

## Company Participants

- Anurag Rana, Senior Technology Analyst
- Stacy Crook, Research Director, IoT Ecosystem and Trends Research Practice

## Presentation

### Anurag Rana {BIO 7440273 <GO>}

Good morning, everyone. My name is Anurag Rana. Welcome to the 2018 Internet of Things Overview with Bloomberg Intelligence. Just some notes, today's presentation will be recorded and available for playback. You can access the replay via the link sent to you in the e-mail from Bloomberg Webinars. At the bottom of the slide window, you can adjust the volume and maximize your screen, ask a question by submitting one to the right of the slides, we will address questions at the conclusion of the presentation. A copy of the slides will be distributed in a post-event e-mail.

Just a word about our speakers today. Our guest speaker is Stacy Crook from IDC. She specializes in the IoT area, and I'll be moderating most of the panel.

A quick word about Bloomberg Intelligence. Bloomberg Intelligence provides in-depth research and data on industries, companies, as well as government ESG credit and litigation factors that can impact business decisions. We cover about 135 plus industries, close to 1,800 plus companies, and we have about 300 plus third-party data providers that we work with. And we also have about close to 300 people that are part of our team and BI is exclusively provided to clients to subscribe to the Bloomberg Terminal and can be accessed via BI GO.

With that, let me pass over the presentation to Stacy, who will take us and give us a strong overview of the IoT market.

### Stacy Crook {BIO 18685239 <GO>}

Thanks, Anurag. Hi, everybody, thanks again for joining us today. So, my name is Stacy Crook, and I'm a Research Director with IDC's Internet of Things Ecosystem and Trends Research Practice. The IoT Ecosystem and Trends Research Practice is IDC's umbrella program for IoT that looks at the market holistically and really looks to understand how the IoT ecosystem is evolving. But I also do a lot of work, looking at the IoT platform space in particular, so we will dive into some specifics on that segment of the market today after we sort of go through an overview of what's happening in the industry.

So in terms of the agenda today, we'll again sort of take a look at the big picture for IoT in 2018. We'll put some numbers around it, so we'll look at the worldwide IoT

opportunity, we'll also look at the IoT vendor landscape from a macro perspective, and then we'll dive into the IoT platform market, specifically.

So I talked about this idea of IoT being an ecosystem, and the reason that we need to think about it from an ecosystem perspective is the fact that there is a complex set of technologies and services required to make this happen. So, we think about IoT from an enterprise perspective, think about all the decisions that they have to make, right. You first have to think about what are the things that we want to connect and those things could be anything from a chipset to a module to an industrial assets to a consumer device or consumer goods, such as a refrigerator. Then we have to think about what kind of connectivity do we need and there's a lot of options there as well, everything ranging from cellular to some of the new low power wide area technologies, to WiFi, to satellite, to even fixed connectivity is still very much part of our IoT implementations.

Then we need to think about the infrastructure that's going to support that implementation, so this could include things like gateways and routers and other pieces of equipment that we need. Then we have to think about the software components of the stack. The IoT platform will help us to build and manage applications, as well as managing the devices themselves and you have to think about how are we going to gain intelligence from our data, so there is an analytics layer that goes into this. And then also there will be IoT specific applications that are oriented towards horizontal and vertical use cases.

And then we have to think about how do we bring this all together, so we see IT services providers as playing an important role in this ecosystem from a consulting perspective, from an implementation perspective, providing managed services, support services, so we really need them to be this kind of glue that can help us tie these solutions together.

And then we have to think about security and that really has to be considered holistically across this entire stack. So there is really a lot that organizations have to think about when they're looking to deploy IoT technology.

If we think about some of the key themes that we're seeing in 2018, we find that budgets are starting to be earmarked for IoT projects and often this is happening within the scope of broader digital transformation initiatives. We do a survey every single year where we ask close to 4,000 IT decision makers worldwide about their plans for IoT. And, in 2016, we found that 30 something percent of organizations had a budget in place for IoT projects. When we did the same survey in 2017 that percentage had jumped about too close to 70%. So that is a huge spike in one year and it really shows that organizations are starting to take this seriously.

We also find that the market opportunity is increasingly becoming used-case driven and, therefore, vendors are sort of narrowing their strategies to become more focused on various vertical industries and various use cases that support the needs of that industry. We're finding that organizations aren't necessarily seeking out IoT

technology, in some cases some verticals don't even refer to it as IoT but they're really looking for IoT technology to support certain business call.

We see that cloud is the underlying enabling capability to IoT success, because it's going to give us that scale, but increasingly we understand that the EDGE is also taking on additional significance. And we talk about the EDGE, it is this capability to compute closer to the source of data generation.

Analytics and artificial intelligence are really at the forefront of the discussion. Today, you go to any technology conferences and all you hear about is AI, AI, AI, but when we talk about IoT it's really important to remember that there is other building blocks that have to be in place before we can start applying any type of advanced analytics on our data. We need to have the right connectivity, we need to be able to manage our devices so that we are getting reliable data from them and we have to make sure that our implementations are secure from holistic perspective. We also see that there is an increasing acknowledgement of these skill shortage and that this is holding back IoT projects today.

When we think about some of the drivers and inhibitors for IoT investments. So we touched on some of these challenges, but again in our survey every single year security comes up as the number one inhibitor to IoT projects. We're really increasing our potential attack surface by quite a bit when we extend out beyond the traditional sort of IT perimeter, so we kind of went from the traditional IT perimeter, then mobile devices, and now as we imagine the IoT perimeter, we're just really, really increasing that surface area by a multitude.

Costs are always the second challenge to these projects when we think about an IoT project. Again, there's a lot of piece parts that go into it. There is going to be a lot of services that has to go into it as well. So there's a lot of upfront costs, but then when we think about the ongoing cost, the connectivity as a part of this, right. So usually there is going to be something, an ongoing costs related to the connectivity as well as just the usual ongoing costs that are part of any kind of an IT project.

Privacy concerns are definitely being raised to the forefront with IoT when we think about retail and the strategies to put beacons that can track our location when we are in the store tracking perhaps demographics about who we are. These things are - bring up real privacy concerns. There is concern about technology stability and capabilities, and I think that we're getting to a point in 2018 where there is becoming more stability around that technology, but still we are talking about an emerging space and so it is a significant concern.

And, finally, we talked about the lack of skills and this is a challenge, there is a lack of skills in terms of some of the embedded technologies that we need, there is a lack of skills in terms of how do you bring the solution together, there is a lack of skills on the analytics and data science side, and you really need all of this to bring those solutions to market.

In terms of the drivers, there is meaningful drivers in place here and that's why despite the challenges organizations are planning to move forward with these initiatives. So there is the opportunity to improve business productivity when we think about this from, say, a manufacturing perspective, we could do dynamic scheduling in our factory, predictive quality, more automation within the factory, the ability to reduce costs. We think about Smart City, for example. If we have Smart Lighting System that can save a lot on energy costs, same thing with the Smart Building System.

Moving into efficiency for customers is an important driver when we think about the supply chain. That improvements that we can make in our supply chain will impact our customers downstream in that whole value chain. Internal maintenance costs, so again we'll talk about manufacturing a lot in this session today, because it is sort of the largest used-case that we see today, the largest vertical area of vertical spend, and many of the biggest use cases come out of manufacturing. So, when we think about, it is the opportunity to do predictive maintenance on our machines and, therefore, save costs on maintenance.

And, finally, improving customer experiences. So we think about this from a retail perspective. Yes, it's a little bit nerve-racking to think that something is tracking us, but, at the same time, this is how we'll be able to have more personalized experiences offered to us. And then, also, we can also think about new service-based products that can be offered from IoT data. So instead of having to buy an asset, we can buy a service to that asset.

So if we look at this from a spending perspective, we believe that IoT spending will grow to \$1.1 trillion in 2021 and it will be growing at a rate of 14.4% over the forecast period. And I know that sounds like a really big number, but, again, we have to think about all the different technologies that are going into that spending. So there is a hardware component, there is a software component, there is a connectivity component, and then there's the services component as well. And we are tracking, I think, close to 75 use cases in our IoT spending guide right now, but that's obviously just one piece of the puzzle. There are going to be hundreds of use -- IoT use cases. So this is going to be very, very pervasive and that's why we think that the number is really going to be very significant as we move through the forecast period. As we can see, Asia-Pacific lead spending with North America coming in second and EMEA coming in third, and we'll speak to some of the regional trends on the next slide here.

So, again, when we think about IoT spending, I'll touch on sort of some of the mega trends that are driving the spending across the region and then some of the top use cases across each regions. So in North America, really the mega trend here is digital transformation. And one of the main drivers for adopting IoT within North America is the need to reduce operational costs and this could be something like headcount within an organization or fuel savings for our fleet. And in North America, manufacturing and transportation and logistics are the two largest use cases or, I should say, verticals.

In Europe, process automation is really the top driver of IoT spending today. And some of the key trends there are really the trends around industry for now. And in Europe, our manufacturing is also the top vertical in terms of spending. But by the end of the forecast period, we also see that consumer industry spending is going to make up a significant amount of spend in that region.

In Asia-Pacific, improving internal efficiencies was the top driver of IoT projects. Again, manufacturing is the number one vertical for spending in that region, followed by utilities and transportation as well. And so, some of the trends in Asia-Pacific that are driving the spending there still have initiatives like Made in China 2025 certainly in the manufacturing space. There is also the fact that there's the kind of rise of the middle class in Asia-Pacific. In Japan, there's a lot of efforts around connected society. And so, as we go from region to region, we do see some differences in what's driving IoT spending, but again manufacturing is kind of a constant in terms of being that -- the top verticals of IoT spending across the world.

And now if we look at IoT from a vendor perspective, so as we discussed, the technology sack includes a broad range of technologies, and so it's no surprise that there is a lot of vendors that participate in this space. And we've broken it out here into hardware, software services, standards bodies and industry solutions. And, again, we've grouped it this way, but when you think about the way that organization has to go about building an IoT solution, they have to make a lot of decisions and there's a lot of different vendors to choose from. So, I think that's one of the key takeaways from this slide.

I also want to call your attention to the IoT platform component of this slide, which is in the, sort of, right in the middle here. I think the important point here is, first of all, that it takes up a lot of real estate. It is a space that a lot of vendors are participating in and the other point here is that, organizations cannot make an IoT platform decision in a vacuum, right. They have to think about the hardware that they need to connect to that platform, they need to think about the analytics that they're going to leverage from the data they collect on the platform, they have to think about the standards the platform supports, they have to think about what industry are they in, are there specific industry solutions that they want to adopt to run on that platform and how they're going to bring it together. So we'll get into the platform a little bit in a couple of minutes, but just wanted to call attention to that on this particular slide.

So, again, when we think about IoT from a macro perspective, one of the questions that we ask in that survey I mentioned year-after-year is, what type of vendor do you think is going to be most likely to lead in the IoT? In the earlier days of fielding the survey, the hardware vendors, sort of, were more at the top of the list. And we've seen this shift over the last couple of years where software and analytics vendors have now risen to the top, and we believe that this is just market maturity taking place, right. In the beginning of the market everybody was really thinking about what are all the potential things that we connect and how are we going to connect them. And now it's moving into, okay, so we may be have a handle on what are some of the pieces of hardware we want to connect in the connectivity, but now we need to think about, well, what is the end goal here, what is the insight that we want to gather from

the data. And so, now there is more attention being focused more on that software and analytics component of the stock.

And so, the next question we asked was, okay, so you think that, for instance, software vendors are going to be really kind of the thought leaders in the space and the ones that are really making a lot of the money. So, who do you think is going to make the money? And so, this is the result and we asked it by each of these different categories, so each person was able to sort of give their viewpoint on these categories. And so, I think there's a couple of important points to take away from this slide. First of all, asking about perception. And so, this is, again, perception versus who was actually making the money right now? I think today -- as it for example, from the software and analytics area, Google came up in number three, but Google didn't actually have a commercial offering for the key space until -- well, in the enterprise side anyway, really -- have really focused product until 2017. So this is more of the perception at that point that the Google could be a leader, and I think that certainly some of that's being driven by what they're doing on the consumer side with also the focus that they have around analytics and everything that they've done with AI.

I think another, sort of, telling aspect of this is also Siemens on the OT side, where they've really just began to kind of mature their commercial IoT offering for market over the last year, but they, from a perception perspective, were ranked number one. So, I think it's very interesting to kind of understand who has -- this is really interesting in terms of like think about who has the mindshare in the market and I think that's our job to sort of track how the revenue shakes up over the next few years in these respective spaces.

This slide also really reinforces the idea that IoT is an ecosystem and that no one vendor can dominate the space entirely.

Okay. So now we're going to move into a discussion specifically around IoT platform, and we really see the IoT platform as an essential component of the IoT stack. And if you've been following the space at all, you may have heard that there are hundreds - I think the number that gets tossed around the last is 400 IoT platforms on the market. So IDC doesn't quite look at it that way, because we have a bit more of a narrow definition of what we include in the IoT platform space. And for us to be classified as an IoT platform within our market sizings, the platform has to have a connectivity component and a device management component.

Usually these offerings have solid [ph] data ingestion, processing and management mechanism as part of them, because once you connect to the device, you start getting some of that data out of the device, you need to be able to ingest it and store it and the processing piece comes in where do you -- where does that gets stored or do you need to run an analytic on it in real-time.

Visualization tools are usually part of these platform products as well, because, again, if you have this data you won't be able to visualize it. So those are kind of the four

key components that we see making up an IoT platform, but it has to be all in one product for us to consider an IoT platform. So, if it's just an IoT visualization tool, we don't consider that a full-on platform, that is a IoT visualization tool.

Sometimes these products include application development tools, sometimes they include advanced analytics. So if it's included in the pricing that we consider part of the platform, if it's not, then we don't. In terms of architecture, we'll talk about this a bit more in a minute, but we really think that these platforms have to support distributed computing. We talked about this idea that the cloud is very important. The cloud and, we call it, the core, because this could be any centralized data center, it could be the cloud and it could be an on-premises data center, but it's a centralized data center, that is not, say, on the mid, on the factory floor, in the manufacturing -- for manufacturing, example.

Security has to sort of run throughout the stack. We don't see that as a kind of a -- there are standalone security products, but we wouldn't consider that an IoT platform. For us, the IoT platform has to have security architected in, and then we also think that the platforms increasingly have to have APIs to integrate with other business systems, because a lot of times raw IoT data itself is not that meaningful, you have to combine it with other points of context to make it meaningful.

So, if we look at the IoT platform from a vendor perspective, it's a crowded space and it's interesting to look at this, because it maps nicely to that. That first slide that we showed, that sort of showed the IoT technology stack from these things to the services. So we've got companies and vendors that makes things that fit IoT platforms. Again, this could be machines, this could be chip sets, this could be cellular modules. We've got vendors that build network equipment in -- heavily involved in this space. We've got vendors that run connectivity networks that have platforms, and then we've got all the analytics applications cloud vendors that are participating, and then the services vendors as well. And the services vendors, sometimes they have a proprietary platform, but usually they offer partner platforms as well, because their focus is really on generating services revenue and it's less so about having allegiance to any one specific software platform. It's more about finding the right fit for the customer.

And so, obviously, there's a lot of competition here. But if we think about it, we don't think that there is necessarily a winner-takes-all strategy in the IoT platform wars. We do think that there will be winners that emerge in each of those categories, but they all have to play together, because when you think about it, nobody's in the vendor landscape is really positioned to sort of lead across all of those areas, so they have to partner. And we see the evidence of this and what's taking place in the ecosystem over the last couple of years. There's partnerships across application development cloud, EDGE, connectivity management and device management and I will talk through a couple of these examples just to bring them to life.

So if we look at application development, AWS obviously offers a number of web services that are really the building blocks to build solutions. Salesforce brings the customer contacts into that situation, so a customer might build their underlying sort

of IoT infrastructure, software infrastructure, I should say, with AWS, but then if they want to bring some points of context into their application, they might leverage Salesforce's IoT solution in concert with that to bring. Again, we talked about the idea of adding context to IoT data.

In the cloud space, one other things we've seen is that the organizations that are really focused on the cloud infrastructure like Google, Microsoft, Amazon, they are certainly focused on their own cloud strategy, but other vendors that do have some cloud strategy but are less focused on the infrastructure piece of that are trying to be more multi-cloud and give their customer's choice. So SAP, GE Digital, and PTC are all examples of companies that are really trying to focus more on the platform-as-a-service layer and they're partnering with cloud infrastructure providers. So that if their customer wants to run their PaaS on a Google IaaS, they're able to do that instead of having to run it on SAP's own cloud.

On the EDGE infrastructure side, we have got a number of organizations that provide the gateways and the hardware, but then when you think about running an application on that hardware, for instance, IBM has an SDK, so that you can run in IBM IoT Watson application on a Cisco gateway.

In the connectivity management space, Cisco -- for this piece of it, we're talking about Cisco Jasper. So Cisco Jasper has integrated with many mobile operator networks around the world. So for an IBM or Microsoft, it doesn't necessarily make a whole lot of sense for them to try to make that effort as well, it makes more sense if they have a customer that wants to do an IoT deployment with cellular to partner with Ericsson or Cisco Jasper.

On the device management side, there will be a lot of partnerships, because there are lot of different providers of device hardware and who knows how to manage those better than the company that originally manufactured the same, right. So Bosch and IBM are good example of that, where IBM has partnered with Bosch on -- for Bosch's device management software.

So, again, there has to be partnerships across the space and I think that we've come to sort of see the IoT platform is an ecosystem itself within the broader IoT ecosystem, but there will be some key attributes of winning platform players. We talk about ecosystem partnerships and like [ph] some will believe at that point, standard support is really important. There's a lot of different standards out there and you need to understand which standards are important in your industry and support them. It's really important to focus on use cases. Again, we don't see customers necessarily going out and saying I want to buy an IoT platform, what they want is a piece of technology that supports their use case.

It's going to be very important to have a developer ecosystem. Anytime we talk about our platform, you want developers and you think cloud momentum is also very important, because we talked about that scale, but also this is where a lot of the



developer interest is being pulled these days. So if you're a big cloud provider with the strong developer ecosystem, that is only going to enhance your IoT strategy.

Analytics are really important, this is where we get the value from the data, so we think the IoT platform players all need to have strong analytic strategies. They've got to get pricing right. We've seen many IoT platform players slashed their pricing over the last year up to 50%, because the pricing models were just too high when we think about all the data that customers want to run analytics on and store. And IoT is very global in nature as we talked about earlier, so whether you're a multinational organization or you're manufacturer that shipping products all over the world, you're going to have to think about global connectivity, you've to think about global language support, global tech support, so these platform players have to really have strong global capabilities.

Okay. So just finishing up here with a quick view on the future of the platform. So, again, we really think that the idea of an EDGE to cloud or EDGE to core architecture is really important, increasingly because of the cost to send everything to the cloud, because of security issues, because of concerns around latency and bandwidth, organizations are going to want to process more of their data closer to the point of generation. So as a platform provider, you need to be able to support that application wherever it needs to run.

We think that trends around containers and serverless computing are valuable to the platform. Containers offer portability, which is important when we're talking about very heterogeneous endpoint environments. Serverless computing really allows us to take an event-driven approach to IoT, which can save us cost if we're just spinning up the computing when we see a certain event happen, instead of running all the time. We also think blockchain is going to be an interesting technology with an intersection to IoT for certain use cases like those around supply chain and track and trace.

In terms of functional enhancements, we think that there will be more rapid application development tools added to these platforms, because they allow more people in the organization to participate in the development process. This idea of digital twin and augmented reality taking the digital -- taking the physical world and making it digital is going to be a really key trend in -- especially in Industry IoT, more integration of the device, so that when organization wants to on-board millions of IoT endpoints that makes that process simpler. We talked about contextual integrations, it could be customer data, it could be weather, it could be location. Data monetization tools, so that you can start to build new revenue models based on this data. And then in terms of consumption, it's going to go two ways. On the one hand, it depends -- and it depends on who is buying the platform. If it's more of a technical sale, you need to have those micro services available, so that they -- that technical person can, kind of, buy the piece parts that they need.

On the other hand, if it's more in a line of business sale, which will happen a lot in IoT, you need to have more of an application go-to-market. And so, we think it's actually quite useful for a platform vendor to be able to offer both approaches to the

market. So that's where we see the momentum in this market happening over the next year or so.

And so, that was all I had today. There I am with my contact information and if anybody has any questions that don't get answered within our Q&A session today, feel free to reach out afterwards. That's it.

**Anurag Rana** {BIO 7440273 <GO>}

Thank you so much, Stacy, for such a good overview. Just a request to our listeners, if you have any questions, please type them out and I will read them out to Stacy. So Stacy let me just talk about a little bit of something that we have learned from just cloud, in general, is, when you look at a cloud architecture and cloud, you could say one of the reasons of going to the cloud was, it was a little more secure or, I would say, far more secure, it has a homogeneous architecture compared to a combination of a lot of internal IT patched together over years. But when we look at the IoT space, we really don't have, as you mentioned, one large mega provider and we are again going back to that same construct of IT services companies patching together these relationships, these products, and are we going to come up with, again, business models that are so flawed with security that would, once these things take off, it might actually come down pretty quickly.

**Stacy Crook** {BIO 18685239 <GO>}

So I think that that's a really astute observation. I do think that what we're going to see happen is that some of the leading cloud providers are going to take the initiative to move into spaces that -- either that they haven't before or they're going to create really tight partnerships with other leading technology providers. So I think one example of this is that we've seen that these cloud providers are moving their cloud technology actually outside of the cloud, right. So the first thing that we've seen is that they're taking cloud technology and allowing customers to run it on-premise.

And now, so -- like Azure, if you take Microsoft, for example, Azure stack is a good example of that. And then with IoT now, they're moving it even further out, so like we'll just continue with Microsoft. With it, now they have Azure IoT EDGE, which is kind of taking a bunch of those web services and running it even further out from the cloud on a smaller IoT endpoint. And then what they introduced most recently with fear, which is something -- which is an operating system for a microcontroller, which is like the end of the IoT endpoint usually.

So we do see that the cloud providers are one -- are taking this initiative to create a more of a -- and part of the reason they're doing this, right, is to create a secure, their trade net chain of trust from the end -- the way end of the IoT back into the cloud, but there are going to be other complete pieces of computing in there that say Microsoft might not do like a gateway. So I think that we'll see these companies, like we talked about the example of IBM and Cisco, coming together to create a partnership around IoT. So that's what I think will happen here. It's not that the services providers won't still play an important role, but I do think that the

technology vendors are going to increasingly take this upon themselves to create this chain of trust within their own solutions to the extent that they can, but then also form these really close alliances with other major technology providers where it's needed.

**Anurag Rana** {BIO 7440273 <GO>}

Now, that's fairly a detailed discussion of that. Now, one of the things that we have also seen as we have been digging around this topic for the last few months is, these EDGE computing services launched by the cloud providers are fairly new. I mean, I think -- it's -- all of them are perhaps not more than 2 years old, is it that concept that is helping the adoption rate, because as you mentioned, I mean, we have been also hearing from some of the services companies that are implementing these projects that the project size are improving and enterprise adoption is going up, is that -- that is the key reason or do you see anything else that's driving this adoption rate?

**Stacy Crook** {BIO 18685239 <GO>}

So I think that that's part of it, right. Because when we think about manufacturing and the -- that -- the majority of IoT spend is within the manufacturing space. EDGE is very important for industrial IoT, right. A lot of these organizations, they are just not going to send, because we talk to them, they are just not going to send that certain pieces of information are just probably never going to go in the cloud. And so, it is really important for them to be able to adopt IoT that they know, that they can keep their information on the factory floor or whatever that private network is that they need to keep it within.

So I actually do think that these EDGE computing technologies are going to make it much more realistic for not only manufacturing but oil and gas too when we think about the fact that you're having an oilfield in the middle of nowhere, you don't have that connectivity all the time. So there's different challenges they're driving it, but I think that that's definitely one part of it.

I think that also digital transformation efforts as those become more mature, IoT should really sit hand in hand with the digital transformation effort. So as we see that maturity happening, I think we'll see more of it. I also think as the analytics technologies mature, that also is really going to help push IoT forward. And one other really key component of this two is connectivity. So I mean we have cellular connectivity, but that's expensive. We have -- WiFi is there and that's fine, but when we talk about somebody's mobile use cases, I think the increasing prevalence of these LPWAN networks will also help move it forward. So, I think we've got a number of trends converging at once to help start pushing IoT forward.

**Anurag Rana** {BIO 7440273 <GO>}

Thanks. So there is another one that has been on our mind for a while. So when you look at some of the vendors that are currently amongst the top list that you have, General Electric pops up and you have a number of other industrial companies, you mentioned Siemens and Bosch. Now, they have been -- at least General Electric has

been talking about this for many years, but it seems like it doesn't look like that had that level of traction as I would have expected three years ago and we recently saw them partner with Microsoft, for example, to do -- use Azure as the back-end for some of those Predix applications. Now, is this a trend that we should see going forward as well that industrial companies will use the tech companies as their backbone and would be more interesting in selling some higher value services? And will the cloud providers be the final winners in that case?

**Stacy Crook** {BIO 18685239 <GO>}

So, I do think that we see this trend happening. So I think GE, as you mentioned, GE Digital is moving in that direction, Bosch is also moving in that direction, where they're running various components of their IoT suite on public clouds. We talked to ABB the other day, who is really highly invested in Azure as the platform for their IoT solutions. And ICG has done this too, where they are moving more towards an IoT solution or application focus, and I think what those companies have realized is that running of the infrastructure for these applications is not their core competency, and that -- and doing that takes a lot of resource and effort. So I think that what they're really trying to focus on is what is our core competency and their core competency is knowing these industries very well and understanding the specific use cases and the value they're trying to get out of it, so I think that they are going to focus more on the analytics and the application layer versus the infrastructure moving forward.

**Anurag Rana** {BIO 7440273 <GO>}

Got it. One of the more interesting use cases I've seen with Salesforce where these devices can be connected to their CRM system and messages can be sent to people's mobile devices or to e-mails about things potentially breaking down, so it's a very interesting concept, because there -- it doesn't look like they are on the device management side, they are more on the CRM side of it. Any other vendors that are doing that kind of cooler stuff in that arena? I know you had mentioned Google, but I wasn't sure if they have something like that too?

**Stacy Crook** {BIO 18685239 <GO>}

So, I think that when you think about what Salesforce is doing, yes, it is on that adding the context piece of it. So other companies that are sort of competing with them in the CRM space are going to look to do similar, look to have similar strategies, right. I think when you think about the way that Oracle, SAP, Microsoft started to think about IoT, they are thinking about -- even GE, with its ServiceMax acquisition is thinking about how do we make -- how do we improve customer service through our field service organization, how do we create those personalized experiences. So if customer is staying in this hotel and we know every time she comes to this hotel, she likes to, I don't know, order the same meal from room service. Then I think that that's something that's being looked at.

IBM too is one to watch and in this space with the IBM Assistant that they've recently launched for IoT, so I think any of these companies too, they're participating in the AI space, which all those companies have some strategy there, they'll look to see how

they can combine IoT with AI to create better personalization. So seems to be a lot of interesting things going on.

**Anurag Rana** {BIO 7440273 <GO>}

I have one final question and that's on blockchain. I mean, that's something that's obviously been in the news a lot for a lot of reasons. What are kind of the use cases when it comes to IoT? And what kind of, I guess, solution/applications can we see emerging from that?

**Stacy Crook** {BIO 18685239 <GO>}

So, yeah, I think -- so let me say, I think there is kind of three big places, big applications that we're looking at right now. We do plan to write some research on this very, very soon and all sort of detail this all out. But I think anything that has a track and trace component can be very interesting to use IoT with blockchain. So the thing and that's moving through the supply chain or the logistics could be transmitting data and could be transmitting data to a blockchain, so that -- and the blockchain is verifying that this is true, so that when the product ends up wherever it's supposed to go. If something goes wrong with that product, so say it's food; if the food reaches its end destination and it's spoiled, you can find out exactly where in the logistics process this happened, because say when it was on a plane, it was sending back information which was verified by the blockchain that the refrigerator temperature was X, Y, Z at this time. But later in the process, maybe we see that refrigerator did not -- it was not at the temperature it was supposed to be, and that was also verified by blockchain, so we can -- it verifies, it gives us better verification on when something may have gone wrong in that process of getting that food to someone.

I think another interesting use case for blockchain in IoT is with security. So when we think about traditional security models, something is authenticating against a centralized authenticator. And in IoT we might not have the time to make the trip. Again that authentication service is in the cloud, we might not have time to make that trip out to the cloud and back. So we can have more of a peer to peer security model for IoT that could be interesting. Again (technical difficulty) that IoT and blockchain are both more or like these distributed models.

Another interesting use case could be for monetization. So if we can use cryptocurrency as our way to pay for something within the IoT, so we can think about blockchain and IoT coming together for IoT monetization use cases. And there are certain organizations like IOTA is one of those that's really focused on that use case of bringing IoT and blockchain together. I think, IoT Chain is, maybe, another organization to look at there.

**Anurag Rana** {BIO 7440273 <GO>}

Awesome. Stacy, thank you so much for such an informed session, and we look forward to talking to you again next year and get an update on the same strategy. And that's all from me. Thank you, everyone.

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**Stacy Crook** {BIO 18685239 <GO>}

Great. Thank you.

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