

【Samsung Electronics' 2017 Investors Forum】

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Good morning, everyone. Welcome to Samsung Investor Forum 2017.

It's great to see you all in Hong Kong. Like previous Samsung investor forum, today we prepare the three sessions, which contain very interesting subject to all of you.

First session is Samsung Mobile Service, and it will be presented by Mr. Peter Koo from Samsung Electronics Mobile division. He is the Senior Vice President and currently Head of Service Business team, and his work has been focused in mobile infrastructure, mobile device and solutions. In this session, he will deliver more about Samsung's unique and differentiated mobile service innovations including Bixby.

Next session is about Connected Car. I want to ask for an excuse. The original speaker was Mr. Phil Eyler, President of the Connected Car division from Harman. But he couldn't be here due to cancel of his flight from Europe.

Instead of him, Mr. Darrin Shewchuk is going to make a presentation. He's Senior Director of Harman. Today, many expect automotive area as Samsung's new gross engines. And I guess today's – his speech will be a good opportunity to share with you the vision for the future of the Connected Car which is one of key focus area over Samsung's long-term strategy. I believe that Harman number one connected car technology company. There will be a huge synergy in the future by combining HARMAN's long year of professional experience in auto industry and Samsung's leading component capabilities including memory, AP and OLED.

Last session is about flexibility, the presenter, Dr, Jong Hyuk Lee is Vice President of Samsung Display and currently in charge of next generation, R&D team in OLED business. As you may know, the OLED market is growing constantly due to the increased adoption of OLED panel into smartphone. But at the same time, what we are witnessing is that various competitors in the

display industry is becoming more aggressive, accelerating the technology development and making investments. Under these circumstances, I believe Dr. Lee will provide you a clear vision of ensuring sustainable growth by our flexible OLED technology based on cutting-edge technology differentiation.

I am sure that all three speakers today will provide you very unique and exciting stories about our business and strategy that most of you have great interest in. I truly hope that you enjoy today's event. Thank you. And to kick off today's event, please join me welcoming Mr. Peter Koo, Senior Vice President of Samsung Electronics Mobile division. Give him a big hand, please?

Peter Koo

Good morning, ladies and gentlemen as introduced by the, Peter Koo, I had a Service Business team at Samsung Mobile. In my bio, in fact actually I'm responsible Technology World Map and Innovation. That was my previous job as head of the Tech Strategy team. Now, I'm heading up the Service Business team, which are very closely related. As head of the Service Business team, my responsibility is a business strategy for our Samsung Mobile services and the business development and service for operation. Now, I'll talk a little bit more about that in a little bit later.

I'm very excited to have this opportunity to share the plans and works of Samsung Mobile, the software side of Samsung, if you will. And for next 40 minutes or so, let me walk you through the strategies of our Samsung Mobile Service business, so you gain some insight of what we are thinking. What is the issues that we are trying to resolve, and what are the thought process in doing so. And the rest of our hour, we open up for Q&A.

All right, so right off the bat, service strategy. Before I go into details of the service strategy, let's look at the mobile phones today. Smartphone has been the key enabler for 21st century digital lifestyle. I cannot imagine my life without.

I carry it all the time. Everything that I do is delivered via smartphone.

Smartphone revolution started with a hardware innovation. Now, software and services are really the ones that getting the user experience. That's the part that we recognize as a trend and we capture this and create our strategy to really deliver the value to our consumers. As I said, consumer experience is not only are coming from hardware but now is coming from software services.

Then we have a numerous debate, countless debate within the organization. Why services in Samsung Mobile? As a hardware company, what can we do? What is the value that we can bring to the table to really to do services? What are the advantages we have? What is disadvantage we have? These are all the questions that we have, and we are still debating within the organization.

As head of the service business team, this is my daily talk that I do. I look at the successful companies, software services company in Silicon Valley, how they'd make money, what is their advantage, and then also look at some of the companies that we compete with today. What do they do? What are their strategies? I do that all the time, and we have debate.

So, in this world, one thing clear is actually consumer experience again. We aim to provide the best consumer experience to our users, and we cannot afford not to go into software services. As I said, because of consumer experience now come a lot from software services. So, we have to go into that area, and we have to do very well.

But then let's not forget our main advantage. Our DNA came from hardware, great hardware they produce. So, you cannot be just simple software services. It has to be combined with our current advantage. That is the hardware innovation. So, hardware innovation, combined with the software services, is the way that we move forward.

Then, when we came out and to set the strategy for our services, what should we do? Why we should do Samsung services at Mobile. And the first thing that is always clear to us is we need to support the current business. Today, our main business is hardware sales, device sales. Anything that we do has to complement, has to really bring the value to our hardware device sales. And that is our number-one target.

So, anything that we do, we really want to combine great hardware capability and software services on top of it to really bring out the best of our user experience. So, that's the first thing that we do, and that's number-one priority of our service strategy to complement – to bring the value of our devices.

The second thing we do is innovation. Why we should do innovation? Innovations come from hardware, no question about that. And I used to lead that effort. Now, also, innovative opportunities in the software and services. So, this innovation is basically enforcing our brand value. So, second priority to me is the brand value of our Samsung mobile.

And this innovation, we have a mantra within the organization, innovate or die. Basically, without innovation, we cannot really go forward, and we cannot afford to not to innovate. And about innovation is meaningful innovation. The word that we use a lot is a meaningful innovation. Innovation for innovation's sake is really not the focus that we have. We cannot afford to have lots of different things going on, and not be able to really make any impact on our life. So, meaningful innovation is where we focus, and I'll talk a little bit about that later.

Then, all this we recognize we cannot do ourselves, especially in this fast age of innovation. We cannot really say, Samsung can do all. No, that's not the case. That's why I head up also strategic business development and strategic partnership. So, big companies and small companies, we actually work together to bring the innovations to our ecosystem. So, partnership is another big aspect of our strategy for services moving forward, okay?

So, let's go next slide about basically smartphone, re-imagined our smartphone. Look at the smartphone today. As I said, it's a center of our digital life. It's no longer communication and media consumption device. It's actually device for I'll call service gateway to your lifestyle. A lot of services are being rendered on the smartphone. And there's lots of applications out there, there's millions of applications out there and lots of developers, creative ideas that connects the service to the consumer.

And so Samsung Mobile recognize this as a trend and we're in luck to even bring the value to this ecosystem. So, there are some services that we imagine

that we can do ourselves. There's some services that I don't think we can compete.

Especially there are lots of people out there, creative ideas coming out with all kinds of ideas. And sitting and so on, Korea, and having a – within our organizations, I'm sure we have lot of innovative people as well.

But there are millions people out there with creative ideas. And instead of saying that we can do it all, we like to bring together this ecosystem. And another one is the – so, what is the value that we can bring to the table? It's really about the platform and toolset that we can bring to the table so that people actually can be creative, and we provide the platform for that, right?

So, imagine the world of payment today. That was the basis with Samsung Pay. That is – today, you can actually go to grocery shopping and pay without using credit card. That's due to Samsung Pay technology that we brought to the table. Another one is the health, the Samsung Health. Embedded sensors that we have on our phone can actually enable managing more of your health lifestyle. Both having – one thing in common is actually great hardware underneath to enable this.

Now, Samsung Pay is enabled by a hardware component that emulates your card-swiping action, and that is the technology that we brought into the phone, and that enabled this universal acceptance of Samsung Pay in a lot of merchants.

And the same thing for Health. We are the first one and still the only one embedding heart rate sensors to our phone.

And that is because, we think, we can provide a value to our consumers utilizing our hardware innovation. Okay?

So, next one, let's talk about the proven track record of our Samsung mobile services. There are four listed here. Now,

Samsung Knox, it began with Samsung Knox when our CTO, Injong Rhee, envisioned this. We saw need for creating superior platform for any meaningful services. If you look at the services out there, especially meaningful ones such

as financial, health, the protection of data is very important. And Samsung Knox provides key enabler for that. So, that's the service that we have that's creative and still is being expanded.

Second example is the Samsung Pay. So, Samsung Pay, as I talked about, universally-accepted mobile wallet replacement solution that we came up with. And Health, I think I talked about it again. It's a great example of using embedded software. Samsung Pass might be something – Pass might be something that you may not be familiar with.

Basically today, when you look at the world of lots of password and login, it's very difficult to remember all this. And now, with the Samsung Pass, we provide a platform so that application developers can actually plug in very easily, so they can provide very seamlessly secure authentication. So, that's the Samsung Pass as example. I'll talk a little bit more about that in the following slide, okay.

Okay. So, let's talk about Samsung Knox. Since introduction, we clearly saw the advantage is in the hardware. Again, in order to really protect your key information on your mobile phone such as financial information, health information, we thought software solution is not good enough. You have to be combined with the very low-level hardware component. A matter of fact, our solution is to really utilize the low-level technology called embedded Secure Element and TrustZone to be able to really store the key information there, so there's no compromise.

Then, on top of that, there's a layer to do protection of the information, if you will. That's the middleware. So, that low-level technology really brings the best of our Samsung Security platform. And since inception, it's been recognized as one of the thought leaders and one of the most secure hardware platform in the industry. A lot of government agencies and B2B business entities are taking this solution as being expensad. Especially the recent issues of WannaCry, consumer actually are very now -awareness of the security level is there.

Now, why do we continue to invest on Samsung Knox?

Like I said, it matters to the business entities, the client and the consumers now that the security is an element, a foundation for any meaningful services.

And so, in order to really increase the peace of mind of consumers, we're going to work with the government agencies and business to harness – to hardened the solution even better and to add extra layer of security. So, that's the that we have. We're going to continue to move forward with Samsung KNOX platform.

Another one example is the Samsung Pay. So, let's talk about that. Like I said, we have proven track record of innovation based on hardware. So here, since inception, the Samsung Pay has been herald as the most innovative solution, especially in the payment space. Again, it's built on top of KNOX, which is our security enablement platform so that you can protect the information.

And also, simplicity. Payment should be as simple as just touch your phone with the point of sales terminals. So, simplicity, KNOX and enterprise security. These are all the things that we put in for Samsung Pay. As you can see, it's accepted in many merchants. Again, our advantage that we have is really be able to really tell the consumers, don't worry that this will work in certain terminals or not. It will be universally accepted. And that's the consistency that we are going after with this technology.

Our competitors' solution, sometimes it works not because it's based on a certain technology called NFC. Well, not all terminals in the world are supporting this.

But the car swiping is universal and basic, and that's the one that we are going after.

So, Samsung Pay is the most accepted wallet, mobile wallet since launch. Now, it's in 15 countries. Soon, and we're expanding our coverage. So, this coverage includes about 15 markets and we're expanding. So, within the near future, you're going to see more countries, including Hong Kong, will actually see and experience the benefit of our Samsung Pay. It's en route to replace the mobile wallet. I often find myself going out during the weekend, I don't carry my wallet. It's accepted everywhere, including transit. So, I use it in my mass transit case

and also pay for whatever the restaurant meal that I take. So, it's a very good solution and it's a meaningful solution for users.

And with 240 million transactions is increasing as well. So, we are en route to have even more Samsung Pay accepted everywhere, and that includes gift card, royalty cards, membership cards. So, we're going to expand our Samsung Pay coverage in many different aspect of our mobile life.

Okay. Health. So, it's got lots of users but we actually relaunched Samsung Health, our previous name was S Health.

So, since starting from S8, we actually rebranded ourselves, regrouped ourselves. Health is one of the most important matter in our life, money and health are two things I constantly need.

And so, when it comes to health, a lot of people want to manage, self-manage their own health, and that's the tool set that we are providing. So, it's been quiet. We actually have not done a lot of justice in broadcasting or advertising our capability, but it's been growing steadily. Now, we can see that many people are using it. And as interest of people in fitness and health are growing, so is a sense on health.

And we are expanding our ecosystem of players. I think to me this is the area that needs, still requires a lot of innovation. It's just early stage. I think there's a lot of innovative opportunities in, for example, calorie calculation, innovative opportunities of chronic disease management. There's areas for asking for technology innovation, and Samsung is well positioned to take forward with the industry leaders and research ourselves.

And so, let's look at the next step of our evolution of. It's about connecting healthcare service providers and consumers. So, it's called, Ask an Expert. This is a marketplace where the healthcare service providers meet consumers. And with our increasing MAU, we see an opportunity to really bring this type of innovation. A lot service, healthcare service providers, lack consumer access or channel. And this is the one that we think we can actually bring to a table. So, we partner with industry-leading player in the America and the U.S. and offer the service since Galaxy S8. And it's growing very fast, lot of good response.

What it is actually for you to really call upon a doctor anytime at your convenience and so no longer you have to wait for the regular office hours or during the weekend. You can actually be connected and that includes not only texting but also video call. And this type of solutions will provide you a very convenient access to the healthcare by the most reliable sources. So doctors can actually meet their patients online. So this solution is available in three countries, but we're going to expand it to other countries as we move forward. And again, this is just the beginning. I think there is more opportunities in healthcare.

All right. Samsung Pass, as I've talked about, it really removes the friction of users today. Today, for consumer, you have to remember a lot of password. So, web log in or account log in, that's a simple matter, but also that's the consumer's point of view, so you would like to have one simple solution to be able to really log in to the website or account. And Samsung Pass provides that middleware, the so that it utilizes the hardware capabilities that we have on our phone.

And as the title of the slide said, you are the password. Why do I have to remember the password. Basically, with iris, with fingerprint, you can actually recognize, authenticate the user rather than taking the password or username. This solution exist before, but what's unique? The uniqueness of our business, again, encapsulation of Samsung mobile capabilities especially iris and fingerprint scanner and put it in a middleware so that third parties can actually implement this type of parties can actually implement these type of solutions very easily and that's the uniqueness. So, again, the middleware that we capture provides easy way for service providers to provide this type of authentication mechanism to their users. That's the Samsung Pass. It's available in three countries today. We are working closely with the banks, the financial institutes and the companies like card networks. That's similar to the path that we took with the Samsun Pay. But then we're going to expand it further.

So, if you look at today, we are working with Bank of America. We're working with Visa, Mastercard, U.S. Bank. So, these are the financial institutes. But also e-commerce companies that we are working with. These are the first verticals

that we are trying. But as you can see, we see expansion to other verticals, such as health and industry players.

And as we speak today, there are 25 partners in Korea that we work with. And the exception – the reception from the financial institutes in Korea have been very positive, because we allow them to implement these type of secure authentication service. Some use cases they do is like when you go into a bank app, very easy to log-in, just looking at iris scanning, you can do that. But also when you send transfer money, that requires additional security. That's when they can actually use iris for second factor authentication before you initiate the money transfer transaction.

And health is another example. Fraud, there is lots of cases of fraud in the western world especially in the U.S. A lot of money being wasted.

So, imagine a world that you go to a pharmacy and you pick up your prescription and there you can actually identify the person rather than someone else go and pick it up, right? That kind of authentication mechanism can be placed with our Samsung Pass.

All right. The next step that I would like to talk about is the technology innovation especially the M&A. We have a proven track record of M&A here. As you can see the list of companies starting from 2014 and the latest one being Harman, these companies, we recognize the value they bring to the table. Of course, we are very proud of our Samsung engineering producing innovative solutions.

But as I said, there's lots of innovative companies out there, especially the ones that fit our strategic direction and we go and that's the one that we bring to the table. With our Samsung Venture and our venture arms, they are ones keeping a tab on the start-ups and innovative companies out there, and that we work closely to make sure that we bring these external capabilities into the organizations so the new ideas and scale of our operations can continue on. So, that's the acquisition side. And in order to really increase our service capabilities, we're going to be bullish on finding companies that fit our strategy. So, we will continue to do so. Okay.

And today, I think, you will hear a bit about our Harman folks. For example, there is a lot of synergies that we see, especially on the Samsung Mobile Service side as well. And our strategy, our service capability It's very clear that we're going to focus on laying the foundation, the foundation being cloud infrastructure, security and big data. Any meaningful service that we do will require security. I think I talked about that, but let's talk about big data. Samsung Mobile's position is really – use the big data today inside our consumer so that we can improve our services to our customer. And in order to do that, we have a lot of data, and we have to protect it very closely. We don't want to pick a position that the data is monetized somewhere else. We want to keep it closely within our ecosystem.

Again, it's to gain insight of our consumer so that we can offer meaningful service to them. And in cloud, there are couple of aspects of the cloud. Backup and restore is obvious reason why we offer cloud but also be able to really offer meaningful service in the area of IoT. When you have multiple devices connected, you need to have a common backend infrastructure to be able to offer services in meaningful way. So, that's the cloud aspect of it.

Once we lay out the foundation, then we move on to the core layer. In the core layer, the big one is intelligence and IoT. This is where I think now we start taking traction. Again, what do I mean by intelligence on our side? And there's a lot of interest in this audience. What is Samsung Mobile's strategy of intelligence? What can we do better? What's different about Samsung Mobile than existing players in the marketplace? With their investment early on, we are later comers. So, what is our strategy?

Again, it goes back to our DNA. There is a strong hardware capabilities and our device capability, and knowhows of our about device.

So, our intelligence strategy, you will hear maybe later when I talk about Bixby that it goes back to what we do best, what we know best, that is the hardware device. And IoT is another big focus for our core layer. When I ask companies and the external partners, what excite them most about Samsung mobile services coming in the future, IoT is clearly number one.

When I also look at my analysis of our competitors in the marketplace, what really stand out biggest is actually our device portfolio, not only mobile devices. We have our Consumer Electronics division that has the digital appliance, TV. Combining all this together is a value that we can bring to the table, IoT brings all of us together. And starting from 2017, starting from our Galaxy S8 launch, you see that we are now finally making a move to capitalizing our advantage. That is the IoT. So, I'll talk a little bit about that when I talk about Samsung Connect, which is a single access point for all our Samsung devices, smart things devices.

Okay. On top of this layer, we bring meaningful services as I talked about, not only the ones that I listed out. There's a few, Samsung DeX, Samsung Connect, and you will hear a little bit later what those services are for. And this is pyramid have been proven very successful for us. So, whenever we think about the new service ideas, we think about, okay, how do we capitalize on the foundation we laid out and core services that we laid out?

And advantage of us owning these layers and component, and basically, especially into working of these applications, one app as a single entity is good enough, and we actually do very well, and our intention is to even increase our MAU there.

But also, when you combine these apps, they're working together, a lot of great synergies coming. In the example of Samsung Health and Bixby, for example, our intelligence, now consumer expenses is quite different. It used to be –well, people go open up their – unlock the device then go to Folder and find the Samsung Health app. Or sometimes, you get the notice saying, how many steps you want? That provides access point to your Samsung Health.

Well, here, you just talk about it, how many calories did I burn today, how many steps did I walk. Even I don't feel well. I want to talk to my doctor, very natural, different way of doing things. So, no longer Samsung Health is a stand-alone application. When they are combined, this becomes powerful. And also, Samsung Health combined with Samsung Pay. Another great example of this, because when we do marketplace, marketplace in many different services, including Samsung Health, then payment becomes important. So, that's just an

example of combining interworking of different layers. Also, within the layer, different services.

Okay. So, let's go talk about Bixby. This is a very big question of interest. Like I said, when we set out to create our intelligence service, we looked hard and gave a lot of thought of what is advantage that Samsung has compared to the other players, especially with late start especially with late start. We went back to our DNA that is the device. So, our approach to intelligence is quite different from intelligence of other companies.

We want to make sure that this brings different ways of interacting with device, phone and other IoT devices and that is the fundamentally main focus of our intelligence effort. With a Bixby, instead of touching, for a smartphone case today, is set up this way that people touch and app, touch and app are two main ways of interacting with a phone today. With Bixby, you will be able to do a lot of things with the voice and this opens up a new experience to the users. It removes friction and also a very natural way of interacting with the phone.

So, there are four properties that I'd like to a little bit go into details of our Bixby. First one is the completeness. With today's solutions out there for voice assistant and intelligent agent type of solutions, the user interaction with services is not complete. Some cases you go into the app and want to do something and you have to remember the entire command to do things. Here, because there are lots of menu items in today's app world. There is lots of menu choices that basically gives the completeness, and our approach is, we implement what's possible with touch command. There is basically many structure of the apps with the voice and that is by having most of the apps supported, most of the menus of the apps supported, we can actually bring the completeness of the intelligent service. Because one thing, the last thing we want is actually for someone to try on certain services command and it's not supported and then they stop using. And that is the completeness because certain – many options are implemented in that. Like a starting app, everybody does that.

But then, going to more details, okay, within the app, you want to do something, some action and you want to be able to talk to it. And that's not

supported, right, these types of things. Because our DNA came from, again, device, enabling device interactions. So, the natural thing to do is actually, let's look at what's happening in the app today, all the command implemented voice. That's the first.

And second is actually context awareness. This goes along with the first one, that is now, you are in a certain context.

And screen of the app you are in is a context, okay. Now, really, the natural interaction of user is within that context, at and within the main structure of certain app screen, you want to be able to talk to it very naturally. That kind of interaction is not supported. With our approach, you can actually go do multi-model and be able to do a voice command in there.

I'll give you an example. I'm in the messaging app and I would like to be able to capture the screen today, what I see on the screen, and be able to send it to my friend. I can do all of these within the message app and that kind of context awareness is really enabling us to be different from other approaches. Again, because our approach is from device, how do we make it easy and a seamless interaction with the user.

The other one is the frictionless. Again, it's very similar to the previous approach. The friction comes from people having to touch all the time and being able to really go into certain structure, unlocking the phone, or going into certain apps, starting an app, and going to the certain menu, and be able to really identify whatever you want to do, right. This all can be done with voice in one voice command. Again, I'll have to talk to my friend, and you can say their name. Typically what happens is you have to look at, first of all, I'm at the phone, go to your phone app, and go down to your contact list, find the person, click on it, and then initiate call action. Three, four different actions you have to do with one voice.

You can do all of this in one shot, and that's the approach that we take. Remove the frictions. Those ones that remove friction actually will eventually win a consumer's heart because today, it will cause many actions. It'll streamline the friction – streamline the action. So, frictionless engagement with a user is another one.

And the last but not the least is actually CognitiV. Here, the, again, when user is asking something, it doesn't have to remember the exact commands. You can actually say in your natural language and we will be able to pick up what the intention of the user and be able to offer that to user.

We're also even considering to add a macro, voice version of macro command. Back in the PC world, you can have a short key. You can do the same thing on the voice world. And these are, again, to enable new user experience interacting with a device. And device not being a smartphone only, but other IoT devices, okay. So, that's the four properties of our Bixby.

We'll go a little bit details on feature. There are four features. Again, Talk, you talk on the phone. And the second is See, vision. What you see also tells you a lot, and you have a lot of questions about it. When you go build on camera natively, you see some object and you are able to tell what that is and also be able to identify a great bargain or a shopping data so you can purchase the item easily. So, that's the See action.

And third is actually Recommend. On our – we call minus one page, we offer this intelligent service that brings the information and the news about what consumers want at a given moment based on time and place and occasion. So, there is a recommendation engine sitting in the back and bring down the relevant information to you. For example, if I go to bed, it brings out the card that shows my alarm clock. I don't know about you but my case, sometimes I worry that did I set my alarm correctly for tomorrow morning. It shows a little card shows this is an alarm set so I can manipulate that if I need to. So, that's one example.

In the morning when I come today, it shows the top news, the news that I need to know. These are the content, relevant content that we show to users based on insight that we've gained from the data that we collected. So, that's an example of minus one page. And Reminder is another example. You can just talk to it to set a reminder for yourself. Those are the four features of Bixby.

Bixby is launched in Korea, a Korean version. U.S. is coming later. Exact time and date, we're still working on it.

There will be communication for U.S. English speaking version. And then we will roll out to rest of the world and then we will roll out the rest of the world gradually as we see fit.

There, a lot of effort is given to make sure that the quality is there, the user experience is there. We do not want to introduce service that is – that doesn't meet our own criteria for quality. So, there's a lot of work going on to make sure that user experience is the best we can deliver. That's the reason why there is some peaking time, but we want to roll out as they are getting ready, okay?

All right, let's talk about the next innovation. This is called DeX, desktop experience using mobile phone only. Again, this one has a tie to previous thinking that is the – unlocking the user experience interacting with the device. Device today, mobile phone device, especially, it's combined with a touch experience. Well, a lot of times you want to be able to productive, you want to be able to – mobility and productivity coming together and security. Now, you want to be able to do tasks using mouse and keyboard in a big screen on your mobile phone. The processing comes from mobile phone probably where you're (42:36) able to do things. Here, with this DeX, you can actually put your mobile on the DeX station and be able to work on it using your traditional keyboard, mouse and a big screen. And some applications are better that way, especially productivity applications.

Come to mind, these type of things are very easy to do with DeX station. And it's become very –received very well from industry leaders. And that is truly you can see BYOD coming into play. The business owners are excited about this so that they don't have to have additional device for their workforce, extremely mobile and business-savvy people that can still do this with their mobile phone. So, that's the Samsung DeX. There is a small video. Okay. Leave your computer behind. That's the idea behind the DeX. You can do all this. All right. So, let's look at the video very quickly.

Yeah. Leave your computer behind. So, that's the idea. Let's talk about the IoT. I know I'm reminded I'm running out of time. So, I have to move quickly. IoT.

Samsung has been committed to IoT for a long time. But really, what have we delivered to the market?

I think with S8 Samsung Connect, I truly feel that now we are actually being able to deliver our promise – fulfill our promise. In the true promise of IoTs, other devices are seamlessly connected and they bring the value to a consumer.

User doesn't have to worry about finding device and connecting all these things. So, as I've said, Samsung has the largest share of devices out in the marketplace. So isn't that natural for us to connect all this seamlessly and also be able to control that in one app. In the past, there are many smartphone apps that require user to interact. But now, with the one Samsung Connect app, preloaded, immediately available, people actually can do a lot of things with Samsung Connect. And this one is one central place for all Samsung devices and smart things that are all connected and that gives you window to the IoT world.

So, here, Samsung Connect comes into a lot of different device you see. The one use case that I see is not only just to traditional things of turning up the volumes or change channels. That you can do with your remote control. But use case that I see is, for example, it's got the window into the refrigerator. So, you go out grocery shopping and you forgot checking your refrigerator before you leave. Well, here we go, you have an opportunity to check what's inside the refrigerator and be able to buy things that you like in the refrigerator. That's one use case. Still not common use cases.

Another use case that I would think is like when you're doing laundry, being able to really know what time is it going to be finished so it doesn't get wrinkled, for example, sitting in your washer. That kind of small things. And then security is another big use cases, and health is another big use cases where we see that this one app, universal app for all the connected things are done by this application. Okay. I think that's the one that I was talking about, the refrigerator case and then the laundry case.

All right. So, these are the examples of services that have come in together but here, what we see is the role of Samsung and being able to really go and reach out to the partner ecosystem. The innovations come from various partners.

Samsung is committed to really work with our partners to bring their innovations into our ecosystem and we work with all the key players. And it is getting more and more important for us to really work with our ecosystem partners. It's no longer one-off effort. It's part of our core strategy to work with our ecosystem partners.

And not only that, but also developers. We see need for us to embrace our development community, especially a lot of innovations coming from them. And so, we're going to beef up our effort of developer relationship and create infrastructure for developers to come bring their innovation and being able to really make money. So, at Samsung Developer Conference coming up this October, we're going to launch a few initiatives and open up so that people, developers actually, can create innovative services within our ecosystem.

Okay. So, I think that wraps up my speech. Thank you for your attention. And then, I'll open up the floor for the questions.

Q&A

<Q>: Hi. Good morning. Nick Gaudois from UBS. The first question is you talked obviously about quite a bit about Bixby's key features and where you see the strategy priorities. How do you see the Viv acquisition coming in into this roadmap and then helping expanding key priorities? Thank you.

<A>: Thank you for your question. So, in our early launch, initial launch of our Bixby, we actually have a lot of internal applications Bixby-enabled. What I mean by Bixby-enabled is, like I said, multi-model, context order, complete commands, so that's the Bixby-enabled. The apps that Samsung has created, we actually enabled Bixby. But we see that is not enough. There's lots of applications out there people use daily basis. They need to have the same kind of benefit. So, we are opening up our SDK, and Viv comes in big play, bring us, we call it CP, content providers, into the ecosystem and being able to really develop their applications, so that the applications become Bixby-enabled. So, yeah, it's a very core part of our offering. We are working together to create enough the Bixby SDK and being able to really open it up. So coming in the

near future, I think we'll be able to announce especially during the SDC, Samsung Developer Conference. There will be some announcement of our interface, SDK, sorry.

<Q>: Hey, good morning. I have two questions here. First, regarding the Samsung Connect, home appliance, and I'm using Mitsubishi air-con. I was going to tell you at the last week, if I'm using a Mitsubishi air-con.

<A>: Mitsubishi air-conditioning.

<Q>: Yeah. Or must be a Samsung air-con?

<A>: Yeah. Okay.

<Q>: Second question is services. Do you have any for virtual reality, VR?

<A>: VR. Okay. So, two questions, one is Samsung Connect especially non-Samsung devices. How do they come in to play? And second is the VR strategy. So, those are the questions. Okay. First, Samsung Connect available for non-Samsung devices, we have to approaches. One is using the SmartThings. SmartThings acquisition is mainly to bring these non-Samsung devices in consistent play. So, we are integrating our Samsung Connect, and integrating with SmartThings. SmartThings has open ecosystem, so they come into that angle, one angle.

The other one is open connect forum. There is actually industry consortium for IoT. So, the lower layer connectivity, a spec we implemented, is also if Mitsubishi or the company that you referred to has the way to go that route, that's another way to be connected. So, those are two things I can see happening. But like I said, there is lots of Samsung devices out there. So, we need to do our part first, to be able to really connect our own set of devices, right, and then have SmartThings available for third parties, right? That's probably the first route that we take.

And so, the second question is VR. VR has been great platform for technology leadership. You actually bundle with our smartphone sales, it has gone out to a lot of users, and there's a lot of – our market penetration is, by far, the biggest compared to our second one. So there's a lot of hype created. But then, still we

are working hard to really bring the relevant content. The content continues to be a challenge for us. So, we are working with our partners to bring the relevant content.

For example, game, it tends to be the case of VR followed by a lot of vertical use cases. But the game, for example, the current experience is limited with our Samsung because the touch interface right there on that is not conducive for meaningful game interactions, so that's why we introduced the controller, and controller frees up a lot of restrictions but still not enough. I see more natural tracking mechanisms so that you know in space where you are. So there's a lot of hardware innovation that we still need to do. On top of that, bring the content ecosystem so that that meaningful applications come in. Another one is obviously current restrictions on the VR has set, still there's a lot of room for improvement, business, the weight, all these things. So, again, a lot of innovation opportunities for product.

Then, the vertical side, there is a loss of interesting applications coming. Healthcare guys telling me that people overcome their fear or different therapy is being done on the VR. And the tourism, real estate industry. There is a lot. Even smart factories. A lot of use cases outside the consumer's case is being talked about. So, yeah, we'll continue technology innovation, work with our partners for content.

<Q>: Thank you. Great session. Simon Wu from Bank of America from Bank of America. I'm so glad to hear you're working with...

<A>: Yes.

<Q>: ... Bank of America when it comes on Pay.

<A>: Yes.

<Q>: So, the question is as a banker, the monetization.

<A>: Yeah.

<Q>: So far, great technologies you have introduced...

<A>: Yeah.

<Q>: ...for Samsung Pay and...

<A>: Yeah.

<Q>: ...AI stuff. But the question is, how are you going to assess the economic benefit from such great technologies?

So, maybe a follow-up question is, these technology –to support your phone business, hardware business or eventually that Samsung can monetize such a great technology.

<A>: Yeah.

<Q>: Thank you.

<A>: Very good question. Like I said, I think in my first slide, when I talked about strategy, right. Again, these type of services most purpose is actually to increase the value of our phone. And so, when we talk about monetization, the last thing I want is actually to jeopardize our \$500 billion dollar business because of small monetization opportunity here, right. That is the last thing I want. And so, we want to make sure that our main businesses are solid and we actually contribute to the increase to the increase of that main business.

Now, at the same time, there are certain business opportunities that we see especially when I look at our competitors, their approach. Basically a close ecosystem, low data monetization, yet be able to create meaningful service revenue in addition to large hardware revenue. But there is a meaningful revenue there we're able to create for service.

Now, what is Samsung mobile's position for that? That's why this team is created, service business team. So, I'm looking at it right now. What is our strategy? How can we monetize what we have? Like I said, the last thing we want is actually to really open up the data and that is the last thing we want. We want to make sure they're kept safe and be able to really utilize that for our consumer. And I think the way it is, when you have consumer engagement, meaningful consumer engagement, there will be opportunities to monetize, to create a business out of it. We don't want to rush into making money right away. We want to make sure that there's enough people use and there's a

benefit that we bring to the table. Then, I think the monetizing opportunity will come after.

<A>: One last question. Yeah.

<Q>: Thanks for taking my question. Thanks for your great speech and I'm a great fan of Samsung devices.

<A>: Thank you.

<Q>: And for so many new innovations and features to be powered on Samsung, do you have any ideas about innovation on the battery because you really need it?

<A>: This is one area that I wasn't prepared to answer. What should I do? Although as head of technology strategy, I actually have very good insight on, but this is not a topic I don't think or the place that we want to talk about. Again, I'll go back to the basic principle, bring meaningful innovation to our users and the battery is one of the major concerns of users. You want to have long battery life and you want to be able to have a safe battery, all these things. We have done our part of innovation, as you can see in S8, very solid innovation that we have created, an 8-point battery inspection program.

But also, really, it's the area in the technology space, probably the slowest innovation, and there's some opportunities there. Very slow because sometimes innovation and safety may not go together. So, you have to make sure that safe innovation is being done, so we are working with industry advisers. I was the one who actually went out and secured the advisers advisers, and that's the discussion that our technology team is having to bring the innovation to our users.

Okay. Thank you. That's the end of the first presentation.

Thank you, Mr. Koo.

We'll have the second session without a break. Next presenter is Mr. Darrin Shewchuk from Harman. Give him a big hand.

Darrin Shewchuk

Well, good morning, everyone. Hi. I'm Darrin Shewchuk. And as you can perhaps see, I'm not Phil Eyler who is your promised speaker for today. Unfortunately, Mr. Eyler's flight was redirected in the middle of his trip on his way here due to some mechanical difficulties, and he was forced back to Detroit to cool his heels there.

So I'm pleased to be here and to deliver to this talk on his behalf. I work with Harman's Communications Group. I lead the communications efforts for the Connected Car division globally. And prior to the acquisition, I was a member as well of the Communications team as well as the Investor Relations team, so we work very closely with some of your maybe counterparts in other parts of the world. And I'm pleased to be with you here today.

So, the opportunity that I have with you this morning is to describe a little bit more about Harman. For those of you that aren't familiar with, I'll start with a more global overview of the company, and then dive a little bit deeper into our Automotive division as well as most obviously, the Connected Car division which is an area for tremendous growth.

So with that, I have a little bit of a video that I'll show you as center that describes the company overall, and I'm pleased to ask them to roll the video.

So, as you can see, HARMAN encompasses a lot of different kind of things, not only automotive, obviously, or what many people know from our audio heritage. But a lot of things like professional audio, increasingly more and more software services and products, and enterprise solutions.

So HARMAN, overall, is really about an innovation company and we try to bring this through every aspect of the corporation, and we're really all about delivering epic experiences from our audio side of the business as well as obviously our automotive groups.

So, from an overall revenue perspective up until the end of last calendar year, HARMAN had about just over \$7 billion worth of revenues, about 30,000 people worldwide, roughly around 15,000 engineers globally, and has really been recognized as an innovation leader in many cases. So, we're one of the

few companies that have actually won things like an Academy Award and Grammy Awards for our innovations in sound and contributions to things like motion pictures and the recording industry. So, this is really a testament to HARMAN's long legacy of innovation and we're quite proud of that.

So, the company is overall organized in four divisions. So, obviously, our largest is our connected car division at about half of the company's revenues. And connected car is what we refer to as the technologies such as navigation, multi-media interfaces, so this would be the ability to connect your smart device, your cell phone, et cetera, into the vehicle, connectivity solutions, security solutions, these kinds of increasingly software-based services into the car.

Our lifestyle audio group encompasses both car audio, so some audio solutions that we provide to an automaker that are installed at the factory as well as obviously all of our home products. So, this is headphones, home audio speakers, et cetera, amplifiers, et cetera.

Our professional solutions group is the division that handles large-scale audio installations for things like stadiums, concert halls, increasingly enterprises. So, everything from banks to secure facilities and the government and the software systems that help organize them and run them. And Connected Services is the newest acquisition that we did about a year-and-a-half ago, which is really emphasized on building out our cloud capabilities.

So, no stranger to all of you, this is a new relationship for us together with Samsung, which we're incredibly pleased in and proud of and one that we see as being a tremendously excellent strategic fit for both companies. So, from a cultural perspective, we believe that the two organizations have got a great fit in terms of our commitment to things like speed, focus on delivery and speed of execution. So, those things, I think, will actually bring great synergies and opportunities.

But, obviously, our technologies are really well-suited and complementary. There's very little overlap in our business.

So, the acquisition was not about seeking efficiencies. It was really about completing perhaps missing elements in each other portfolios. So, I'll talk a little bit about that as we go on.

I won't spend a lot of time on this but the synergies are obviously across all of our parts of our business. There's some tremendous opportunities to do packaging and cross-marketing and things like our home audio. We've already done that. I think for those of you that followed the launch of S8, that product will come bundled with our AKG headphones as one simple example of where we can begin to cross-pollinate. We're looking at similar opportunities in the areas, another home products such as and monitors with JBL sound bars or speakers and across the home. Even in the enterprise or in the large-scale venue areas where huge Samsung monitors and displays, in a stadium for instance, can easily be integrated with our overall audio solutions that we provide to those kind of venues. So, tremendous opportunities.

But I think we all agree that the real tremendous opportunity and highest growth potential is within the automotive space, and we see that as a tremendous opportunity as we look at areas, which I'll talk about in the coming slides. But the proliferation of more and more display technologies in the car, with additional services that are coming into the vehicle with the need and complement of smartphone-driven connectivity solutions and other kinds of connectivity solutions, the combination of Harman and Samsung will be really tremendous for us, and one that really redefines in many ways what it means to be an automotive supplier.

Harman is known as a Tier 1 supplier which means we're sort of the top of the food chain for those companies that interface directly with a automaker. We integrate many technologies in sub suppliers and the combination now at Samsung I think really distinguishes us from the rest of the competition. There aren't other – there currently really isn't any other competitors or technology company that have the scope and breadth that the Harman-Samsung collaboration does.

So, we're tremendously excited about this. I have a short video that maybe does even a better job of describing the excitement about it and I'll let it speak for itself.

So, it's a whole new world ahead of us and a lot of great opportunities for us to collaborate and really see the synergies that I was talking about earlier. So, let me dive a little bit more into the automotive portion of our business and then I'll get more specific into connected car. So, within automotive businesses, currently Harman is organized around three main areas that we sell in to automakers, car audio and I'll explain each one of these independently in a minute. So, car audio, connected car and connected services.

So, let me start with car audio a little bit. So, our makeup in this area is – from a market share perspective, we're the dominant player on both of these markets. So, from a car audio perspective, Harman and its brands address about 40% of the market, whereas the other portion of the pie is split between a variety of component suppliers, et cetera.

On the connected car side, Harman's share is about 24% and growing quite rapidly. All together, our revenues in this space up until the end of last calendar or just about \$4.5 billion and about 12,000 people working expressly in the automotive areas directly as well.

Our customer base is global, and I sometimes like to say it's easier to name the companies or the automakers or our customers than the ones that are – We really cover the gamut of the largest automakers in the world that are currently customers. So, long-term customers know that we've supplied for, in many cases, 10-plus years. Our company is like BMW, Daimler, Audi, the VW Group and many of their sub-brands that are owned by these now. And in emerging markets where we haven't addressed them or where these companies have – are really growing up quickly were also making great inroads. So, particularly in China and in countries like India, we have been winning a new business both in audio and in connected car businesses.

And then in terms of expansion areas, Harman is not just focused on passenger cars, but we are actually also becoming more successful in looking at things like the two-wheeler market. So, you saw Harley-Davidson like the two-wheeler

markets. So, you saw Harley Davidson as long-term customer that is providing actually infotainment or connected car solutions on to their bikes, and we see this is another market for us and we're getting more interested from the likes of Honda and Suzuki in those areas. And we've recently won contracts with Ford to be their provider for next-generation infotainment with them and our new customer in that category. And we're just coming on board now with the General Motors and launching those infotainment systems in the market at about two months ago. So, these continue to be areas that we expand and commercial trucks. So, this is also the need for infotainment systems in this category. So, just suffice to say that we not only within passenger cars where I think the proportion of connected vehicles on the road is still something like less than 20%. There's still tremendous growth there and also in other kinds of vehicles.

So, product lines. So, speaking specifically about car audio, this one is broken down under a couple of different areas. So, we provide solutions under three different categories, branded premium audio. So, this would be a solution of Harman designs and manufacturers for an automaker, typically under of our brands, although it could be non-branded which is in the sort of the second bucket where we only provide – we design the system but we perhaps do not license the brand. But generally speaking, the OEMs come to us a for a completely customized audio solutions that they will sell as an upgrade. Some times as a standard and a more luxury vehicle and we also licensed one of our brands under them.

Non-branded is just fast as would be where we would design the system perhaps only provide components to them and sound management solutions is a growing area for us. So, these essentially are software products that help enhance the sound experience once it's inside the car. So, if you think of the branded premium audio being the actual speakers and amplifiers that are going to a vehicle, the sound management solutions is software module set on top of it, and help create different kinds of soundscapes that would allow a driver to customize the sound inside the car to a format that they like. This also is a way for us to upgrade software and capabilities in the vehicle so that your soundscape changes with the lifespan of the car.

There we go. All right. So, let me talk now a little bit more specifically about connected car. So, what is connected car?

It's a very broad term, but essentially encompasses a very broad number of things. And at the top level, we like to describe this now as a compute platform. Connected car and the technologies that Harman built are really a very sophisticated computing system that goes into a vehicle. And it encompasses many of the kinds of things that you see across the bottom.

So, many of us think today of a connected car solution or an infotainment solution as navigation, but it's really much more than that. It typically includes things like multimedia capabilities, security, connectivity, and increasingly things like productivity suite solutions, personalization, and connectivity to the cloud. So, I'm going to talk a little bit more about this. But generally speaking, the connected car experience is all about integrating all of these solutions into a centralized compute area and that's really the way forward.

So, what keeps – what's the secret to Harman's success so far and we like to describe it as the three eyes, which we refer to as innovation, integration and industry expertise. And these really can – sort of the understated, they are really fundamental to our business and fundamental to what automakers look at Harman to provide.

So, innovation I think is rather self-explanatory and it's not just in the areas of technology or being innovative about new technological solutions, but it's also in the way that we bring these solutions to market, how we integrate them, how we make them more efficient, how we help automakers reduce cost in the vehicle. For those of you that are familiar with automakers, you'll know that there's a lot of talk about the bomb, right, or the bill of materials. How much is the cost to put all these great technology together because it has to hit a particular target. And technology plays a big part in looking at how do we make those solutions more cost-effective, while increasing the amount of value that the automaker is driving from it.

Integration. This one really can't be understated in terms of its importance. These systems are highly complex and they can't be built by one company alone. The integration work that goes in to providing an infotainment system as

you can imagine – for those of you that have a new model vehicle, you know that the infotainment system integrates with many other systems within the car. If your conduit to control heating and ventilation or HVAC systems, your radio, satellite services. If you're in North America, you know Sirius XM Sirius XM or those kinds of services as well as other sensors and information inside the car. And this is only increasing. And this requires a deep knowledge and expertise in the automotive field. You have to be able to engineer these products to automotive grade capabilities. No disrespect to my colleagues here, but you can imagine that when we build a system to automotive-grade tolerances, that means it has to work in extreme temperature variations. I think the temperature degree changes something about 120 degrees.

So, if you leave your car in a parking lot in wherever, Northern Sweden or Iceland for a week at the airport, you expect to get in your car, turn your engine on and turn your NAV on expect it to come up immediately. In the same way that if you leave your car in a parking lot in Arizona for a week, you certainly don't expect your infotainment system to melt or not be able to.

So, there's a lot of depth that goes into being able to create products that are meeting the unique challenges of an automaker. And that kind of speaks to the industry expertise element, Harman's decades in providing infotainment systems to automakers is part of our calling card and is part of the trust that we've now built up with automakers. I think our first systems were launched in the early-1980s and continued on since then.

And this really speaks to the history of innovation that I was speaking to. I won't necessarily go through any of this but just suffice to say that Harman was the first with many innovations that came to market, things like turn-by-turn navigation, which now seem quaint but at the time, it was really revolutionary back at 2000, introducing Bluetooth solutions and Internet AVB to solutions. And even at AVB to allow for a more sophisticated networking inside the car.

And more recently, things like the integration of cybersecurity solutions with the acquisition of Red Bend and over-the-air updates capabilities, cybersecurity and, of course, our relationship with Towersec most recently. So, it's a history of innovation that spanned a long period of time.

So, let me switch gears a little bit and dive now into sort of how we're addressing the future. So, talk to you about a lot of our history and our path, and let me sure I'm tracking okay for time, and look at what are the megatrends that are transforming Connected Car. And many of these are sure – for those of you that are at all tracking, space or even just reading quite frankly the front pages of the newspaper, you're seeing these things talked about quite a bit. So, let me start at the left and talk first about ecosystem integration. What do I mean by this?

Ecosystem integration is the continued trend to have our digital lives become more and more integrated, whether you think of that as your cell phone or your smart device, your cloud profile, all of these things are increasingly overlapping with each other, and we want that to be seamlessly following us wherever we go. And that is affecting every part of our life and the car is no exception to that.

Conflict convergence. So, what do I mean by this term? This is really the trend to wear formally analog systems in the car or non-digital systems in the car are increasingly becoming digitalized. And with that, it presents the opportunity to have more and more of the systems be integrated. And as we're seeing it, the opportunity now is to look at things like instrument clusters as an opportunity for Harman to increase its capabilities within the car from just what we call the center stack or that slot where the center stack or that slot where the infotainment screen is to include the areas behind your steering wheel and in rear seat and other places, and I'll talk a little bit more about how this will impact as we look at things like autonomy.

Car connectivity, I don't have to, I think, explain to anybody but generally speaking, as I said earlier, there's a tremendously low rate of penetration so far on connectivity to the car, and this is only going to dramatically increase over the coming years. It will change how we think about a car on the road and what its capabilities are, which is really critical to having things like a V2V solutions come to market. So, we'll talk about vehicle-to-vehicle communications or vehicle-to-infrastructure communication. That all presupposes the fact that the car has some ability to talk to something else, and

that's not necessarily through a smartphone or cellphone connection, that need to be a connection that the car uniquely own.

Vehicle electrification. Again, this is a trend that's interesting, at first glance, we think what does it have to do with connected car. But the advent of electric vehicles is changing the way that automakers are thinking about how their vehicles would be used. So, when we think about the next box of things like shared mobility, and some of these two concepts go hand-in-hand somewhat with the ability to recharge a vehicle, to have it run more efficiently, quietly and a variety of other things. It's beginning to change how the physical makeup of the car might be designed. And with that then, what happens with the interior of the vehicle. So, it's a trend that's forcing Harman to rethink how infotainment will be delivered and how it's integrated with the rest of the vehicle.

And like I said, that trend really impacts as well things like this is a trend really impacts as well, think like shared mobility with the opportunity for people to be using more services like Uber or car-sharing or car-hailing services. It also changes the nature of the need for a more flexible vehicle interior if one day I'm driving that car or riding in that car and the next day you're driving or riding in that car. My preferences – your preferences and we'll talk about that a little bit more in a minute.

And autonomous driving. All of these things sort of pre-supposed that's coming together and thinking about the future that are related to self driving cars. And again, this is really going to radically change the way we think about the interior of the car currently. If the car is able to drive itself and let's take the most extreme or most capable version of autonomous driving, this will free up time for you and the vehicle to be doing other kinds of things.

So, if you're freed from physically having to be holding a steering wheel, what else can you be doing and how else can information be imparted to you in a much more efficient and effective way, perhaps more entertaining way. So, I'll talk about that. So, these are all things that are driving the way that we think about connected car.

And today, we think about the somewhat of the ecosystem that goes around each of us. And for all kinds of purposes today, the car is separate from most of what we think of as digital lifestyle. So, we all know that we can go to our smartphone or our device and get a plethora of services and capabilities that are customized to us, delivered to us when we want them, they're seamlessly integrated with what we do, we share things. But the device is the center right now of that universe which is really terrific.

But the car doesn't really share in that. But the car doesn't really share that. The car is off the grid so to speak. It doesn't have its own unique set of identifiers. And automakers in particular are looking at this saying, that's probably not the most efficient way for us to be thinking about how do we deliver value and how do we do things like retain brand loyalty, and how do we make the experience for our customers more unique, more exciting.

So going forward, we think that these two areas are going to converge somewhat and be much more integrated. So, as automakers want to roll out things like capabilities for service with the connected vehicle have them be more proactive and being able to monitor the health of your vehicle and make suggestions to you as to what you should do, being to see what a trouble light or an indicator on your dashboard says and offer you a solution to that whether you need to come in for servicing, whether you need to look at changing your oil, or whatever it might be they want to be able to increase that interaction directly with their customers. But that should be integrated with the rest of your digital life and capabilities that you have on, let's say, the left side should seamlessly work with what you have on the right.

So again, this is a trend that we sort of see as defining a much better end-to-end user experience, and much of this also related to alleviating the need for people to be interacting with their handset or their smart device manipulating inside the car because we all know is not safe, and a distraction quite frankly.

So, with these megatrends and with these areas that we see us going what we want to achieve, and Harman had said from a near-term goal with Samsung as to really wanting to become the industry leader in connected car and autonomous driving. And I'm going to explain to you what this sort of bold goal

means. We're going to do it with five pillars that we really want to expand on and have the center for our strategies of growth.

So these are Digital Cockpit and I'll talk about each one of this in a little bit more detail on the following slides. So, the Digital Cockpit, telematics and cybersecurity, cloud, user experience and design and autonomous driving. So let me go through each of these ones in turn.

So, Digital Cockpit, I will explain this one a little bit in the previous slide. As I said, the cockpit is increasingly becoming digitalized. And so, there's a tremendous opportunity to offer more and more value off the centralized computing platform in the vehicle and Harman has been demonstrating this for the last year or two at places like CES and this is only going to continue. So, today, let's just say generally speaking, we focused on this area here, infotainment. So this is sort of your plastic navigation, hands-free calling, et cetera. But there's a great opportunity to offer more services off of that same platform with more capabilities, more features off of that same platform such as display. So using that centralized computer to offer a display that would be projected onto the wind screen in front of the driver so that they don't have to look to the side or look down information like speed, turn by turn, et cetera, would appear on the wind screen in front of them.

Audio and sound management, I talked a little bit about this in the audio side of our business but running these capabilities for software-driven enhancements to audio can also be driven off of a compute platform. Connected Safety, this is an area where there's tremendous potential for growth. You hear this referred to many times as ADAS or advanced safety capabilities. But this is really the opportunity to aggregate data that may be on your vehicle and share it with data that's also being collected on other vehicles in that same fleet or of that same model, and perhaps be able to analyze that and draw conclusions about what's happening with a particular model or year and offer more services back to the car. It's also things like being able to take camera data and share it through a connection to warn other drivers about situations that are on the road ahead of you. So, all things that are intuitive, perhaps even sometimes invisible to the driver but will appear as a benefit to

them as they'll get a warning alert or something like that because the car is speaking to other vehicles in the network.

Intelligent personal assistant. So, this is really the concept of offering a interactive voice agent along the lines of, let's say Bixby or others that are offered by other providers. But or it could be something unique that the automaker looks at offering. But it's the ability for you to interact with your car, much like a concierge or let's say chauffeur offering commands and having the car also give you prompts as to things you should be doing.

You can imagine a universe for instance where you take a note while you're in your home in the morning noting that you need to remember to pick-up milk on your way home. If you're like me, I always tend to forget at the end of the day when I'm driving home. But I'd love it if my car look at my notes or my calendar and reminded me that while I'm on the way home, please stop and pick up that milk Lighting is an increasingly interesting thing. For those of you that are frequent travelers, you'll see airplane cockpits these days really changing the nature of lighting throughout the day and to time it to move, or to recreate a certain kind of atmosphere in the car. And this is an area that we also think has got potential for Harman to expand what we currently do on the interior to include things like that.

And I talked a little bit instruments in cluster. So, all of these presupposes the fact that we need a degree of connectivity and cloud connection to it. But all of this will come together under what we call an end-to-end compute platform in the digital cockpit.

So, telematics cyber security and over-the-air updates, these sort of three areas or this area is really the foundational element to building a connected car. Obviously, without a live connection, you don't have a truly connected car. So, that's step number one, how a telematics box or telematics device that allows for a real-time connection to the vehicle at all times, having a capability to conduct an over-the-air update. So, we all know that increasingly software is becoming a more and more important part of the car.

I think the current stat, yeah, I didn't about talk about this earlier but one of our modern vehicle that we would make for some of the German luxury

automakers, how about a 100 million lines of code in them. And that's a factor of about 10 times more software than a 787 Dreamliner in a cockpit.

So, I mean, when I talked about the complexity of systems, the completely of integration, you get a sense for what vehicles are facing moving forward. So, the ability to keep those systems updated and fresh is hugely important. We know that the statistic is something like, for those of you that are familiar, but building an infotainment system or connected car solution usually takes about a minimum of 24 months, usually about 36 months in the development cycle before that vehicle comes on the market. And then that car will stay in the market for up to 10 years. So, from when we – if we start a vehicle today, we're looking well into the 2020s to know that that vehicle has to stay relevant and vibrant on the road.

Over-the-air update is critical to making sure that we can provision these vehicles going forward and they stay fresh and relevant. And of course, increasingly, we all know that we have to keep these systems secure. The minute that you have an open connection to anything, you need to be locking it down with some level of cyber security.

Harman is one – is the only Tier 1 that is providing a dedicated cyber security solution currently, and all of these things together work hand in hand to make sure that the connected car stays secured, connected and up to date. And I'll talk a little bit on the next slide to both cloud and analytics and how that fits into all of this as well.

We'll just go to the next slide. And this is a growing area for Harman and in the area of services that it's providing to automakers, but it's in the ability to manage cloud, services cloud content, data generated from the car, being sent to the cloud for analysis, and in many times, the back of the vehicle then has a service or capability. So, Harman has a product that we call Harman Ignite which is our automotive cloud platform, and it has the capability to do all of these kinds of provisioning. So, I talked to someone about some of these areas. But if you think of things like a cloud-based driver profile, this is really fundamental to areas like car sharing if we want to be able to roll this out on large scale be personalized and meaningful for our customer. So, as an example,

I talked about this earlier, but imagining if you were able to get into a Uber vehicle and either through a smartphone recognition of you or perhaps through something like fingerprint recognition. When you're in the rear seat, all of your vehicles preferences or downloaded and perhaps your work suite can be then put in front of you on a tablet or desktop.

Perhaps, your music playlist is accessed, whatever it might be.

So, that's really reliant on having a cloud platform that can support these things. Maps as a service and cars as a service is an area that has got tremendous potential. Vehicle analytics. This isn't one that we see as being a really great potential for growth in an area that I think OEMs are particularly interested in. In many cases, once their vehicles leave the lock, once they're sold, they don't really have an opportunity to understand what that vehicle is doing and tell you bring it back into your local garage for servicing when they can take the key fob or connect the vehicle and see how many miles have driven, what kind of conditions have you been driving through.

With a real-time connection to the vehicle, an automaker has much better understanding of how their vehicles are performing in the field, and in many cases, could actually forecast problems before they become large-scale problems, before they become, for instance, a recall. It may be something as simple as understanding that there's an anomaly and then downloading a software update. But all of this needs a sophisticated cloud platform to help run it.

UI and UX or User Interface or User Experience is really what these terms mean and they're increasingly critical to how we think about the vehicle of the future and the connected car. This really refers to the ability for you as to how you interface with all of the systems in a vehicle. And as we all know, there's more and more things that are coming in to the vehicle, not less and less. But the demand is to make these less demanding or taxing on the driver and to be contextually aware. So, as we think about having more of these capabilities on the vehicle, until we have a fully-autonomous car, we want the ability to have our digital lifestyle follow us. But we want the car to know when it should serve us – when it should serve up some level of capacity.

So, if – I'm trying to give you an example here, but thinking of when we have an advanced interface like a head-up display for instance, et cetera, you want that when you need it and you want it to go away when you don't. And this is all going to be something that will be connected with things like perhaps biometrics, with contextual awareness and this will tie into areas on our displays and other intelligence that are in the vehicle.

Personalization I've talked about somewhat, but again, this is the ability for your profile to be carried in the cloud and allow you to choose your desired preferences. Some people like differences, touch and tech, an actual touch screen, something of this nature, other people prefer voice setting. And you may have the same people in one And you may have the same people in one family having different preferences that both you and your wife drive the same car or your children or whomever it might be. So personalization will be important to allow the car seamlessly switch between identity profiles and offer up capabilities that you wanted to do.

I talked a little bit about personal assistant and IoT. But again, in a context of voice interaction and more intuitive suggestive kinds of assistance to the driver, a personal assistant will be critical and we're looking at, this is a really differentiator, the ability to have a personal assistant that can monitor your calendar, perhaps other work interface areas which will increase productivity, and offer a better easier driving experience.

OLED and QLED area, that many of you probably know more about than I do at this point, but this is really the continued importance of displays in the vehicle. Here, I talked a lot about things like voice and other areas, but certainly visual displays are going to become more and more important in the car both for instrument cluster for center stock, navigation capabilities for rear seat entertainment, and if we cast forward to a universe where we think about autonomous driving and the ability to sit back and perhaps watch a movie while you're in the car the audio and the visual experience inside the car will become more important than ever. And depending on the makeup of the vehicle and what it's doing at that time these screens and the auditory experience inside the vehicle will become increasingly more important.

So, autonomous and ADAS capabilities. So, this is an area where abilities. So, this is an area where most interesting too was this is really the next generation of our long-term play with Harman and Samsung and it's an area that we see tremendous potential about.

There are sort of four areas that we see as possibilities that we can play with them as this market continues to involve and mature. So, we have sort of like a compute side, the capabilities to look at things like processing memory and in-vehicle connectivity as sort of foundational layers from a hardware perspective. There's also the complementary algorithm to software that go along with that. So, to an enabled and autonomous vehicle, there's a great demand for things like artificial intelligence and the context awareness for the vehicles to be able to understand perception and decision-making on how it should undertake particular action. So, a lot of focus on software and algorithms. place and the ability to keep them up-to-date. Mapping is an area that continues to be a huge focus.

The autonomous vehicle needs to have super highly-accurate map data at all times. And like any kind of map, it's only as good as yesterday's information because the world does not stay static. So, the ability to collect real-time mapping data, have it sent to the cloud and have it transmitted back to vehicles in real-time is incredibly important. And a part of that is obviously the ability to have a high-speed connection to the car. So, 5G is really going to be the game changer for enabling a lot of these kinds of capabilities to the vehicle. It's not necessarily an easy transition. 5G is in its early stages in an automotive context and will require lots of different kinds of ways we think about how we implement a 5G solution. For instance, it needs a different kind of antenna architecture so that there's much more high degrees of triangulation happening with the vehicle, et cetera. But with that adding a higher, faster digital type to the vehicle, these kinds of capabilities are much more realistic.

And then, of course, sensors. So, the preposition of connected car and autonomous car is that it is using a high degree of sensor information to scan its environment around it and communicate back to the mechanics of the vehicle or to other vehicles around it. And we're looking at all of these areas for potential growth.

So, all of these things together really represent what we sometimes refer to as the evolution to the revolution. Clearly, the connected car and path to autonomous driving is going to dramatically change the nature of how we think about driving, the driving experience and certainly the in-car experience for sure is set to change. And Harman and Samsung are committed to being leaders in redefining that for automakers. So, in areas of – the five areas that we're prioritizing, and we talked about entering the cockpit, enabling the vehicle with connectivity through telematics, cyber security and OTA. We certainly will lead in cloud-based platforms. We want to own that user experience and deliver that above all else and to the best of what the market will bear and empower autonomous driving.

So, with that, that concludes my summary for today. And I'm pleased to answer questions such that I can for you.

Q&A

<Q>: If you think about the evolution of this market and compare it to smartphones, is there sort of – do you see it is a market where one or two operating system evolve? Will there be an equivalent of an Android and iOS in this market and do you see yourself playing that role?

<A>: Right. That's a good question and I used to work for QNX. That was how I came to Harman. So, the Harman position on this currently is I think automakers are still figuring this out. And I think along with many aspects of this business, there's opportunity for rationalization. But that being said, there is a recognition that there are certain things that we know certain platforms do better than others. So, when I talked about things like the integration of the cockpit, for instance, the automotive rules and regulations demand that, for instance, the instrument cluster has a higher safety validation process than the infotainment system, as an example.

So, as we look at providing those capabilities, that needs to have a more robust operating system capability because some of the things that the instrument cluster does are deemed safety-critical whereas in infotainment system and the

ability to serve up music or have connectivity to multimedia, et cetera, is maybe better handled by a different kind of operating system that allows for more developers that are familiar with the platform, that can offer higher degrees of apps and services on it, et cetera.

So, all that being said, I think that automakers are still looking at different models. We're still seeing that some areas are preferencing Automotive Grade Linux, some are still preferring QNX, some are looking at Android. We'll see how that shakes out over the coming years.

<Q>: All right. So, in your initial assessment of what Samsung brings to the table in terms of core enabling technologies, if you look at the for processing for logic, memory, display technology, as well obviously IoT, Bixby, you referred to, et cetera, I mean, how do you see that playing out in terms of the timing of those starting to generate synergies from your perspective?

<A>: Well, we're already down those – that path quite a bit. Obviously, this is an area for great prioritization by Samsung. So there are synergy teams that are looking at all of those elements as you describe now. And I think the really great aspect is that the response from the OEM market about this deal and about the potential for Harman and Samsung is tremendous.

They – I would generally describe it as the automakers get it. They understand it exactly as you said, in the areas of whether it's AI, memory, the other – hardware, sensors, all these kinds of things that Samsung already has deep capabilities on and deep knowledge and understanding of the, shall we say, the smartphone market and consumer electronics is exactly what they're needing more of in the automotive space.

I think what Harman brings in that context is that understanding of the automotive space and how we best leverage them, how we best leverage them now, and how do we transition to other kinds of solutions in the coming years.

As I said, the things that the – the automotive market is not necessarily a fast-moving one. It's getting faster, but typically each of these design cycles takes a while. So, we're working with all of those elements right now, but we'll take a little bit of time as we work through them.

<Q>: Thank you. Maybe a little bit longer-term question because Harman sounds always great stereo system, all the good quality of the audio system. But when we look at the autonomous and then the ADAS area, it seems to be very broad. Even Google is working on the software, and also they are sometimes showing the demo for the auto.

So would you describe with more specific color what kind of the components or services you can deliver to the BMW or auto OEMs, and how you generate revenue? Your current business model, very clear. Audio system, consumer pay, consumer appreciate is good quality. But the ADAS autonomous in a lot of competitors and it's a very, for us, a little bit unclear what kind of product services you are offering for the particular audience. Thank you.

<A>: I understood, yeah. Thank you. And I think it was very early days for this. I think it's a perfect question and it is something that we are still looking at ourselves. So nothing but the business model aspects to autonomous. I think that, clearly, as I was saying a little bit earlier, if we look at what the opportunities are in ADAS, we must take ADAS before we get too far down into autonomous.

But even ADAS, connected safety is something that is really the most immediate sort of front here and the ability to look at the data being collected in the car and how can that be better leveraged to offer better safety capabilities and that is an area that Harman has been looking at for a couple of years now and think that there are some opportunities in the short term to enhance the offering and integrate into that compute platform or perhaps into another system in the vehicle but leveraging software capabilities, integration of the sensor data and offer a better experience.

I'll give you a little bit of an example of something that we're doing right now with one OEM. But this is the ability to take camera data – this is on the market right now. But it is taking forward-looking camera data that's being collected and the Harman system basically triangulates or looks at the differentiation between map data that is static and what is really seen in real life. Maybe an example is the forward-looking camera is capturing the fact that while a map data says that the speed limit on this particular stretch of road is 100

kilometers an hour, it's been reduced to 60 because it's under construction or it's been increased. That information can then be sent, collected, collated, sent back to the cloud and then shared with all of the other vehicles that are on that same platform to update the maps in real time. So we're doing that currently. That's an example of a data aspect, but it's tied to an ADAS-related feature, so that you're not going too fast in a particular area or that you know when to modify your driving behavior.

That's one tiny example of where we see some of those capabilities going in the short term. And I think longer term, ADAS platforms are still developing and they go somewhat hand in hand, I think, with the business case, too, is to – is this a vehicle for consumer self-driving capabilities or is it something that's more akin to a fleet of self-driving cars that might be used by an Uber or something like that. So I think it will be different models and different capabilities and probably different platform solutions being introduced in the market.

<Q>: Okay.

<A>: We should end – okay. One last question.

<Q>: Hi. For your auto business, I'm just curious what differences are there between – because you're a Tier 1 supplier, so what differences are there between working with Samsung as Samsung being one of the suppliers for display or for other things and working as a Samsung company, so – yeah.

<A>: That's a good question. I think we're really somewhat figuring that out in the short term. Harman does enjoy that capability of being currently a Tier 1 that a little bit what comes with that is working with OEMs on a very long-term basis with OEMs on a very long-term basis as you kind of were indicating. So we're being brought in very early.

Typically, if we're looking at being – if we are looking at a new engagement with an OEM today, we're looking at a platform that wouldn't come to market likely and tell you 2021 right now or 2022.

So we're very much a – I'm going to call it an innovation partner or a – sometimes even we – the nature of what Harman brings to the table is spurring

them to think about how they redesign these experiences. And that's kind of a little bit of the purpose of what I was showing you here, although it's a very technical and somewhat broken apart way.

When we look at the cost of cars that we'll bring to the automakers or talk to them about how we see all of this working seamlessly together, it's the opportunity to have that conversation with them on a much broader basis.

I think that what they all see now is the opportunity with Samsung to get instantly much broader scope, access to additional resources, access to deeper thinking on any one of these areas that Harman had by itself. So I think it's just – is a much deeper, richer, more real conversation for the automaker than what Harman previously could have done in and of itself. And I guess this is really the opportunity that OEMs are seeing as a game changer.

Okay. This is the end of the second session. Thank you, Mr. I'll give you a big hand.

We'll have about 10-minute break, and the next – or the last session will start at around 11:10.

[Break]

Okay. We will start the last session today.

The presenter is Dr. Lee from Samsung Display. Please welcome him.

Jong-Hyuk Lee

Hello, everyone. I'm sorry for the change of the title which is a little different from the one from your leaflets. Anyway, let me introduce myself first as the Vice President, I'm in charge of developing next-generation OLED product in the Samsung – in the R&D center at Samsung Display. I'm sure today to introduce technology innovations and future strategy of Samsung Display which is a leading company in OLED business, as well as OLED technology.

I divided my presentation into three sections. First, I will give you a brief overview of business and the display trends.

And second, I'm going to review the superior characteristics of OLED for smartphone and the recent update of technology innovations. And finally, look at the technology innovations and future strategy for new application of OLED display.

Okay. Let me start with looking back at the history of display and the future trends. The growth engine in the display market has been changed from IT and TV to mobile. The first wave from 1998 to 2004 was driven by IT whose CAGR is 35% and the second wave was driven by TVs and, however, from just – since 2010 to 2016 even now, the portion of the mobile has been increased dramatically. However, those TVs and ITs has been decreased substantially. It is expected to keep increasing and mobile will dominate the market in the future.

As shown in this chart, Samsung Display has been first place in mobile phone panel market for 25 consecutive quarters since the first quarter of 2010 and the market share of Samsung Display reached last year 43%, occupying almost 97% of OLED market share.

And the Samsung Display's OLED business has been continuously outperforming most other players in the market.

Since 2011 to 2016, our average annual revenue growth was around 18%. And one more thing which I'd like to point out is it only took six years to reach the annual sales of \$10 billion. While for LCD, it took 16 years to reach the same amount.

Okay. Let's move on to the wide RF for smartphones. Since the debut of the smartphone in 2007 until 2014, the CAGR was 45% due to that pure technological innovations such as touch innovations like embedded touch in 2010 and full edge driver, high resolution in 2013. However, since 2014, CAGR increased very slightly even though there were technological improvements such as screen size.

And so, what will be the next innovation to break the plateau – not actually plateau, but slow growth. I think the pure could be OLED, the RF, the device itself and acronym of the superior characteristics of OLED, which stands for original color, light and thin, eye friendly and design innovations.

OLED can express the original color via wide color gamut and the lower power consumption of OLEDs can make it lighter and thinner. And the recent update of technology made OLED eye-friendly and stylish.

Let me elaborate them the superior characteristics one by one. Let me start with wide color gamut. Recent update of whose color coordinate is 0.68 of white color coordinate made OLED to cover 100% of DCI color gamut. DCI stands for Digital Cinema Initiatives.

If you re-calculate that degree of discussing original color by color volume, what we call system or tool, OLED has 1.6 times the color volume gain. What this means is even at our, at the luminous of 40,000 lux, OLED can express 40 times better image quality than LCD.

The other strong point of additional color is the level of our ad is 0.0006 which is lower than their limits for perceive black and far lower than the level of LCD 0.4.

And even at low grade scale, OLED can cover a 95% of NTSC color coordinate compared with the 50% of LCD. These strong points enable OLED to express full expression at night, and also enable to get perfect nice picture quality.

And power consumption, OLED type of managing of power efficiency which extends operating time of mobile devices. And shown in the last part of the chart, people are watching video more times than ever and AR games such as Pokémon GO consumes much more power. So one-day charge could be enough for OLED phones but not for LCD phones. And based on the same usage time, the battery thickness can be reduced 13% due to the low power consumption.

The blue light whose radiance is 435 plus-minus 20 nanometer is hazardous when you expose for a long time.

Activated by blue light can destroy the retinal cells and therefore cause the many eye problems such macular degeneration or. It's very, very difficult – too difficult for me to pronounce it today.

Okay. For this purpose, the software such as Night Shift in iOS 9.3 or blue light feature in Android are used. However, in the case of the OLED, the central position of the blue wavelength shifted toward the long blue wavelength, which means OLED has two times more blue ray ratio than LCD, which means OLED is most suitable for.

An interesting fact is about six people – 6% of people suffer from color weakness. These people can't distinguish between red and green colors. Actually, we developed algorithm to control the intensity and the wavelength so people who have color weakness also can recognize the real true colors.

The other technology update is about screen-to-body ratio. According to a survey by, the importance of the screen-to-body ratio preference, over 90% people answered that screen-to-body ratio is important with the standpoint of design. Screen-to-body ratio has been increased from 58% to 83% on Galaxy S8.

Nanometer technology has kind of reduced the data space and force touch integration to replace the home key have innovated the portion of the screen of total device set.

Okay. Let's move on to the section three, innovation for new opportunities. I'm going to look at the technology innovations and the future strategy for new application of OLED. I'm pretty sure that these innovations will widen the gap

between Samsung Display and the other players in the market and the gap will not be easily bridged.

Okay. Before I move on to the strategy, let me review the megatrend for industrial evolution. As you know very well, we are in the era of Industry 4.0, which almost everything is connected with each other and controlled by the network or artificial intelligence.

In this megatrend, artificial intelligence, smart cars, AR and VR could be big three trends. And all of these things are closely related with the display devices. In that sense, OLED can create new opportunities in connection with trends.

For your information, Society of Information Display will be held today – actually tomorrow in Los Angeles in the United States.

The two main keynote speaker comes from Google for VR and comes from Harman for automotive display applications.

Okay. One of the promising application of future OLED could be automotive application. Let's take a look at the video clip of this great actor, Will Smith, who starred in the movie, iRobot, in 2004. As shown in this video clip, driver's car provide the driver with much more free time, time to get information, or time to do something other than driving.

In addition to traditional cluster and sensory information display, the windshield, display, they've much popular. And even rear view mirror will be entabulated in the form of a display. Automotive display requires several technology innovations for harsh operating environments and conditions. This display requires high brightness and high reliability as well as safety design. These stringent requirements can be transferred into a technology such as robust transistor and robust organic materials and so on. Let me elaborate this technical language.

For the automotive industry, over two times luminance is needed than the standard mobile phone and the space side should be larger than the standard mobile devices. This means current voltage is increased due to the brightness and the panel size.

For this purpose, new pixel circuit design which can avoid damage of by high current and which can improve the leakage current needed. And also, itself should be robust as well.

Imagine your car is parked in Nevada or a desert of Australia at noon, in the middle of hot summer day, inside the car, display should endure the harsh conditions. Organic materials, OLED materials is vulnerable at such a highly elevated temperature and under such a intense solar radiation.

On the other hand, there should be no color shift from the different wide angle. In that sense, robust OLED material which have long life time and materials device structure should be optimized.

What we call image sticking is caused by the same image for a long time. In technical world, current or constant current voltage stressed for a long time. This image sticking can be avoided by pixel shift technology or current compensation technology by.

Inside of car, the surface of the car, almost all the surface of the car is not flat, but multi-curve or rounded. In that sense, flexible panel technology and flexible technology is required for this particular multi-curve and free form display applications. The other interesting application, which can create new display market, could be AR and VR.

When thinking of VR, people recall the market such as video games or video entertainment. Yes, we do have the market for them, market for them. However, the other application of VR has the beam market for enterprise and public sector, the market for healthcare, engineering, real estate, retail, military education and so on. Last year, a surgeon, a medical doctor at London Royal Hospital broadcasted live his colon cancer operation via VR. And one more proper application of VR is complex engineering designs such as cars and such as airplane designs.

In the near future, we will take for granted to see all the wearing the VR and discussing their designs and the – in the office. The VR not yet for B2B or enterprise is growing very rapidly in my opinion. Even though OLED is the optimum device for the VR and AR, there should be some technological

innovations for AR and VR. The scale of the VR is magnified by the lens. So, we can easily recognize the grid between the pixels.

This phenomena can be transferred into technical language. It is about the resolution. This phenomenon is called the screen-door effect. And the people who want to have it, why they are natural field of view and have it light and comfortable. And the other pain in the neck for the VR which have been the problem is selling. So there should be some technological innovations for the solution.

First, high resolution. The resolution of Galaxy S8 is around 500 to 700 ppi. However, to remove the effect, the resolution should be two times or three times larger. In other words, 1,200 ppi or 1,600 pixel per inch is required.

Integrating more pixels in a display – restricted display area should meet technology innovations, in the area of backplane as well as area of color patterning.

In that sense, new pixel software design and the process architecture and high precision evaporation technology is needed for the VR applications.

Flexible OLED advantages for getting wide field of view and can make it compact. In the near future, you don't have to wear heavy, big, thick and inconvenient. As I mentioned, the other pain in the neck for the VR – yes, we do have the problem VR sickness. VR sickness is caused by the inconsistency between visual information and body movement information. When you rotate your head, and if we ourselves cannot catch up with the speed of the movement – your body movement, you feel dizzy. However, if we can reduce the latency less than 10 millisecond in the display level, we can be free from the dizziness. We are working on developing the various technologies for various driving technologies including high-speed driving.

Okay. Let's move on together, application. What will be the the smartphone? I'm not sure whether the smartphone can be combined – will be combined into – with a tablet or a PC. However, I'm sure that people wanted – want to – it – carry one to carry it small but people want to see it big. It could be the answer

for that question. However, in this case also, we need technology innovation for new materials and new architecture.

People tend to fold and unfold around 200 times per day, and we have to warrant three years 200,000 times folding is needed even at the high temperature and the high humidity conditions. To do that, we need structure optimization including the control on neutral pane. And also we need window. The outer side of the mobile phone is the glass now, it is called glass window. However, the glass cannot be easily fold or bendable even though it has very – been flat surface.

On the other hand, plastic window is easy to bend or easy to fold. However, it is easy to be scratched. So there is a contradiction which we have to solve as a technological challenge. Okay. That's it for the foldable display.

I've introduced three main future applications of OLED. Yes, we know that these innovations are very tough technological challenge. However, we can overcome these hurdles and pave the way for it. We will be the leader in the display market and the gap between Samsung display and the other companies cannot be easily bridged. Now, we are around the corner from creating new market in the future. Thank you so much.

One more thing I'd like to point out is that actually I focus on the small and medium sized OLED excluding OLED TV applications. Okay.

Q&A

<Q>: Thank you for the presentation. And my question is I'm quite interested when you mentioned foldable phones.

Does Samsung have some plans for these kind of technology into our new flagship smartphones yourself, what is the potential schedule or plan?

My second question is, you mentioned that we have to solve some problems with the foldable phones, for example the cover glass and you mentioned the plastic once. I heard that there is a new kind of technology named colorless PI film.

So do you think that this kind of technology will solve the problem?

<A>: As for the first question, actually I came from the panel provider and the launching time of the foldable display is the part of the set maker. So I'm sorry, I'm not in the right position to answer the question. However, if you can understand the technological hurdles and when we will overcome, we can easily imagine the time of the completion of the panel and that is the one thing and set is the other thing okay?

And the second question, yes we do consider the colorless PI as a foldable display window and we do not exclude the possibility of using glass itself because glass is the – the glass has enough strength for modular and if the glass is thin enough to fold, you do not have any reason to explore the glass window.

<Q>: Thank you for taking my question. Thank you for your team's hard effort on developing your technologies. My name is Claire Kim from Daishin Securities, Seoul, Korea. I have one question on organic material business. One of the key challenges of next generation display is the development of blue-emitting phosphorescent material. And as far as I know, the existing challenges is the very low level of energy conversion rate from electricity to emitting light and how does your team work on this technological challenges to develop new blue-emitting phosphorescent material?

<A>: Okay. That's a very good question. For the blue-emitting materials phosphorescent has very good transfer efficiency. However, in terms of the lifetime, it is not enough to meet the current display devices. So we are on the way to develop – to secure the – enough lifetime of the phosphorescent materials.

And in parallel, if there is the other way to get high efficiency – current efficiency as well as the lifetime we will largely explore the way to obtain the new materials. It can be the other form of the phosphor materials, for example thumb-only activated GED app, okay.

<Q>: Hi. Could you give us your perspective on whether you think micro-LED technology is appropriate for some of the segments that Samsung Mobile is

especially working on and whether you actually – you do intend to address that technology? Thank you.

<A>: I'm sorry. I'm not the specialist for that micro-LED area and I don't know whether it will be successful or not in the future. However, as far as I know there is some technological obstacle to array on the display real panel. So in that sense, there should be some content jump in developing the device.

<Q>: One question on production, as you either increase the size of the display or the size of the substrate in the production process, could you give us a bit of an idea about the difficulties both of a larger display and a larger substrate as.

<A>: In general, the technology for the larger-sized panel can be classified into some areas: the backplane and the areas, the backplane and the evaporation and the module process earlier. As far as I know, the scale up of the backplane is not the problem at the moment. However, there should be some improvement in the evaporation technology. The equipment for the evaporation and the map of the evaporation should be developed in the near future for the larger-scale display.

<Q>: We see the OLED and RG is commercially ready for payment used in laptop, monitor, computer? OLED technology for mid-sized payment using computer monitor.

<A>: For our company.

<Q>: Yes. And also, if you may comment on, is the cost competitive?

<A>: As you know, we've already showed 10.5-inch tablet OLED panel. And it did not explore the expansion of the panel into a medium-sized one. So, basically, the technology for the medium-sized is being developed in the R&D center and if the concentration in the market is good, we can jump deep to the area, but it's my private thought. Okay?

<Q>: For the medium-sized panel that you talked about, say, for a notebook or for a tablet, what kind of backplane would that require for OLED?

<A>: Basically, it could be the

<Q>: It's still too small for amorphous silicon or?

<A>: Yes.

<Q>: Or metal object.

<A>: rtPS means the low silicon. Yes.

<A>: This is the last question. Yes?

<Q>: Sure. I have very little knowledge about OLED, In your presentation, you showed automotive as a second example of growth area for OLED. I'm just curious why automotive – is it automotive display more suitable? Is OLED, no – is automotive likely to be a bigger market for OLED than laptop or other medium-sized panel?

<A>: The intention of my presentation for the automobile is the new opportunity of the OLED market.