of a slower start than you hoped. But it seems like you remain pretty confident that by the second half of this year, you're at the levels that you'd hope to be at.

A - Colette M. Kress {BIO 18297352 <GO>}

We do. I think our expectations of Turing at the overall launch was a little bit higher than where we actually came out. A lot of things likely to have influenced that in terms of the overall macroeconomic conditions that may have been there, both here in North America, possibly elsewhere in terms of overall China. So again, still great overall sales. It's just that our expectations were overall higher. The excess channel inventory probably also caused part of our expectations not being met. Our now ability to provide the full stack of Turing that we now have available, all the way from our super, super top end to our lower end, will again fuel the overall market for the opportunity of Turing.

Q - Joseph Lawrence Moore {BIO 17644779 <GO>}

Okay. Great. Then the other question we get a lot is China, which I know is a pretty big market for your gaming business. And there have been a number of challenges, both just the sort of general macro slowdown. There's been some issues with games getting approval. What do you see in that region? And is demand coming back there an important part of your forecast?

A - Colette M. Kress {BIO 18297352 <GO>}

As we indicated at end of our Q4, possibly those macro conditions in China did not allow us to realize the full potential in terms of China, in terms of what we believe is the underlying demand for overall gaming. It's tough to point to any one of those issues in terms of regulatory, in terms of game approvals or the impact of it in terms of the excess channel inventory. Again, as we now are leaving the Q4 behind us and we've launched the new product, the new products in terms of 2060, there's tremendous great reviews. There's tremendous excitement. Still early for us to see. So we're just finishing out Chinese New Year. And we'll now look to see how well Chinese overall demand has come back.

Q - Joseph Lawrence Moore {BIO 17644779 <GO>}

Okay. And the 1660 has been pretty well reviewed so far as well.

A - Colette M. Kress {BIO 18297352 <GO>}

Absolutely.

Q - Joseph Lawrence Moore {BIO 17644779 <GO>}

The 1660 Ti. Okay. Great. Then I guess, just final gaming question for me. On the gross margins, you've had this kind of unusual environment where last quarter was really all high-end products because you were clearing inventory at low end. Now you get a little bit more of a mix. Is that where you get a little bit of gross margin pressure in the April quarter that you just had sort of artificially inflated over the last quarter?

A - Colette M. Kress {BIO 18297352 <GO>}

So as we discussed, our overall gross margin, the largest contributor in terms of our gross margins is the mix, our mix across our segments but also our mix with -- inside of our segments. So these things change from quarter-to-quarter. Over the long term, you've seen us consistently work on improving our overall gross margin, which for the long term, that has done.

Q - Joseph Lawrence Moore {BIO 17644779 <GO>}

Okay. Great. So maybe we could shift gears to talk about the HPC cloud, the data center business, which is about 25% of your sales. Obviously, you've had several years of really explosive growth. You had a quarter where it was down 14%, which just it sounds like it's more of the lumpiness of the business. But we've seen this pause elsewhere at other vendors into cloud as well. So can you talk a little bit about what your visibility is into that segment right now and just describe what you're seeing for us?

A - Colette M. Kress {BIO 18297352 <GO>}

Yes. At the end of our Q4, we didn't see some of the deals that we had hoped would close by the end of the quarter to close, which really drove our overall down sequentially in terms of Q4 from the overall data center. So at this time, our visibility is not high as we look forward in the near future. However, we do believe intact are all the key priorities that both the hyperscales as well as enterprises need out of the data center. When we think about those priorities, we're tremendously aligned to them, aligned to them that the slowdown of overall Moore's Law forces them to look at new accelerated compute opportunities. The goal of improving overall AI in terms of what they do is also really key and important. So in the short term, visibility, probably not high. But as we move in terms of in the second half of the year, we do believe that we would restore the overall both visibility as well as the demand that's just in the data center.

Q - Joseph Lawrence Moore {BIO 17644779 <GO>}

And I guess you talked about that being all segments within HPC cloud. You've got high-performance compute. You've got some enterprise business with the GTX family. You've got some cloud exposure. Was it really all those things that sort of simultaneously you saw an acceleration or did anything stand out?

A - Colette M. Kress {BIO 18297352 <GO>}

There are always tremendous great pieces of the data center that have been accelerating quite well over this time. Our experience, for example, in our overall DGX business has been phenomenal over the last year, really helping people take an

end-to-end overall high-end system, incorporating with all the different frameworks for software, as well as a significant amount of compute. It's been kicking off both in terms of work with hyperscales but also key in terms of key parts of the industry. We're seeing this being a key piece in terms of in automotive, We're seeing this being a key piece in terms of in healthcare. But again, in the early stages of the overall enterprises. We're continuing to see the growth in the industry, the growth in the enterprise expanding our excellence that we have already with the hyperscale and in high-performance computing. But remember, the overall hyperscale and high-performance computing is still a majority of our business. And again, given what we've seen in the regular slowdown at this time, we do need them to overall improve to get back into the growth rate sequentially.

Q - Joseph Lawrence Moore {BIO 17644779 <GO>}

Okay. And I guess within really expanding multiple end markets, sort of the deep learning workload is so critical. And it shows up in every one of our surveys as being the fastest-growing workload. And NVIDIA really still at the center of it despite numerous kind of optical threats to the business. I mean, everyone we talk to is still using NVIDIA for training. Is that part of the business also part of the deceleration? And I mean, there's always going to be some lumpiness in that. Is there any particular reason that deep learning as a workload is not -- didn't grow as fast this quarter?

A - Colette M. Kress {BIO 18297352 <GO>}

Deep learning is very, very key to what we see as both the future of data center and growth but also one of the very important workloads that enables what we see in terms of the AI going forward. You're correct. That is still the case in terms of NVIDIA. And most all training that is existing is done in terms of on the NVIDIA architecture. But the piece in terms of not only looking at our overall hardware and the overall performance that we push out with every single architecture that we have. But also the additional work that we continuously do in terms of that software. That software is essential to influencing the performance of what they get out of the deep learning workload, the work that it needs to be in terms of connecting with the different frameworks that are out there that help them. And we are constantly in work, working with the frameworks. But also working in terms of the scale-out and the scale-up for the advancement in terms of the (elements) behind the overall deep learning workload. So you'll see us continue and see this as an important part of our data center, both opportunity in TAM but also a very important part of our overall revenue.

Q - Joseph Lawrence Moore {BIO 17644779 <GO>}

Then the subject of competition always does come up. You have multiple cloud vendors that have talked about ASIC products. Generally more inference than training. But Google has talked about training a little bit. You've got multiple startups that are focused on the opportunity and certainly, Intel and AMD are attacking it as well. How do you think about that competition? And how -- is it CUDA that's sort of the main barrier or is it events like GTC that sort of teach people about how to do machine learning? Or what do you see as critical in terms of maintaining that early lead?

A - Colette M. Kress {BIO 18297352 <GO>}

Yes. So first, when looking at other types of form factors of hardware, whether it be ASICS, the types of ASICS that have come out or other types of overall inferencing products, we still get down to the key most important metric that comes out, which is overall performance. Even when we think about this latest MLPerf benchmark performance contest that went on, clearly NVIDIA, from being able to participate in that in every single category that we chose to enter, we won. And performance, when you think about training, is extremely, extremely key. Most of what we've seen in terms of the hardware that has come to market is not close. They love to comment, they say it's close enough. But reality is when you're thinking about these very, very significant workloads, close enough is not okay. Adding multiple (of them) together is also not actually getting to overall close. So from a hardware performance standpoint, we've just not seen the competitiveness there at all, nor are we seeing it in terms of the overall commercial availability of some of that. But now let's move to the second part of that, which really is talking about the software and the importance from that in terms of the full architecture and the vertical integration. The piece that keeps us in terms of the clear leader is our ability to stitch together everything from the application and the framework down to the overall hardware for specific scenarios that are constantly changing. AI is a field in terms of massive growth. But also mass evolution along there in terms of how things have changed from the beginning, over several years ago, to how they end up doing overall workloads together. People look to NVIDIA for our existing software, including CUDA and all of its overall libraries and stitching together to help them. But also as they enter into new areas, they can continue to program with overall CUDA for those new areas they are doing. We don't see anybody really close to the overall software or even concentrating talking about that from the software. So again, right now we have a very, very strong value proposition in terms of using us end-to-end as it relates to training or as it relates to many of the different workloads that we see in the data center.

Q - Joseph Lawrence Moore {BIO 17644779 <GO>}

Okay. Then we talked about training, which is sort of constructing your own network database. Inference, which is sort of pulling the data from it, is kind of a newer area for you guys. It's traditionally done directly on CPUs. But you've talked about it being significant. I think you made that comment about 10% of HPC cloud. Can you give us a little insight into what you're doing there?

A - Colette M. Kress {BIO 18297352 <GO>}

Yes. We're very excited about the overall inferencing opportunities. We've been very clear on helping them understand that history has said that it's an overall CPU workload. And we are giving now the opportunity to change that given the performance that can be realized using an overall GPU, incorporating what we have in terms of our Tensor cores. Our Tensor cores sit on top of our overall GPU architecture, which allows for multiple precision. As we move in terms of from training to overall imprint, the overall precision of accuracy is necessary for the overall speed of that overall workload. Our Tensor cores and the use of our overall software enables that. We've seen adoption quite quickly both from Google Cloud using it as well as in terms of Baidu that is using it also within their cloud and also in

terms of interim reviews. So we're excited about the initial adoption. And we do know that this is a great, huge opportunity for us in front of us and we think we're very well positioned.

Q - Joseph Lawrence Moore {BIO 17644779 <GO>}

Okay. Great. Then one other growth driver that you've talked about more recently. I was in Munich last year when you introduced RAPIDS, which is a sort of acceleration of more traditional machine learning analytics. Can you talk a little bit about where you are there in terms of creating a revenue opportunity from that?

A - Colette M. Kress {BIO 18297352 <GO>}

So RAPIDS. RAPIDS are our opportunity to address yet another market in data center. We've been working on this from workload to workload in terms of what else now needs to move to an overall accelerated workload. When we think about the enterprises and the amount of work that they spend with their data scientists, their data scientists working in terms of algorithms that is (starting) from a machine learning, whether that be forecasting, whether that be inventory management, a lot of different pieces in there. And how they can use our overall software and our stack to speed up their work in terms of what we think is the overall software platform called RAPIDS. We have begun with many key lighthouse accounts, helping them understand how their data centers are using overall accelerated computing and using machine learning. And we feel we're very well aligned to that. But again, it's a software plug-in to many of the key open-source software that they are using with their data scientists and that's where we came in. We come in with a standard overall hardware performance ability. But now stitching together with the overall key software platforms that they use, we can now bring this and address much of the work that it's doing in terms of machine learning in the enterprise. An enormous market as well. We'll probably talk about this more in terms of our Analyst Day coming up in terms of in March. But this is a great, again, additional expansion that we've seen around data center.

Q - Joseph Lawrence Moore {BIO 17644779 <GO>}

It kind of seems like Jensen sort of talked about it as being as important to some of the original deep learning?

A - Colette M. Kress {BIO 18297352 <GO>}

Absolutely. I mean, deep learning, as you noticed, started with our overall hyperscale. We know the enterprises also have a significant amount of data, data that they are mining every single day to help them with their overall business. Being able to take that to an acceleration for enterprises is very key as well.

Q - Joseph Lawrence Moore {BIO 17644779 <GO>}

Okay. Great. Then can you just talk a little bit about enterprise, bringing deep learning products to enterprise with DGX-1 and DGX-2? What drives that decision to sort of buy hardware in-house versus just using the cloud and what (inaudible) that?

A - Colette M. Kress {BIO 18297352 <GO>}

As we go forward, there is still an opportunity for hyperscalers for internal use for overall cloud development to use both our overall Volta architecture or any other future architecture to incorporate it in terms of their infrastructures and in the self-build (algorithm) infrastructures they need. With DGX, though, it allows the opportunity to say, you have done a tremendous amount of work internally at NVIDIA to establish that complete end-to-end solution in terms of supercomputing. And what can you do in terms of making that available with the enterprises as well? So what we have is we have a full stack of opportunity inside the overall box that allows you to accomplish any type of workload that you need accomplished. So what we've seen is a tremendous growth in terms of overall DGXs, that it's essentially just a plug-in. You have the availability to see all the tremendous software libraries and our connection to cloud Level 2. And you'd probably see a tremendous amount of hybrid environments, where people will have things in the cloud, things in terms of on-premise and the ability to go back and forth between those 2. That's what we see as the opportunity with DGXs.

Q - Joseph Lawrence Moore {BIO 17644779 <GO>}

Okay. So you're not lacking for growth drivers for the HPC cloud business, you're just waiting for the visibility to come back?

A - Colette M. Kress {BIO 18297352 <GO>}

We are. I would say all of our overall opportunities that we had laid out, whether that be training, whether that be inference, whether that be high-performance computing, supercomputing as well as the new advancements that we see in terms of machine learning for the enterprise and more, they are absolutely aligned in terms of those priorities, We're just looking in terms of how we can see the economies of the world improve and the visibility to improve.

Q - Joseph Lawrence Moore {BIO 17644779 <GO>}

Okay. Let me talk a little bit about cars. And then I'll open it up to the audience. Auto is about 5% of your business. But really transitioning away from infotainment towards more of autonomous and ADAS. One of the really interesting recent developments, I thought, was this Level 2+ push that you had at CES, which is you've always come at it in terms of higher end, building fully autonomous prototypes in cars. Now you're offering more ADAS capabilities with kind of what you -- the capabilities that you can turn on over time. Can you just talk about Level 2+ and what that initiative could do for your revenue in the next couple of years?

A - Colette M. Kress {BIO 18297352 <GO>}

Sure. Our work in terms of autonomous platforms, autonomous vehicles, has been extremely an important part of our future in terms of automotive. When we had stepped back several years ago, our thought was that just passenger cars would be the #1 area. But as you've seen, there's also a tremendous effort on overall robotaxis as well and taking things to that Level 4 and Level 5. So what Level 2+ allows you to do is what we've developed in terms of an end-to-end platform for robotaxis or

high-end Level 3, is to start with Level 2 with the same hardware and software that will enable you as you own a car for them to enhance it and move to Level 3 over that period of time. We have been known as the full platform incorporating a software, enabling the overall safety requirements that are necessary to allow them to begin the overall programmability and development process that they need in order to bring these passenger cars in the future, in a year or 2. It's important they have the sampling together now as what we have enabled with overall Xavier being visible now or in their hands now for them to do that overall programming.

Q - Joseph Lawrence Moore {BIO 17644779 <GO>}

It seems like in this space in particular, the technology can get ahead of the regulatory environment a little bit as well. So where you have this capability of doing real autonomy. But you're not really allowed to do so. And it seems like this can get you to revenue quite a bit quicker?

A - Colette M. Kress {BIO 18297352 <GO>}

It may. It may in terms of where the overall car companies want to take this. But keep in mind, the overall safety is #1 concern in terms of the automotive world. When they think about bringing those cars into market, safety is key. That's what we're most excited about, it's the availability of it now so they could continue to work on making sure it is of the utmost safety when they bring this to market. That development time right now is an opportunity for us to work together with the overall car manufacturers. And that's what you see in terms of our business results right now.

Q - Joseph Lawrence Moore {BIO 17644779 <GO>}

Great. Then how should we think about revenue in this automotive segment? Obviously, you've had the infotainment piece kind of flat line there, coming down a little bit. You've had some NRE spending from your customers. Then revenue, it sort of seems like you're starting to get some real revenue sources emerging in the not-too-far-distant future. Can you just talk a little bit about the path to revenue growth?

A - Colette M. Kress {BIO 18297352 <GO>}

Standard infotainment systems have essentially reached probably a commodity level in terms of just the regular overall infotainment systems. You've seen us move to incorporate AI inside the cockpit, inside those overall infotainment systems. Recognizing voice, recognizing overall commands, gestures inside of the car. Our relationship, therefore, with Daimler has been very key in terms of continuing to build on our existing overall infotainment business. You're correct that we are working in terms of partnerships in terms of the development work for them -- car companies to bring autonomous cars to market too. And you see that. All of this is the overall base in terms of what we need to overall grow in terms of in automotive when we see into production in the next couple of years passenger cars more in volume than what we're seeing today.

Q - Joseph Lawrence Moore {BIO 17644779 <GO>}

Okay. Let me pause there and see if we have questions from the audience.

Q - Unidentified Participant

A simple question. A couple of years ago, I had a chance to listen to you, Colette. You mentioned the number of engineers that you have employed at NVIDIA. Can you just bring us up-to-date and give us some idea how you're allocating those resources and what your pace of hiring is?

A - Colette M. Kress {BIO 18297352 <GO>}

Sure. So when we think about the company as a whole, more than 13,000 people that we have employed at NVIDIA, we have a significant amount of R&D and R&D overall engineers. Our overall group is organized essentially across a unified platform. But we have them focused in terms of engineering from the base in terms of an overall hardware and building out the overall hardware architecture and then the overall software that is needed on top of that. There's a small portion in terms of where we specialize for certain workloads, for certain overall markets on top of that. So when we think about our use of resources and how to allocate across, we allocate it across our largest markets that we see in front of us. So when we think about the overall gaming market, when we think about our overall data center and AI, when we think about the future of autonomous vehicles, those are probably some of the key areas that we are focused in terms of allocating additional resources to, to expand those markets and address them from our overall products that we are producing. Our overall growth over this last year in terms of headcount was the largest driver of our overall OpEx increases because most of our cost in terms of OpEx is associated in terms of headcount. When we look at this year in front of us in terms of fiscal year '20, we see that likely to slow down as we look to both absorb the significant amount of investment that we are making today and concentrate it on these key areas of focus (inaudible).

Q - Unidentified Participant

I'm wondering about the Quadro opportunity and professional visualization, especially about the maybe TAM-expanding opportunity on real-time ray tracing? So ray tracing all these diffuse server farms. If you can discuss a little bit the opportunity you think is there because that business, that has been outperforming expectations.

A - Colette M. Kress {BIO 18297352 <GO>}

Yes. So when you look at our pro visualization, which one of our business segments that we haven't talked about. But again, a great business in terms of its growth. Our pro visualization is essentially our workstation for enterprise business. We've been in this business for a long-term time, taking the overall graphics capability, not from a gaming side. But from an overall enterprise side. This has been very key in terms of the overall visual capabilities of any product that has been designed over this period of time to use high-end workstations in their overall design process. We have been seeing what we say a transformation of that business, focused on moving from just a desktop type of workstation to mobility. Okay, the mobility of the workstation allows the overall designer to do their work anywhere, to access their lab in any place. That's been a key driver of the success that we've seen. Additionally, we refer to our success in terms of Max-Q. When you think about what we also love as overall normal desktops or normal notebooks in terms of the enterprise, the workstation

follows that same piece, which says if I can get to thin and light but also high performance, I now have more flexibility to do work in terms of anywhere. So our Max-Q overall workstations over this last year has been rolled out, has been a great overall growth driver of that overall business. So lastly, we refer to overall ray tracing and bringing ray tracing to the enterprise as well. This allows us to speed up a significant amount of work of what it takes in both in the design phase, whether that be in the film industry, whether that be in terms of creating overall catalog growth for them to also process the overall rendering side of that overall picture in a faster amount of time. Rather than spending that time overnight for it to render in the overall server farms, you can actually do that more in terms of real time. Or another way of saying that, we can expand the overall market of ProVis to not only on the workstations to render. But the servers to transform in terms of accelerated use of overall GPUs for that rendering side. This is both an expansion of the market that can help us in ProVis but also help us in terms of our data center and our data center service.

Q - Joseph Lawrence Moore {BIO 17644779 <GO>}

Any other questions?

Q - Unidentified Participant

There have been some reports that at a game developer conference next month, there's going to be some cloud gaming launches from Google. Maybe Microsoft, Apple, Amazon are probably working on it also. Is that a positive or a negative for NVIDIA if gaming shifts from console to the cloud?

A - Colette M. Kress {BIO 18297352 <GO>}

Yes. So the goal of high-end gaming also in the cloud is something that we've been working on for many, many years. It's a hard problem because cloud gaming doesn't just mean the same thing as having a desktop close to you. You have many other factors that are in between you and the overall gaming that is in the overall cloud. Things that we need to focus on in terms of the reliability, the overall latency and the overall performance that a gamer actually has. And this is something that we understand well. We've been in beta with our GeForce now for some time in terms of making sure the performance of what we see is aligned to what we think the high-end gamers would want to do. And when we see others in the market, we know that this is something that they have also communicated. But it's going to be a long time coming. It's a long time coming to figure out that challenge of providing the reliability that somebody would change from the overall desktop to the overall cloud. From our standpoint, it has opened up a huge opportunity for us because we've enabled essentially a significant amount of the Mac users to have the same excitement that the overall PC user has by games that have not been available to them and available in terms of an overall cloud experience. So we'll continue to work on this. We'll bring it to market when we think it is ready. But again, in order to work through the overall infrastructure, the overall business model in the future, we still have a ways to go as an industry as a whole to make that system work.

Q - Joseph Lawrence Moore {BIO 17644779 <GO>}

You obviously still need a GPU in the cloud. Is there any reason to think that you wouldn't do as well with those types of cloud gaming installations as you would do with sort of a retail gaming card?

A - Colette M. Kress {BIO 18297352 <GO>}

Yes. This is something -- an area we understand very well, understanding the gamers and all that you have to do to provide that performance level that they expect. This is right up our alley of years and years of work that we have with our software developers. So we feel absolutely confident that we will continue to work this and make great opportunities as we go forward.

Q - Joseph Lawrence Moore {BIO 17644779 <GO>}

We have time for one more quick question? Okay. Let's just wrap it up there. All right, Colette, thank you very much. We appreciate it.

A - Colette M. Kress {BIO 18297352 <GO>}

Okay. Thank you.