

## Credit Suisse Technology, Media and Telecom Conference

### Company Participants

- Colette M. Kress, Executive VP & CFO

### Other Participants

- John William Pitzer, MD, Global Technology Strategist and Global Technology Sector Head, Credit Suisse AG, Research Division

### Presentation

#### John William Pitzer {BIO 1541792 <GO>}

Good afternoon. Why don't we go ahead and go get started? My name is John Pitzer. I am the U.S. semiconductor analyst here at Credit Suisse. It's my pleasure this afternoon to introduce the fireside keynote chat with Colette Kress, the EVP and CFO of NVIDIA Corporation. We've got about 35, 40 minutes opportunity today to have a fireside chat. We will have some opportunity for Q&A. There will be a mic. So if you have a question, please don't be shy and please just raise your hand. And we'll get you the mic. And with that, Colette, first, thank you for coming.

#### Colette M. Kress {BIO 18297352 <GO>}

Thank you.

#### John William Pitzer {BIO 1541792 <GO>}

Appreciate the support on the conference.

#### Colette M. Kress {BIO 18297352 <GO>}

Absolutely.

### Questions And Answers

#### Q - John William Pitzer {BIO 1541792 <GO>}

In this sort of setting, we've had sort of a 6; to 7-year unprecedented run in the semiconductor industry. And you guys have been right on the top of that unprecedented run. So I'm not sure there's many people in the room that aren't sort of somewhat aware of NVIDIA and what you do. But I always find it kind of nice to

start out a fireside chat by helping to level set everybody in the audience and on the webcast. Maybe you can spend a few minutes just talking about your core IP, the 4 end markets that you try to exploit and maybe in your own words, help to frame sort of the investment opportunity you see at NVIDIA for the audience.

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

Sure. So we're not a startup. We're not a new company. We've been around for probably more than 24 years. We began our business focused on still what we're focused on today. We focus on the GPU. The GPU stands for graphics processing unit. And we found an application for graphics like no other, which was gaming. So in our early days, we were known within the PC platform and known in terms of the high-end video card that would enable some of the high-end gaming. But a lot has transformed over that period of time and particularly probably over the last 10 years. We continue to look for other opportunities for the GPU in terms of other platforms, other key use cases, because it is such a unique processor. It's probably one of the most complex processors that is out there. But what gives it its overall complexity is its overall ability to do parallel processing. The overall graphics is key. It's still a very big part of our business. We use it in 2 of our key market platforms, including our gaming business, including our pro visualization. Our pro visualization takes graphics to the world of the enterprise, enterprises that focus on building buildings, focusing on designing products, focusing on high-end graphics that is necessary there. But we looked for other platforms that don't necessarily focus only on graphics and focused on moving this in terms of its compute capabilities and its compute capabilities in every type of device. What is key and front and center right now is the devices that run much of our data center and much of our significant amount of compute in the world today. But what we've expanded in terms of not just overall doing in terms of compute functions, compute functions that started in terms of high-performance computing but starting in terms of the new era that's in front of us, which is probably artificial intelligence. Now that was a meeting of the togetherness, the togetherness of a GPU, its overall parallel and significant processing power and the new way to approach AI in the decades in front of us, a new way that really doesn't look in terms of writing software line by software line but actually letting the software write itself. If we can put a significant amount of data together in (inaudible) and using the overall processor to process it, we can probably infer what is necessary for artificial intelligence. So we branched out many years ago to focus on this field, to focus on using a GPU. And it has taken us to where we are now. We've defined these 4 markets, gaming, pro vis, data center and automotive, based on both their complexity and their uniqueness such that a GPU is most well engineered for them to overall be successful. So those are our 4 businesses and where we are today. Each one of them are growing overall platforms. We have growth across all 4 of them. It's unique to be in a position that our core market of gaming is still a very important growth opportunity for us, allowing us the investments in terms of the other businesses that we are building. Our automotive business is really an adjacency to our overall data center business because we are taking that same technology, that same focus of artificial intelligence and applying that to the future of self-driving cars and autonomous. We believe that is an AI problem in front of us. And we're here to solve it using the overall work that we have done with the data center as well. So our investments today, our investments in terms of building the future are really about continuing to focus on our gaming business, continuing to

build out and democratizing AI for all and also focus on self-driving cars as we move forward.

**Q - John William Pitzer** {BIO 1541792 <GO>}

That's a very helpful setting. Clearly, when I talk to investors about NVIDIA, the most interest/focus is within the data center and the growth opportunity there. And as you look over the data, it's just been tremendous. Over the last three years, you've grown the business from a \$200 million a year run rate to now something eclipsing \$2 billion. So it's a tenfold increase. The first question, I think, a lot of investors are struggling to try to answer is, what is the ultimate TAM here? And I know earlier this year at your Analyst Day, you kind of talked about a \$30 billion TAM. And I think that consisted about \$4 billion of your traditional HPC, \$11 billion of training and sort of \$15 billion of inference. Can you help us understand some of the science behind that number? Because to me, we've got to start somewhere. But a couple of weeks ago at Supercompute '17, I think Jensen in his keynote talked about the opportunity for AI to be perhaps part of 70% of all workloads going forward. And that, I kind of agree with. But it also kind of means it could be much larger than \$30 billion TAM. So what's the science behind trying to size the TAM?

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

Yes. It's a really good question of being able to size an opportunity of a new era that will probably be with us for 10 to 20 years. And when you think about what we're trying to accomplish with AI and now is probably what is feasible, it's probably not the right calculation to look at what the computing environment has been over the last 10 to 15 years and indicate that the use of a GPU now is a zero-sum game where the GPU will benefit and something will lose, okay? The reality is we're looking at things forming in the data center that haven't been there before, things that will now be transformed to where humans were doing it in a manual method that we can actually use computing and use AI to get it done. That's why the numbers can be extremely large. And that's why it actually is a policy if you actually started with what we know in terms of an installed base and backing into what the overall size of the GPU could be in terms of data center. So what we have done and consistently tried to view it as to say, what are we seeing today? What are we seeing today in terms of GPUs that are entering into the market not from an overall unit perspective or a unit perspective as the size of everything else that is there. But how much compute are we enabling? How much compute with the size of GPUs and the performance that they can do are we enabling? And how can we extract that forward as in -- and as an extension of today to what is maybe possible in terms of going forward? A best indication in terms of how we think this will be will be a continuation of some of the things that we are seeing today. That forces us to make assumptions in terms of both the continued expertise that we have in GPUs and improving their performance, looking in terms of how much value we will be providing to enterprises, to cloud service providers, such that we can continue to maintain our growth in this business and also maintain continued investment back into the business to build the next set of things that we are doing. So that's what the basis of our \$30 billion market was. It aligns also to Jensen's belief in terms of how many and what percentage of our workloads in the data center will probably be AI-enabled. The only question that we can't fill in is the time that it's going to take to get there.

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**Q - John William Pitzer {BIO 1541792 <GO>}**

That's helpful explanation. I think the other kind of question I get, especially from the naysayers, is that the GPU was -- has clearly dominated the AI space today. But from an architectural perspective, it's the best thing that the world has today but not necessarily the best thing. And there's clearly an architectural debate about what's the best way to do AI. Is it a GPU? Is it an FPGA? Is it an ASIC? We're finally starting to see venture capital money come back into the semi space and actually start to fund new startups like Graphcore and Cerberus. Help us understand how you think about the architectural debate because you're clearly been very sort of an evangelist on GPU. And you're still sticking with that as kind of the sole architecture.

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

Yes. So there's a couple of reasons why in terms of our focus because it's not necessarily just focused in the case of the focus of the hardware. We do believe the GPU is a collection of multiple ASICs altogether that allows any individual to come in for any type of AI workload that they may consider, that a GPU is perfectly well suited in order to do that. We're in such the early stages that we want the ability for them to get moving and to get started quite quickly and their ability to find that within a GPU for each and every one of the workloads that they may want to do. We're seeing 3 major sources of data that form workloads for AI focused on video, focusing on imaging and certainly focused on natural language processing and the many different forms of that. So if we have all of those capabilities within the GPU, that's great. One of the things though that makes us quite unique from many of the other types of focus areas on different forms of silicon is to focus in terms of the computing language, a piece of hardware without an ability to develop on top of it. Ability to write instruction sets to it doesn't serve its vast purpose of what it could be possible. We have focused more than 10 to 12 years on a computing language or CUDA development language. It is now used by more than 650,000 developers in the world over 10 years. We're seeing downloads of CUDA probably close to 2 million a year in terms of our current run rate. So the reality is you have the best-of-breed in terms of a processor that can accomplish. But probably what is most informative is a development platform that is unified across each and every single one of our GPUs. It's available everywhere. And people know how to use it. And its overall goal is to be cohesive with the overall AI frameworks that are out there, not just one framework. But all, in order to improve the overall capabilities of those frameworks and overall improve and enhance in terms of AI. If we can keep that consistency, we've done our part to democratize AI as best as we can for the masses, for the enterprises that want to get started that don't have the ability and the time to market to do anything specialized. You can get started. And the significant amount of time savings, which equates to value savings for them, is immediate. And that's what we're seeing right now. You've seen a significant evolution in terms of the infrastructures from what you saw maybe 10 to 15 years ago. Enterprises probably would have gone and self-built a cluster inside one of those data centers to say, "I'm supposed to get started with AI." Right now, all they have to do is go into the cloud, which one is their favorite cloud service provider and get an instance using an overall GPU, supporting each and every framework that is out there. We've enabled it. So within probably a matter of 15 minutes, you're ready to go.

**Q - John William Pitzer {BIO 1541792 <GO>}**

Colette, the other perspective I get, I'm sure you've heard it as well, is that the GPU seems particularly well positioned for the training market. But the inference market, which by your own TAM definition is a larger market, the perception is that's a good enough market. And I think when it comes to NVIDIA, I think the investment community has the perception you do really well on the hard stuff. And the good enough stuff, we should leave to something else. How do you view your sort of competitive position with the GPU and imprint? And I know last quarter, you actually started to ramp new inference products into the marketplace. So maybe you can give us some anecdotal evidence of how the ramp is going.

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

Sure. So let's first start back that, yes, training is a more complex horsepower needing a significant amount more performance overall get done. When you think about the overall inferencing market, what we're talking about is that incremental data. You've already trained your initial data, you're looking at the incremental data that's coming in and that needs to be processed in the same manner that you had in terms of the training. A lot of this can be done in terms of on the edge or can be done in terms of the data center. Existing today, you're right, most of that is more simplistic and has been done or isn't owned by the GPU at all and is done by other different form factors in the market. But if we move forward and if we think about the complexity of AI, the inferencing also does get complex. The inferencing will continue to be a multiple step process. Different than the inferencing of yesterday, the inferencing of the future will probably just be just as complex. When we think of probably one of the most important inferencing pieces as we go forward is automotive, okay? The car is going to need to be able to process while on the road. It doesn't have the ability to just continuously go back to the data center (inaudible) announcer. It's going to pick up new information along the way. We've continued to find the right form factors, obviously, for automotive but also the complexity of the supercomputer that's going to be necessary in that form of inferencing. So today, inferencing is a very small portion, a very small portion of our business. But we probably have more than 1,200 different companies that are focusing on using inferences, also for the synergistics of using it for the overall training environment. But also the ability in terms of us to improve the throughput in terms of what we're seeing with our new inferencing products. We have products both in our Pascal line, the P4 and the P40, as well as new capability in terms of Tensor Core, which allows multiple precision. Multiple precision really says at an inferencing, "Can I quickly get to the answer without getting to the X amount of digits afterwards to actually infer what the overall answer would be?" So we've done great progress. We have a great excitement on that and more to probably come in the next quarters.

**Q - John William Pitzer {BIO 1541792 <GO>}**

Well going back to your definition of the inference TAM being \$15 billion. And I know that's a best guess today, do you believe that your inferencing portfolio will be able to address all of that? Or are you only going to go after the portion of the inference market, which is sort of the harder part of the market. And leave the more commodity part to other architectures?

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

Yes. Absolutely. A lot of people confuse in terms of inferencing and in terms of IoT devices or simplistic devices to be part of that overall TAM. We will really concentrate in terms of high-end devices, stand-alone devices that are going to need that significant amount of inferencing. Robotics overall manufacturing in terms of on the edge, these are examples of where you will probably see inferencing front and center and that we will focus on.

**Q - John William Pitzer {BIO 1541792 <GO>}**

You mentioned TensorFlow earlier. And clearly, you're starting to ramp your new Volta product. One of the questions that I get asked very often is you've been a GPU-centric architecture, (UP)-only architecture. Volta's clearly a significant improvement over the Pascal family. What investors kind of asked me. And I don't have great answer for, is, to what extent is Volta better than Pascal because of what you've been able to do with the GPU transistors versus the TensorFlow? And is the move to TensorFlow sort of a tacit admission that maybe it's not an all-GPU world out there?

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

So when we moved to our Volta architecture. And we currently have the Volta 100, we actually enabled probably a 10x improvement in terms of what we had in terms of our Pascal architecture. That is a significant improvement that has driven excitement both from a demand on applications used in service, cloud service providers for internal apps. But also what they may be enable in terms of the cloud. Now what we put into place with Tensor Core, Tensor Core was that piece that also allows the overall inferencing capabilities. So we have spent both times in terms of improving that overall hardware and the capability but also a significant amount of software. We, as a company, have really moved to where we probably have a higher percentage of software engineers than we do hardware engineers. Our focus as we go forward is continue to think about that software layer as it's enabling certain parts of the industry, certain parts of workloads. Tensor Core is the immediate work in terms of what you've seen over the last couple of years of us coming together to think about the inferencing, to think about the dual capability of a GPU to do training and inferencing together. More and more work is being done on CUDA, being done on CUDA in terms of libraries and work in terms of all of those frameworks in terms of the software. So although Volta is an architectural change, an architectural change that allows us both to focus on the nodes and focus also on different types of parts of the design to improve performance, there is still a substantial amount of software work that we are doing and doing consistently across all of our platforms to hold that together.

**Q - John William Pitzer {BIO 1541792 <GO>}**

Maybe you can elaborate on that a little bit. You mentioned CUDA. And clearly, you guys have been evangelizing CUDA for over a decade. And it's created a good moat for you here in the near term. I think there's some skepticism about how sustainable that moat is. And the other question I would ask, is there a first movers advantage also in this space? And I look at the announcement you made earlier this week with GE and your partnership there on the health care side. Is there increasingly a domain

expertise that becomes a barrier to entry as you work with these customers and specific industry verticals around AI?

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

So the overall development of CUDA, you're correct. A multiple year, we are on version 9. And we come out with a very consistent cadence of that. We come out with new features. We come out with new capabilities. And we are consistently working with those that use CUDA to take those suggestions and make sure we've incorporated in there. So when we think about that value add, there is no one else in the ecosystem of what we're doing from a GPU to AI that is covering that. Nobody is covering CUDA. We cover CUDA. We are enabling that complete middleware and focusing on that. So I think that will be a standing asset that we have going forward. Now when we think about the industry specifics, we did have to move to industry specific, for example, for automotive. Automotive is very industry specific in terms of the knowledge and the understanding of both understanding just maps and high-definition maps as well as what is going to be necessary to get the car to drive by itself. Each of those industries is where we are reinvesting back into the business, where areas that we think we move fast, where we feel it's a very, very challenging problem that we can focus on. If we've enabled a platform and a software for everyone for those that allows us the ability to focus and specialize on very important markets that we want to, health care is one of them. I think health care, we look at in the same manner of automotive. If we can save lives, if we can improve the overall safety in automotive and if we can improve some of the solving of tough problems, that fits both of our overall needs as a company, both of serving the community but also accomplishing a hard problem.

**Q - John William Pitzer** {BIO 1541792 <GO>}

Given the TAM opportunity here over time, it seems almost a little bit silly to focus too much on the near term. But you've dealt with investors long enough to realize that we focus on the silly stuff. You had what you called or characterized as a transitional quarter in data center in your July quarter, which was the quarter where you introduced Volta. And I find it odd given how strong the year-over-year growth was that you would call that transitional. But it was a quarter we only grew 2% sequentially. This most recent quarter, you reported data center growth reaccelerated on a sequential basis to 20%. And you characterized on the call that you're still in the early stages of the Volta ramp. And so help us understand how we should think about kind of the sequential growth from here. And given where we are in the Volta rollout, is there a tailwind that, that should increase the confidence of sequential growth in that business?

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

Sure. So when we launched Volta, we launched Volta at our May GTC in San Jose. That was an opportunity to bring to world a tremendous overall product. And when we launched it, there was a tremendous amount of excitement around it. Folks could not help to focus on the 10x improvement in terms of overall Pascal. But our launch, as we knew, was still a process of, yes, it's launched. We actually have to get samples to customers. Samples actually have to qualify that in terms of their infrastructure and give it a good test drive. So when we finished our Q2, we were extremely pleased

with our results of the overall company as a whole as we moved from about a 15-day into the quarter to a quarter where we had a material amount of our data center business on Volta. That means from launching samples, qualification, shipping and working through, we met that goal. So we're extremely pleased. But yes, that's why we called it a transition overall quarter. So we started the beginning of Q3, what we referred to as full production in terms of Volta. We were ready to go. But I want everybody to understand that this is still an enterprise product. Enterprise products are not stop on the way home, pick one up, put it into your infrastructure the next day. It can take anywhere from a couple months to 18 months in terms of qualification in full and in terms of the size of projects that they may be working. So we have many people, many of our CSPs around the world that we are working with that have all endorsed and are all working in terms of the qualification of Volta. Some already have it in terms of their cloud up and running. And some of them are working fast and feverishly to do so. So we're in full production. We still have a ways to go in terms of the qualifications. But I think nothing takes away from the standpoint that we still think this is a huge opportunity in front of us. And it's an opportunity for us to capture with the overall platforms that we have.

**Q - John William Pitzer {BIO 1541792 <GO>}**

The best endorsement for GPU as a viable architecture in the data center has been your own revenue growth. That said, Intel recently made an interesting hire, bringing onboard the ex-head of the Radeon graphics business at AMD, which is, clearly, I think, an admission that GPUs are taking share in the data center and that perhaps their own internal efforts are kind of behind where they should be. How do you think about the competitive environment from here, both with Intel and AMD, specifically on the GPU architecture inside of the data center?

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

Yes. So when we think about the work that we have done with GPUs, particularly in the data center, it is not a short amount of piece of work. It is not a 6-month cycle that we can come back and say, "We now have the software available. And we're ready to go." It is not even about a single person in terms of it. The teams of people that we have focused on our data center that are either focused on certain frameworks, focused on certain libraries, focused in terms of CUDA, that seamlessly keep it all together is a major, major effort. So I think for the many years that people focused on a good enough. And we continue to focus on the better use of more performance coming out of a GPU, has served us quite well. So I think there is a lot of focus. I think there's a lot of focus of people wanting to be a part of AI. And I think it will be large enough that there will be several different players in there. But we are focused in terms of how quickly we can establish our platform, enable others. Not only are we enabling our platform out for others, we are spending a significant amount of time teaching others. We've learned a lot in terms of our years of focusing on this, on how to do deep learning in terms of how, in terms of the code. And with each of our GTCs and then some, we continued to teach deep learning, which that is something that I don't think anyone of our competitors can really talk about. We are looked at in terms of how can you help us move forward. We're pleased with that endorsement. And we take it seriously. And I think it will benefit us going forward.



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**Q - John William Pitzer {BIO 1541792 <GO>}**

But my last question on the data center before moving on into gaming, I know that you as a company don't necessarily focus or at least communicate to the investor community around an ASP dynamic. But clearly, when you look at what's happening in your data center business around ASPs, you're bringing incremental value. And it's performance-driven ASPs. But ASPs have been moving up pretty significantly. And you can see a path for that to continue. I think one of the concerns some investors had is that those rising ASPs are helping to fuel some of the innovation outside of GPUs. And so you look at what Google's been doing with the TPU and some of the statements they've made around how that's significantly lowered the cost of doing AI. How do you think about the pricing environment in the data center market over a 3; to 5-year period? And can you differentiate between sort of the deep -- the training part of the market and the inference part of the market?

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

Yes. So when we think about overall pricing and when we think about what we are overall delivering, the first calculation that we are working with in terms of customers is what we're going to save them in terms of if they moved to an AI world, there is a significant amount of not just infrastructure costs that change because what you have is you have a GPU-enabled server that can replace a significant amount of regular CPU type of servers. If that is the case, that's a significant savings on their part. But there's also a peripheral around that in terms of the operations cost of running that and also the overall improvement in terms of having that readily available information. So our overall thoughts in terms of pricing is really about the savings that they achieve in terms of they receive so much significant savings as well as our pricing is really focused on the years of development, the years of CUDA, the years of design in terms of the GPUs incorporated in that. So it's kind of a meeting in terms of the middle of that. In the same manner, in terms of where we have in terms of gaming, we want a gamer to feel at every single time that they are coming to market to buy a new GPU, that they're getting more performance since the last time they came to the market for each dollar that they spend. And we're consistently doing that, which means the performance, the infrastructure is extremely important. And our innovation in GPUs is extremely important for us to maintain what we have in terms of there. So so far, that is our model. Now when we think about in terms of training versus inference, those are 2 different types of things in terms of what is necessary. Training is going to need a little bit more performance. That little bit more performance is going to command likely a higher overall price, again, just based on the overall success that we are enabling them in terms of improving their workloads. Inferencing may be more of a volume types of things. We will probably get to much different in terms of price point that we will have in terms of inferencing versus our overall training. And again, we'll gear that just based on what are we saving them? What is that overall TCO improvement that they will receive?

**Q - John William Pitzer {BIO 1541792 <GO>}**

Let's segue into the gaming part of the market, which is actually your largest single business at about 60% of revenue. And despite all the attention and excitement around the data center, if you just look at yourself as a stand-alone gaming company, you're still the fastest-growing semiconductor company over the last 3 to four years.

You've been able to grow this business at about a 20% CAGR, talking about the incremental performance you're bringing to your customer every year and their ability to pay up. But the question that I have is I think the last time you updated us as far as the Pascal ramp and penetration was at the Analyst Day when you said it was about 15% penetrated. We've now had 2 fairly strong gaming quarters both in July and the October quarter. Can you talk a little bit about where we are on that penetration today? And how do we think about sort of the ASP uplift of Pascal from here for the business?

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

Sure. So if you think about our success in terms of gaming, you do come down to 2 simplistic parts that says, "There must be a unit increase. There must be an increase in terms of overall ASPs." Of course. But it's actually a little bit more involved in terms of those pieces. One, when we think about the overall unit growth that we have seen, our unit growth is really focused on the overall growth in terms of the market as a whole. Gaming over this period of time has changed significantly. It's changed in terms of a sport that you would play with your computer. You would play by yourself. It was probably mostly male-dominated. It was probably mostly 18 to 25 year olds. Right now, it is both genders. It has moved to younger, probably starting at teenagers. And they've gotten older. They're probably 40 years old or older in terms of (inaudible).

**Q - John William Pitzer** {BIO 1541792 <GO>}

People in this room probably.

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

They're starting younger and they're staying longer in terms of that. But also most importantly is it's a social platform. It's not all just about the game. It's about the socialization that is involved with it. That is staying with your friends. You've moved to an entertainment business. You've moved from -- away from the television. You've moved to gaming, not gaming yourself but, believe it or not, you just watch others game. And that has become a significant part of this industry. So there are just more gamers. There are more that are participating in there through and through, every part of the world, every age, every gender. But then secondly, when you think about the overall price, when you have this large of an overall industry, we tend to try and move to where we have a gaming product for each and every one, depending on what your price point that you want to spend. We want to enable all. So we have many different cards, \$100, \$1,000. Generally, as you get older, the discretionary income may overall improve that you may be able to do. Additionally, you may just want the right gear to be seen in terms of your entertainment (for it) in terms of what you're doing. So we've been able to both benefit from the higher production value of games that need a higher GPU. We've been able to benefit from the overall entertainment. But I think it's important to understand that gaming has also transitioned or transformed quite a bit over the last 10 years from what I've seen.

**Q - John William Pitzer** {BIO 1541792 <GO>}

One of the themes you didn't bring up. And I asked you on stage last year. And I know it's difficult to track within your gaming business. But how do you think about the impact of AR, VR longer term onto the size of the market? And are you getting better at being able to track what's going into an AR, VR application versus more of a pure gaming application?

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

Sure. So at the same time that we can talk about what we've seen right now in gaming, we can get just as excited about what's in front of us. Gaming is still a tremendously healthy type of business. We know that the focus in terms of on AR and VR, which makes things more and more realistic, makes it even a better platform going forward. But it's a little bit of a Catch-22. The content is important. The applications is important. And we have done our role in terms of serving up the overall innovation in terms of to enable VR. And just as we do with the overall high-end games, we focus on all the VR players that are out there in terms of the content, in terms of what we can do to enable their success in terms of the market. So we still believe that is a next generation, not only for the gaming market but likely for enterprise as well. Enterprise has a great need for using virtual reality and/or AR in many of their different types of resources.

**Q - John William Pitzer** {BIO 1541792 <GO>}

A couple of near-term questions on the gaming business that kind of originated out of the quarter you just reported. Again, if The Street assumes that data center continues to grow sequentially. And it looks at your full guidance for the January quarter, it does imply potentially a gaming business, which is down a lot more than seasonal. Help us understand the dynamic with the switch versus the pure gaming? And was that the intent? Or is there a level of conservatism there?

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

Yes. So we didn't provide guidance down at the business level, at the segment level. We provided a growth rate sequentially on total. There's many different scenarios that may come out. We have as much visibility as most, as we do have market leaderships in many of these. But our goal is to make sure we get the total number right. Then we work through in terms of all the different scenarios. And any one of those may happen. Looking back in terms of seasonally, I think the seasonality that we have seen in gaming is essentially H2 is bigger than H1, okay? That I can safely say is the seasonality. That tends to be -- rides a lot of holiday, a lot of buying season associated with that. That also seems to be the time in terms of great games come out, too. So we'll see how this pans out. But there was nothing materially that was thought in terms of our guidance of trying to make any statements otherwise, other than, yes, we'll probably grow in total sequentially.

**Q - John William Pitzer** {BIO 1541792 <GO>}

And specifically to Switch, how do we think about the product growth from here?

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

Yes. I mean, Switch has been a tremendously successful product. We're very pleased both with our partnership with Nintendo, the success, the vision that they had, the work that we've jointly done together to make that a successful product. And we wish them the best. There's nothing more that we can say in terms of what we'd see in terms of Switch going forward, as we will work in terms of the partnership with Nintendo in terms of what they say. But again, we couldn't be more pleased in terms of the success.

**Q - John William Pitzer {BIO 1541792 <GO>}**

The other thing that I think was a little bit different about the October quarter relative to gaming, correct me if I'm wrong, I think it was the first time that you had mentioned cryptocurrency as being partly driven by -- that's partly driving the gaming side of the business. If you look at it historically, it's been in the OEM business. I think it was down almost 50% sequentially in the OEM portion. But you did say that some of that crypto demand was made up for in gaming. Can you quantify that? I know it's not easy. And I guess, the more important longer-term question with Bitcoin hitting \$11,000 earlier today, what's the longevity of that business? I know that you guys have been very conservative about thinking about it longer term. But on the last conference call, Jensen talked about perhaps this being -- having more legs or more sustainability than I think I've heard you guys talk about in the past. Did I misinterpret that? Or is that how you feel?

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

So in the last 2 quarters, we've been relatively consistent about cryptocurrency and our general point of view. In Q2 is when we started to create boards specifically for cryptocurrency that we classify in our OEM business. Now keep in mind, what that means is these are boards that can be done for compute, okay, meaning they do not have any graphics capabilities so they can't be used for overall gaming. And the reason we did this is we wanted to make sure that we supplied the overall cards that we needed to our gamers, because that is our very important strategic importance that we did. However, in certain times, if there is not the overall availability and/or if price of Ethereum reaches high levels, there's a fairly good return on investment by buying a high-end card. There could be a good return on investment that says, "I could actually buy a higher-end game. I can actually do gaming and mining at the same time if I was doing that." So you're correct, there probably is some residual amount or some small amount in terms of that. And that's not something that we can visibly see, we can visibly count in (inaudible) there. We do believe the majority does reside in terms of our overall crypto card, which is the size of about \$150 million in Q2 and met our expectations in terms of Q3, that we thought it would be more residual and most probably closer to (inaudible). There is a tail right now in terms of the current cryptocurrencies that we see. We've probably reached in terms of its peak in the past. But that doesn't mean it goes away. Or another way of looking at this is it has some unique market dynamics to it. There is a desire for cryptocurrency out there. Whether or not people agree that it will exist (inaudible) there is a desire. We have the ability to serve that market. We can create a GPU quite easily for this market. And it can work out very well for us if we can do that for them. So we'll participate from that being easy. But I don't think we believe it has a tail to it or a full market but rather some tendencies. And we'll just have to see where this goes, meaning this may not be the last currency that we see.

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**Q - John William Pitzer {BIO 1541792 <GO>}**

Colette, my last question focuses more on the auto business. And if you look, I think last quarter was the slowest year-over-year growth, still strong year-over-year, yes. But the slowest we've seen in a while. And I know that's a business that's a little bit in transformation for you because you were focused mainly on the infotainment side of the business. I know you've sort of redirected head count and R&D resources to focus more on advanced ADAS, Level 3, Level 4, Level 5, which is a huge market opportunity. I do get asked from time to time though, as we think about the bridge between the infotainment business today and when advanced data 3, 4 and 5 really begin to take off, should we be concerned of revenue weakness? Or do you think you've kind of planned the revenue growth from that business appropriately?

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

Yes. So let me kind of expand on that. So we have been with the automotive industry for more than 10 years in terms of focus. I think that gives us tremendous credibility and understanding in terms of how that business works. We entered that market focused on infotainment systems. Infotainment systems at the time came out in terms of premium lines of cars and premium infotainment systems. And this is where we concentrate on. We will probably see an evolution of those that says they'll move from just a touch screen right now in terms of premium, where they will probably be AI-enabled as well, meaning you may bring in voice recognition quite a bit in terms of infotainment. And that's an area that we would like to be part of as well. But it doesn't mean that we would focus in terms of the mass market of infotainment because I think we see right now, infotainment cars have probably reached a commodity, that they're available at all. Therefore, we're not here to really use our technology and resources down to that mass market. We usually stay where that visual computing piece is extremely important and/or we can add in, in terms of the AI. But we are in terms of this transition as we focus on autonomous driving. A harder problem than infotainment, taking a significant amount of resources and a significant amount of time also with the automotive companies. They've honed in though on a time frame where they think they will be ready to go in terms of them keeping a balance in terms of everybody else. You're probably looking about 2020 or 2021, where they will be out and available with the production. That does not mean the full fleet. That probably means to set or part in terms of their fleet or it can mean in terms of overall pilots. But from now until then, that is continued work with them. That work may evolve in terms of development services for them. It may involve some other things. It may involve in terms of releasing piloted development platforms for them. That's what we'll be there. But I do believe our infotainment system will probably be consistent with our overall automotive industry as a whole. And we'll think about this overall development platforms on top of it before we get to the actual platforms that will be inside a car in 2020, 2021.

**Q - John William Pitzer {BIO 1541792 <GO>}**

Fantastic. I think we've run out of time in this session. But I really want to thank Colette and everyone for joining me this afternoon. This was very helpful. Thank you very much.

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

Great. Thank you.

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