

**Carl Ford:** Welcome everyone. I'm Carl Ford. I'm your moderator today. I'm joined by a wonderful panel - Dan Warren from GSMA, Manuel Vexler from Huawei, Stefan Svensson from Ericsson, Geng Wu from Intel plus of course our host and the guy who knows how run SCOPIA, Anatoli Levine, who is hiding in the background, pushing the slides for us all right now. I want to talk real quick about the logistics of this event. First of all it is recorded so you'll be able to see a copy of this going forward almost immediately, but let's say within 24 hours. If you have questions please use the Twitter account or the Skype chat @IMTCORG and the presentation is up on this link if you want to go there and look at it from SlideShare. I also want to say to you that this is kind of an important discussion for a couple of reasons . One of the major ones is that we can think of voice over LTE as kind of the canary in the coalmine. When we fully implement Voice over LTE we have truly reached the tipping point where the evolved packet core is dominating our communications network. It's important for us to keep paying attention to where we're going. There's an effort in the US to have the death of pods and when we see the fact that even wireless has gotten to the point where it's using the evolved packet core for voice it's obviously time to look for better quality on voice and video and I'm hoping to hear this part of the conversation. The last thing I want to say to you is that unfortunately Dan has to run away from us so I'm going to start him off in the presentations and then I'm going to stop and let some questions come around and then we will continue with the rest of the conversation and we will have those questions at the end. So without further ado- Dan, let me get you started.

**Dan Warren:** Thanks Carl. So if we move on to my first slide we can move straight past that one . I think the requirement which I was presented with on this webinar was to give an idea of where we are today and what's going to come next so just to give you a quick recap of where we came from and how we got to where we are on voice over LTE - originally it was a profile called 'one voice' which was defined by six operators and six vendors that was published in November 2009 and essentially was looking for a home. And in looking for a home two choices were naturally presented. One was GSMA and the other was 3GPP and it was decided that GSMA should take this forward and from that came the Voice Over LTE work. So we spent a lot of time over the last two years writing a bunch of specifications. Perhaps the best known is IR92 which is the user network interphase definition for a SIP profile for Voice over LTE which builds on 3GPP MMTel but since then we've looked at things like interconnect and roaming. Most of that work now is done and the last piece of - if you like dotting the I's and crossing the T's is the roaming architecture which we found we had a couple of additional commercial requirements that fell out the work which we started on that which resulted in use needing to go back to 3GPP. We've gotten around that block there's a Revel work item in 3GPP right now which once that's completed will finish the technical definitions and from that point onwards everything going forward is about implementation and realization of what Voice over LTE as a service. We move on to the next slide .Right now we're expecting to see first Voice over LTE deployments sometime in the late 2011 or early in 2012. I'm suspecting it will probably 2012 right now. The implementations that we're seeing, the Voice over LTE definition as it spans defines the absolutely bare minimum of what's required for VoLTE - narrowband codec and the basic default sets of functionality but the good news is that everybody who is implementing

seems to be moving forward with some of the enhancements that can be done and for those of you who are of a technical mind you know that SIP is a protocol and within the certain description protocol allows additional functionality to be negotiated in or out of a session on a per session basis. Things at wideband codec usage, things like video additional functionality, that Rich Communication Suite is all coming along on the basis of Voice over LTE becoming a live service. In the meantime European and Asian operators are still turning towards CS fallback and we think that probably the reason of that is probably a complexity around a piece of functionality called Single Radio Voice Call Continuity which is the mechanism for handling a Voice over LTE callback down into 2G and 3G and back into the circuit switch domain and that seems to be proving a little bit more troublesome than people thought. The good news from the bigger perspective is that ultimately everybody's heading towards Voice over LTE and like I said it's just that people are choosing different paths to get there. So the focus of the work now that we're completing at GSMA has moved on beyond the original Voice over LTE technical definitions and we're looking at a number of enhancements and there's a bunch of spec numbers on your screens now but I'll take a little moment to look at each one of the additional parts in detail. So if we move on to the next slide again, the first one is this IMS control for all voice calls. This is made up of two elements. The lower one is single radio voice call continuity again and there are elements within that which have commercial effect. So if I'm on a call which is Voice over LTE controlled and I want to do a handover back in 2G or 3G then the IMS needs to remain in control of that call. And knowing these are a technical requirement there but it also means that there needs to be tethering together of the billing records associated with what amounts as a PS call and enhance over into the CS call so that you don't intentionally get charged a double call origination or call termination fee and the billing records match. The upper one is access to main selection functions so if a call is made into Voice over LTE subscriber there needs to be a decision made about how that voice call is routed. It's barely straightforward because they're either LTE coverage or they're not but because the LTE coverage has a certain implication around it to do with IMS, IMS needs to make that decision. So within IR 64 we're defining how both of these pieces of functionality work moving forward. The next one is Video over LTE. One of the great things about the way that Voice over LTE is that it sets a framework which is based on the MMTel principles. As a result it sets a template for applying additional services on the basis of MMTel. If you need a really interesting read for the evening you can pick up the latest version of IR 94 which is available on the GSMA web page and have a read of that. And what you'll find is that a lot of it refers back to IR 92 because the functionality is pretty much the same, the only things which are changing are the usage of some of the SDP lines within to include a video codec instead of just a voice one. So to do that you need to be able to apply all of the great things that MMTel prescribes so supplementary services like multi-party but also integration back into existing video-conferencing systems and in person the more interesting part is early media so the idea that instead of just giving a ringtone or an indication of the person that you're calling's phone number on the screen in front of you when they ring, you have the potential to actually play out a piece of early media so that they're may be a short video stab which is played on to the person you're ringing the phone. We move on to the next one. IR 92 defines how Voice over LTE works but one of the things which is being pointed out is that essentially one of the things which drives the IR 92 is the fact that there is no CS domain but

the other thing is that you have an awful lot of bandwidth there which you can use to apply additional voice services on top of the services that you have already. So why wouldn't you use all of that definition on other broadband accesses and the one which lends itself most readily from the perspective of GSMA at least is to also use an IMS profile for voice and SMS over HSPA. The illustration on the right hand side here shows you the sum total of what's defined in IR 58. You have all the same IMS features, all the same media ,all the same bare management of other functionalities and the only thing which really changed is the radio capabilities from LTE to HSPA. So this again is a fairly thin specification, it makes a lot of reference into IR 92 and then the result is that what you really end up with is the absolute specifics of what the radio technology is that you're connecting across as the difference between the two .So if we move on to the next one - so proving how it works. And I guess part of the reason why I'm invited onto the call today is there has been definitely a positive exercise that took place in May 2011 with the IMTC who ran an event which they called SuperOp! to do interoperability between the networks and their devices. It did struggle slightly on the basis of a lack of handsets but we think that's coming up strong soon. The IMTC is hosting a Voice over LTE Webinar which you're all seeing here, listening to. I guess these slides have been used a number of times. The other thing which we've done was the MSF Voice over LTE interoperability event in September 2011. It was hosted by Vodafone and China Mobile within their lab so the Vodafone lab in Dusseldorf and China Mobile's lab in Beijing and what they were looking at more was the network equipment side of the definition so they demonstrated calls, they demonstrated the interconnect, they demonstrated roaming. They put their results out on the 8th of November and they are going to be speaking about those results in an event in London in two weeks' time. They have plans to do further OT testing and that's going to go across a whole bunch of things - Voice over LTE, RCS, and co-hosted with ETSI and again it's backed by the GSMA .I think one of the things you're going to see as we move forward throughout 2012 is the kind of theory turning into reality side of everything which is going on in Voice over LTE. We've had an awful lot of talking about the technology; we've done a lot of standards definition. Where we're getting to now is beginning to develop that maturity and understanding of what it takes to put a network and a device together to not just build a single Voice over LTE network but actually to build an entire ecosystem and it's that ecosystem which is essential to the overall success of Voice over LTE, it needs to be something equivalent to the mobile technology ecosystem which is out there today, GSMA is in the basis of that, to a certain extent CDMA has been a parallel system. When we get to LTE we're going to have one big happy family on a global business and technology platform and this implementation needs to be something which has that same ecosystem feel about it. So I think that's probably my last slide, we can move on. Yup, there we go. I've seen, Carl that you've been taunting questions across. I'm happy to answer pretty much anything .

**Carl Ford:** Excellent, I'm glad to hear that because I have a few on - I haven't seen anything yet on the Skype side. I remind people that IMTCORG is the place to send questions both in Twitter and on Skype. And Dan let me start with an interesting question. Right now we have a lot of transmediation going on where we have a lot of different codecs being modified and managed in dealing with the network. Is your expectation that we're going to standardize

codecs and in effect the need for transmediation declines as a result of Voice over LTE or are you expecting that we're going to have so many different standards involved in the codecs that we're actually going to still need the transmediation?

**Dan Warren:** The approach that we took with the definitions of Voice over LTE was to define so that the least minimal set which is required to put a service in place which is equivalent to that today. And one of the things that we did in that was to identify the default codecs. Default codecs give you two things. The first thing is that they give you a guaranteed baseline functional set which in this case has to be narrow-band because we don't want to make the people who don't want to implement wide bands going to do it from day 1. But the second thing it does is it means that you're guaranteed there is always going to be a codec there to establish a call with which really means that there should be no reasons for any calls that have to go through a transcoder. So as a bare minimum everybody should support AMR. On that basis any call can be established using AMR between any two endpoints and there should be no need for a codec. If you find both sides support a wide band codec then use it. And I can see there's a question which is related to that. from Daniel Berninger which he says about obstacles supporting AMR wideband Voice over LTE. There are no obstacles in the implementation of the codec itself. Essentially you just identify in the SDP line that something that one side of the call supports and if you have a side support it to that will come back in the answer part of the SDP of the router so you can establish the call using AMR wide band assuming that you have enough band width to do that. If you're unable to access you don't have enough bandwidth to do that.

**Carl Ford:** So let me ask that Wi-Fi question to you too. So EPBG is a protocol that's being run through the Wi-Fi community to basically enable it so that the wireless carriers can frontend Wi-Fi networks and use them like they're using them for upload and in effect they would enable managed services and that kind of stuff. Is there expectation that as we do Voice over LTE that we really aren't going to pay attention necessarily to where the call's coming into and will we be able to take advantage of that to make it so that there's some wideband codecs associated with the voice over Wi-Fi that's connecting up seamless when you go to carrier?

**Dan Warren:** As we move forward the consumer is going to demand the specifics of the access network and the access technology are almost hidden from them. I know there are a number of things which are taking place right now to allow that to take place and they're all around Wi-Fi offload, Wi-Fi roaming, some of the stuff which has come out on the WUFA on [inaudible 16:32] [all of that kind is moving in the same direction of saying "You have a device, you're going to be using it indoors and outdoors, it's going to need to be able to attach to whatever technology is going to offer you the best level of connectivity any time." And I think the next step beyond that is to say "You know what? It's all an IP bearer and essentially kind of the idea over the top services is going to go away and die" because

everything runs over the top of something now .You have a baseline IP connectivity which is going to run not just from consumer to network but also between networks themselves and so everything is just protocols back on top of that and so rather than being over the top in the traditional sense that the people refer to that, it's more a question of the level of inspiration into the operators' network. So if people have got Wi-Fi access into their traditional MNO services then yes, why not, why not run voice over Wi-Fi using exactly the same IMS stack. It's only the same principle as the Voice over HSPA stuff we've done and the point about IMS is that it was built from day one to be access-agnostic. It's kind of ironic that the biggest IMS deployments right now are in the fixed line network when it was originally a mobile-defined standard but essentially there isn't a huge amount of access-specific stuff within the IMS domain so as long as you can reach the IMS and you can authenticate to you can access any of your services which are in the IMS domain over any access you like.

**Carl Ford:** Yes, that is irony and we should have a whole other conversation about that which we will in Miami. But let's do Dan's follow up question. Are there costs in an HD voice call that its standard definition could not suffer?

**Dan Warren:** I don't think so. There's probably a license cluster supporting the AMR wideband codec but one of the initiatives which we've been driving in the GSMA alongside Voice over LTE is an HD voice ready logo, basically a service mark which says from a device and a network perspective the HD voice-AMR wideband is enabled. So my perspective and my understanding is that this is something which is going to be pervasive into the network at such a level that scale cost down to the bare minimum and it needs to be something which is a globally accepted standard in its own right. AMR wideband is being defined in 3GPP for some time. I think what has been limiting its adoption has been available to your bandwidth on the bearer of the cost of the implementation itself.

**Carl Ford:** Okay, so let me ask you this question then - if we don't see any extra cost should we consider it that it's going to be deployed as an enhanced service or do you think that it will be a service associated with specific carriers in their rollouts? Do we expect that - you've been blessed Dan in the fact that you haven't been subject to some of the states commercials. There was a point where Whitney Houston's voice was being used to offer a "better quality service" and all they did was in effect increase the base on the network. The question I think I'm asking is should we expect that the carriers are going to try and differentiate themselves or do you think that they're going to try to create differentiated services?

**Dan Warren:** I think there's a window for differentiation on the basis of availability of high definition. But the thing about high definition is that it has to be supported on both ends on the call and as a result that naturally lends itself to the need for a high definition codec to be

supported ubiquitously for everybody to get out value. So my expectation is that there may be a window there, it will be relatively short, and then it will become table stakes, it will be something that you have to do otherwise you're a have-not rather than you do it as an option to be had and so my expectation is that over time we'll see HD voice become the baseline standard .The fact that we haven't defined it within Voice over LTE as a default codec is really because we wanted it to be something which was absolute bare-minimum because we need to take a global view of this rather than something which is specific to market so from a global perspective we don't want any kind of additional bells and whistles to become a barrier of entry on the basis of price, cost, or maturity of technology but my expectation is that high definition voice becomes the default for Voice over LTE implementation .

**Carl Ford:** Great. Dan, it looks like we're going to give you five minutes to spare before your next call so we want to thank you again for your time. And with that said let's move on to Manuel. Manuel - are you there?

**Manuel Vexler:** Yes, I'm here, and good morning, good afternoon, whatever the case is. let me jump right in and Carl hopefully you can hear me okay .

**Carl Ford:** I hear you fine .

**Manuel Vexler:** So I titled actually intentionally my presentation Voice over LTE in 'SMS over LTE' because the way I understand Voice over LTE is a migration path. It's really the effort to turn off the [inaudible 22:18] network in mobile and that makes us or forces us to think of all the services that carriers offers, not only the voice. Also I want to take an approach which goes end to end. As you know Huawei is a vendor which has all the portfolio from terminals all the way to IMS and core networks, mobile networks, and so on. So moving to the first slide I think we have seen this forecast before - mobile operators are still betting the next four or five year's growths or at least core revenues on voice. And this forecast is based on the fact that we expect the consumer demand to continue to grow. If we look worldwide we have many countries who are very close to the saturation point actually in deploying voice mobile technologies which include also countries underdeveloped or in early stage of development. If you look on the bottom part of the chart however and if we look at the US market in the last year we can see actually a decrease in voice usage in mobile networks. The decrease is about 7% to 8% year over year. We see a decrease of voice traffic at the expense of SMS traffic of text and Twitter. So in planning the Voice over LTE strategy I definitely ask and I think we should work very closely with GSMA, 3GPP, IMTC to factor in all the services we deliver over the circuit network and SMS is a key one. Moving to the next slide -- now I think Dan already touched a little bit on the prospects for 2012-2015. I brought a little bit more data about those and if we look at LTE in the US it's being pushed extremely

aggressively by Verizon. I expect the same pattern to be seen with other large CDMA providers which they decided to use LTE as the 4G technology and that obviously poses a different challenge to the migration from CS to Voice over LTE. Other vendors - AT&T, a follower in the US for LTE - they have four or five regions at the moment. They launched the service in Dallas for instance. I checked it there, I have an LTE phone now, and I think it speeds up to 10 megabytes per second so just as a footnote this opens an opportunity for over the top such as Skype to compete with Voice over LTE, both in quality as well as in functionality. A couple of reminders - Skype is now part of Microsoft, they also offer not only Voice over LTE, there also offering multiparty conferencing with audio and video capabilities and so on; DOCOMO, again an aggressive and early adopter of LTE, in general adopter of new technologies, and last but not least Deutsche Telekom in Germany with a fallback as a strategy. If we look at the operators' plans we see 128 LTE networks commitment in 52 countries so LTE is definitely here, the question is when voice, when the circuits switched network will be turned off and Voice over LTE voice over broadband becomes the technology of choice for voice. Next slide please - on the most important factor in the migration to Voice over LTE of course is the capabilities of the terminals. Just second to actually the deployment of the LTE radio capabilities. I think we need to go a couple of slides back to the fast developing ecosystem. We're measuring very carefully the evolution of the devices. We see the Voice over LTE actually being now available in handsets from the Android side and we can see that evolution happening very quickly. I'm looking particularly at the US market - we've seen a number of vendors offering LTE terminals from Verizon and now AT&T. I think and I'm hoping that we'll see soon an announcement from the Apple camp so the Android camp is already in that area. Next slide please - the proposal in Huawei strategy is to take a phase approach. I see in this strategy actually shared with many of the participants in the LTE market and what I'm predicting is that the Voice over LTE opportunity would start actually earlier than maybe some of the analysts are predicting. The reason for that is that first thing the terminals are enabled to have SIP clients, to have VoBB clients like Skype so that puts pressure on operators to offer more functionality. As a result, and I think that's important for the IMTC as well, we need to focus a lot on not only testing the capability, the basic capabilities of voice in Voice over LTE but making sure that in our tests for interoperability we factor in the requirements for the market for a high quality voice for voice features such as voice conferencing as well as mixing media such in the video conferencing. So I don't see the Voice over LTE being a market which is a stand-alone market anymore. As soon as we move to LTE, as soon as we move to a 4G technology with large capacities in the network we are opening actually the market for the triple and quadruple, for the triple play on the mobile side - so voice, video, and high speed internet access become really a reality. Next slide please - the solution from Huawei is actually made of the three components. As I said I'm taking an end-to-end approach to today's presentation. As I mentioned the diversity of terminals has to be factored in because we are dealing with consumer markets, dealing with different price points, different acceptance levels, different education levels so diversity in terminals has to be matched with actually keeping the network as simple as possible, as homogenous as possible so our strategy in Huawei is while we diversify in the terminals and consumer devices and enterprise devices we streamline the network and our strategies are around the single core, single ATC and combining the databases for mobility and functionality, typically IMS so we're looking at single HSS and so

on for the strategy. Last and definitely not least enriching the user experience past the circuit switch voice is mandatory. We're looking and I've seen in our presentations we're looking at the challenges from a technology and migration view point but really from a consumer view point this is transparent, it's not going to be advertised. What needs to be changed is the approach to the way - the quality we deliver voice, the services we deliver with voice, and as I mentioned at the beginning of my presentation, we should definitely look at text, SMS, and so on - it's not enough to look at the VoLTE migration but we need to look at the circuit switch to all IP networks with IMS and 4G technologies and Wi-Fi technologies actually integrate as Dan has mentioned in his presentation, Next slide please - so summarizing, keeping simple the migration and keeping simple the core network we're looking to make it easy to deploy and definitely I cannot stress enough enriching the user experience is critical as I showed on my first slide ,voice in mobile network is following the same path as voice in circuit switch network - people use less voice, more text, more multimedia, more Facebook, more Skype, Twitter and so on. Thank you, Carl. I'm ready for questions.

**Carl Ford:** So I said Manuel as I wanted to make it so that we ask these questions towards the end and we move on to Stefan. So we've got a question about silicon which I think it will be better if the panel answers so let's hold off that question and let's move on to Stefan.

**Stefan Svensson:** Okay, thank you, Carl. Can you all hear me?

**Carl Ford:** Yes, you're fine.

**Stefan Svensson:** Okay, thank you. So I'm Stefan Svensson from Ericsson. I will share some VoLTE insights and perspectives from an Ericsson point of view. So moving on, first slide, if you can skip please. VoLTE is happening now - let me describe a little bit around the moment we see and then some basic facts that are really leading us to this conclusion. Operators planning them and I think we share the views earlier on said that they will start having launches during the next year, 2012, and very much driven from North America and Ericsson being part of the installations done in North America, seeing a very good [inaudible 34:34] the next phase, it will be followed by Europe and Asia but the need for CS functionality is slowing a little bit down in Europe. We have as a second point IODT/IOT starting to happen with good proofs. We're starting to look at IOT for the radio parts, for the IMS application parts, and also tying it together then for the total stack in towards the network, combining networks and terminals. We have seen good progress when it comes to network vendors providing products and solutions and the functionality as specified in VoLTE profile is being released into commercial products. We have the optimized] [inaudible 35:34] available, we have the IMS systems so it's really them coming into the phase where we can see that materializing commercial solution, both on the device side and chipset side

and on network side. And good proof is cs4(?) being rolled out as we speak and then the next phase being VoLTE rollouts during next year. And LTE being deployed on very relevant frequencies for doing voice in the US with the 700 bands, in Europe with 800 bands, giving the right coverage and really see that coverage is key for having a good service. With these bands available and being launched that's really a good basis for launching services. And LTE and the pace that we see LTE being rolled out, it's really superseding what has happened before on 2G/3G sides so it really gives good hope of fast transition and fast introduction so I think these are five strong points for VoLTE happening in the time that we speak, starting them from basically next year and onwards. Moving on then to the next slide please - when it comes then to the foundation for doing VoLTE it's very much about catering for service evolution. And the best way as we see for serving service evolution is them to see that you have a good foundation of continuous package coverage where you can really use a number of capabilities in the network and spread it to a number of devices. Communication in an all IP environment, adding on - we have spoken about HD voice and video capabilities further, multimedia services, etc. and specifically if we look at video we've done the initial VoLTE profile, the IR 92, and then coming to the add-on IR 94 adding then possibilities to do ad-hoc video conferencing, etc. We see a very good interest to add-on video and even a lot of operators looking to do video as a day 1 service, adding them to the voice and the VoLTE services. So it is then of course not stopping with these services but it's a multitude of possibilities when it comes to adding then support for different types of accesses, having multiple devices, etc. but all these framed into more of the technology legacy of telephony while still being then reachable for everyone, being able to contact everyone. There's a lot of good legacies to bring into the service evolution and that's really what we see VoLTE doing for the future. Moving on to the next slide and talking about end-to-end approach. And we can't emphasize this enough when it comes to looking at the value of keeping them together, the full chain of the stack, all from the application to the packet core access all the way towards the device. We are working throughout the full stack, having matured solution from doing initial functional tests to gradually coming into more and more of the service quality, the capacity aspects, etc. and focusing then on aspects of voice quality, service quality. The goal has then been and is to be able to offer at least the same or better service as you would have on 2G, 3G when it comes to voice quality, etc. and really where we are when it comes to proving that is that it's really showing good quality, we are basing that kind of statement on tests done - first done in labs but also done in commercial networks, field tests. So if we look at some of the main key performance indicators for doing VoLTE when it comes to speech quality. To the upper right in this chart there's a graph indicating then speech path delay which is one of the critical measurements in order to follow up the voice quality. And this is on one side measured in labs but also in field tests. But if we look at the charts we have on the green and orange part the transport delays, the coding-decoding parts, which is then really showing a good and healthy low contribution to the speech path delays and of course there is also an additional part generated from the device. We're already at the level around a little bit more than 200 milliseconds but as more and more mature devices are coming into a commercial deployment, wider scale deployment we're very confident that we will see more and more optimization in the devices to bring this down to below 200 and really ensuring good quality when it comes to the delay aspects. Another vital part when it comes to quality is then the call setup. And here we see that

traditionally some kind of average numbers for 2G, 3G system - call setup times around six seconds - that's really what we have to beat when it comes to VoLTE. And you have a number of different charts looking down to see depending on what state the device would be in and on one side you can have a device fully connected, fully active mode, on one side in the battery-saving mode and even then with a not prepared device in idle mode you talk about call setup times around two to three seconds and extremely fast when you have then two devices in connected mode. So looking at all in all the different measurements of course still improvements to be done, we really see that VoLTE is going then to meet technology potential in the hopes that we have put to it and this is really, as I said, measurements being done in real networks and in field trials. So coming up to the last slide, a little bit of summing up - realization is really starting to happen. Of course there's a process to come into launch but the deployments, as I said, happening from next year and really see good momentum in the industry overall, active dialogue when it comes to device players, operators, network vendors. And the technology efficiency and end-user experience, really the technology potential is something that we are able to prove and really differentiate the service around. VoLTE is not only doing voice, it's really a combined starting point to see aligned and work for interoperability but it has a great potential in adding video capabilities, other multimedia capabilities into the offering and to competitive bundle from the operator point of view. And stressing then again putting together a full system, managing it from a total end-to-end perspective, looking carefully at the KPIs and all the optimization that needs to be done and I think that really summarizes what our main message is from Ericsson.

**Carl Ford:** Great, thank you, Stefan. Did I hear you right that there's a six second or was it six milliseconds in setup of the call? Is it actually six seconds ?

**Stefan Svensson:** Yes, in the normal kind of average call, just clock it the next time you do a normal phone call and you will probably experience something in that range .

**Carl Ford:** Oh my God, I didn't realize it was that bad. I know in the very first days of MCI it was two minutes for the setup on their phone network. I recognize that we've got an order of magnitude better here but it still sound –

**Stefan Svensson:** Yes, you sure do, so you're invited to our labs and you can really see that it is a difference even though you might not notice it in your everyday life .

**Carl Ford:** Right. It made me wonder, when we did Voice over LTE, when we did Voice over IP we actually had to make it so that the phone generated the sound of dial tone itself just to make it so people knew that they were connected, right? And wireless doesn't work that

way, right ,you just press send. But now i'm sitting here saying we're going to bring back the sound of dial tone to wireless - we'll see. Let's move on -Geng are you there ?

**Geng Wu:** Yes .

**Carl Ford:** Okay, Geng Wu from Intel, please continue

**Geng Wu:** Thank you, Carl. Thank you everyone for attending this webinar and thank you IMTC for offering this opportunity. So I will talk about from an Intel perspective how the VoLTE and its role in the future of the telecommunication and information society. Next page please. The world is increasingly connected and as we speak today Intel's platform is powering the telecommunication networks around the world from the data center to application server to gateways to radio access network nodes and the other devices that include the text, [inaudible [47:53 and the mobile terminals. So one thing interesting is that LTE significantly increased the uses of data bandwidth for rise in new potentials for the new applications; on the other hand it also raised users' expectations.

**Anatoli Levin:** I'm sorry, someone is typing on the keyboard right now very loudly. It would be great if you can mute yourself please. Please continue .

**Geng Wu:** Okay, thank you. So we can somehow expect that LTE are the ones that will further push the envelope in enabling new innovative service center applications and a greater users chance with new technologies to [inaudible 48:42] aggregation. However, a major issue that we here from the market and our customers is that the experiences are clearly fragmented and there's a lack of service consistency and in addition as a network involving hydrogenous networks we can expect more challenges and the risks of customer expectations. Next page please. So Intel's goal, the ultimate goal is to improve user experience. That would actually include consistency and the service availability and the cost and the power consumption - we need to reduce that. We also need a framework for new service application introductions to add a new value and revenue for the consumers and the operators and also the new framework has to enable the future hydrogenous networks to deployment and also enable the future multicom, what we call multicom at Intel ,basically different type of interfaces working together and having consistent service. Next page please. So Intel sees VoLTE offers an attractive offering is first mainstream application for IMS and it's a part of a future rich platform that not only bridges the past with the future but also with expansion in the future, expansion of future technology. It was systematically designed and thoroughly designed from a requirements point of view, from interoperability , backward compatibility, and also from a service and a revenue generation point of view. Also ,it's was highly optimized over the data plan for the quality of service delivery over an IP

network infrastructure and there's a lot of consideration put in in the interface for power saving and cost reduction. Another thing we found VoLTE attractive is that it can operate across many types of devices and also is standards-based and potential for larger scale global deployment and application. However, having said so, we also recognize that there are still quite a number of challenges for VoLTE. For example, it's highly complex and with many specifications. This page lists just a few and if you look at GSMA IR 92 documents there's a long list of specifications. So as a result integration of LTE from a practical point of view a gating factor in the VoLTE [inaudible 52:35]. And from the past experience, user experience cannot be granted and delivered by just by one or two companies. It requires the whole ecosystem working together. Next page please. Now the challenge for the ecosystem is how to make it happen. We are certainly dealing, as I mentioned earlier, we are certainly dealing with a complex network and the picture shows there are many elements involved in this network and it will only become more complex as we introduce hydrogenous network deployment concepts. We need a rigorous faster process in ecosystem collaboration and we see IMTC a very good initiative to help achieving the goal. To summarize, from Intel's perspective VoLTE is a good starting point for the next generation technology innovation, a lot of work still needs to be done, and for example I mentioned the roaming that still needs to be completed and more importantly integration and the testing process is key, and the ecosystem must continue its current progress in 3GPP, GSMA, and IMTC. Thank you very much .

**Carl Ford:** Thank you, Geng. I appreciate that. I've got questions for you but I'm going to hold them until the end so that we can get to Anatoli and talk about how we see things moving forward. So Anatoli, welcome.

**Anatoli Levine:** Thank you, Carl. Hello, everyone. Thank you for attending our webinar. I'm essentially, right now I'm more or less talking head because Tsahi Levent Levi was supposed to speak on behalf of Radvision and also IMTC IMS activity group but unfortunately he could not join us so I'm going to speak for myself but really on his behalf. So in essence I'm going to be, as I have to do on a lot of my presentations, I'll have to constantly twist ahead, left right, back and forth because I'm going to be between Radvision and IMTC but really the way we see things, the way Radvision sees things is pretty much very aligned with the whole IMTC vision, the implementations are not the same as standards and this is why IMTC exists in the first place but most importantly for Radvision, for us in the company this was always extremely important. It doesn't matter that you have a standards-based implementation; it doesn't mean that interoperability will be achieved just by the virtue of fact that your implementation is standards-based. There are always issues which need to be worked on in a signal capabilities, in media, and the overall alignment of the technologies. There are always issues to work on. So if we look at - you've heard a lot, Dan Warren gave us an excellent introduction into where Voice over LTE is, where it's going, and if you look at the overall process of how standardization works so we start from the specification that exists today, we've got IR 92, we've got some of them were new to me today like IR 58, I heard

about IR 94 so there is a whole bunch of other specifications coming into play that will be all important. And here they come from GSMA and then once we have those specifications then what we can do, we can get our R&D departments, get them to work, and get them to implement. So once this is done, once you go through the R&D process you've got something you can now play with. First of course you're doing the internal testing, you want to make sure the software works, it works on the proper devices, everything is great at least for your internal needs but then so technically you have something which is working but now that's the real time, really it's time to make things work. So this is where you get to the phase of the interoperability testing and this is what IMTC is essentially doing since 1992 - interestingly enough the organization will be 20 years old next year - and in essence there's a whole bunch of different areas: video, communication, and so on and so on. We always see IMTC as an organization who is focused on video but we've always done all kinds of Voice over IP streaming, really everything, 3G324m which is mobile media, a lot of different work was done, all within IMTC and the latest one is the Voice over LTE process which is done in our IMS activity group. And in essence unfortunately I only saw it when Dan was presenting his slide, when he mentioned the IMTC SuperOp which was the last interoperability testing event which took place in May of this year and we did have headsets, we've had Voice over LTE headsets from SE Ericsson, we did have Voice over LTE headsets from Samsung, and we had a soft client from Intel so I would not say that we didn't have Voice over LTE headsets and most importantly all those headsets have been deployed on a live Voice over LTE core which was provided by Huawei. So in essence we did testing, we tested voice calls, we tested from functionality such as transfer and so on. This was all working and again this is what IMTC does, we really do interoperability testing for a lot of different technologies. And so once you pass through the interoperability testing, not even passed, but from the outcome of interoperability testing now becomes an input into certification process because this is what carriers want. When they're going to carry a device they want to know that this device is going to be not only standards-compliant but it is important that it will perform under whatever circumstances are so this is where organizations like Global Certification Forum comes to play which defines the process, they define the process of certification, and they conduct certification testing. I would like to stress that IMTC doesn't do anything with certification, we do interoperability testing, we develop test plans and do just an interoperability testing and then GCF, that's totally a separate process, certification is different from interoperability of course. And in essence just here are a few more bullet points. We implement test specification and then we conduct events. We conduct face-to-face events when all the vendors get together and test their implementations and then based on the results of that testing effectively there are a few possible outcomes. One outcome of such an interoperability testing is of course the enhancements in the product; not even enhancements but you're really making your product interoperable. What else is happening is that sometimes specifications has issues so those issues IMTC has ongoing relationship with all those standards defined in organizations, GSMA, 3GPP, ITET, ITF and so on so every time we see provided feedback we always can do it, we've done it on numerous number of occasions. There was an interesting dialogue about call setup time so I'm not sure if we have that point here but that might be outside of our realm but I can tell you when the mobile media telephony was popular based on the 3G324M protocol based on IMTC work the call setup time was improved from - initial call

setup time was almost close to 20 seconds. We managed to get it under two seconds and that was all based on the practical work done in the IMTC activity group .The important thing IMTC does is working well is because our interoperability testing events ,they're really engineering events. Most of the operations of the consortium is engineering. We have engineers working in the activity groups, building the test plants and then we have the same engineers coming together and test their implementations, there are no marketing folks, of course there are no sales, needless to say, but really it's all engineering events, engineers , there are rules of engagement which guarantees that everything which is happening is private within that testing room and therefore engineers can work in an open environment and they can effectively - it doesn't matter that the company is our fierce competitors but engineers can work together and engineers can solve issues -- this is really a great benefit. That's what makes IMTC somewhat of a unique place. Now going back to the Radvision as a software vendor what we do is of course we implement, we have a lot of different products which support Voice over LTE implementation, we have different IMS clients, we have our toolkit products like SIP Toolkit which is supporting full IMS compliance and of course it's supporting the Voice over LTE implementation, we have video clients which are also Voice over LTE compliant. This is all done in R&D of course and those products come with a Q&A and then they become part of something which has been implemented by our customers so that's our focus as a software vendor. And with that here's the contact information for IMTC and with that I really would like to thank everyone for their attention. We're done like formal part of the presentation and in our Skype channel I saw Carl vigorously talking to I don't know how many people but we definitely got some questions so it would be great if all the speakers will unmute themselves and you can definitely speakers could use video and Carl, take it forward .

**Carl Ford:** Thank you, Anatoli. Great job and thank you for organizing this and it's been a great learning for me and I think I know a lot about this stuff. We've got a few questions, one of them that came about was how did the setup time compare to over the top voip calls. I don't know the answer to that. Has anybody been actually paying attention to looking underneath the Skype protocols and Google talk and what the normal setup time is for these things? I think they're much less but I think that's because of the fact that there's much less signaling involved in end-to-end?

**Stefan Svensson:** I don't have a benchmark on that but I think really the strong point is when we talk about the setup for VoLTE is that we have the controlled flow throughout the network so when it comes to the reliability aspect and so on of actually succeeding, doing the call setup ,having it extremely fast and that's really the big advantage as I see it .

**Carl Ford:** I think an apples to apples comparison would have to be something other than an internal Google Talk or an internal Skype or internal iChat, it would have to be like the Skype

for Mobile that Verizon implemented with RCS to get a good handle on that on how that signaling works.

**Stefan Svensson:** The experience is basically an instant setup and that's really the good part around that.

**Carl Ford:** I love it when acronyms come in that I don't know so I'll ask Anatoli to start me off answering this because he will probably know the acronym. What is the lowest QCI needed to support acceptable Voice over LTE for instant latency requirements?

**Anatoli Levine:** QCI ?

**Carl Ford:** QCI .

**Anatoli Levine:** I have no idea. From QCI, Carl, now would come in the CQI codes, some kind of quality indicator, I'm assuming, but my guess would be call quality indicator. Excellent, now we figure out the—acronym. I still don't have an answer. I think the acceptable latency for any phone call is about 200 milliseconds -- that's technically considered acceptable.

**Carl Ford:** Let's just [inaudible 68:23], if we go to HD does that change any of the parameters at all, does it make it so that latency has to be better because of the fact that we've got a deeper samples or packets are packets and UDP is UDP and we're okay ?

**Stefan Svensson:** If I can just give a comment on the quality I think we are talking about a little bit of the framework of having - speech path delay below 200 milliseconds and frame error rates below 1% and I think what we have indicated and I got from tests is independent of that radio unload. We are getting frame error rates from 0.2% and then we have the speech path delay in the area of 200 milliseconds so I don't know exactly what the question was aiming at but that's a little bit of some of the parameters involved in ensuring good quality.

**Geng Wu:** May I add some comments. This is Geng Wu from Intel. So CQI is basically internal feedback and it actually dictates the data rates on the physical layer. So I think the - oh

sorry, I'm actually talking about something different. That's the QS class identifier - okay , now we're actually coming back with QCI, sorry. So I was answering CQI question and then the question actually turned back to QCI. So QCI that's really guaranteed, you basically have a guarantee. I have to check back the specifications and there is a level that they need for voice services. Essentially it's the very high class basically .

**Carl Ford:** Okay, I'd ask Pat if he's got any insight himself into this. Geng, I'm not sure whether it was you or Anatoli who mentioned a Samsung Ericsson implementation for the - that basically had the VoLTE put in and the question is was VoLTE implemented on the client side in silicon or was it from an IMS client software implementation ?

**Anatoli Levine:** Those were definitely handsets. Those were handsets which were used in the testing .

**Carl Ford:** And were they silicon based or were you in effect—

**Anatoli Levine:** They're actual handsets like these - not this device but exact handsets , silicon-based .

**Carl Ford:** Okay, so the silicon was already implemented. Okay, cool. So do we have a rollout schedule? Like do we know what tasks our panel with silicon involved. Manuel, the handsets that you guys provided are they going to be commercially available or did you build them just for the testing purposes?

**Manuel Vexler:** There are already - we're talking about the tablets, right?

**Carl Ford:** Well Voice over LTE, I'll take it in any format. I would love to have a tablet, I'm fine with that.

**Manuel Vexler:** I cannot provide a detailed answer but I know we have IMS clients working on our devices hence on an IMS LTE implementation it should be able to provide VoLTE .

**Carl Ford:** Okay, Geng just out of curiosity is Intel implementing this in the A4 or should I expect that all atoms are going to be Voice over LTE capable regardless of who's making them ?

**Geng Wu:** It's in the baseband chipset so in other words really the optimizations include three parts that we're actually working out of them. One is the control plan, basically they're all for the Pay-Station, the server, platform with virtualization that has speed up of the similarly controlled plan process. There's another one, there's the data plan optimization for quality guarantee and that's back to the part doing across the application processor and also the baseband. Then there's a silicon supporter in the base band ship side and that's also something we're working on .

**Carl Ford:** Got it. And Stefan I know that that's normally done by that Sony Ericsson crowd so maybe that you're not privileged to what's going on on the chip sets but have you got any insight?

**Stefan Svensson:** I mean you're right, when it comes to participation in the IMTC event it was in the ST Ericsson but of course we are involved when it comes to on one side testing the radio aspect of modern products, doing that IT labs with the radio and then we do the client, the application part towards our IMS applications, and then we put it together into the [inaudible .]74:35 So we are of course involved but not responsible for it if you like.

**Carl Ford:** Got it. So [inaudible 74:47] has admitted knowledge about the whole QCI question in case anyone can't see it because they're on audio and it says most over the top is best effort today but jitter free voice might demand highest QCI class except quality might be achievable with QCI with less rigorous demand. I understand that LTE's goal is 10 milliseconds latency for the user playing which is fine for voice quality at it's highest level .

**Stefan Svensson:** So he definitely should be invited to speak at the next event.

**Carl Ford:** Yes, he's a ringer. We need to get him involved. So let's see - we had a whole bunch of discussion with Mr. Good here. Let's just see if there are some questions of implement .Actually there was one thing that was kind of interesting which I'd like everybody to just talk about in general - here's my perspective and you guys can tell me I'm absolutely wrong - but as we move to LTE my assumption is that we're going to get less radios not more on the devices and therefore battery life will improve. So the question was kind of a general rant about comparing voice of 2G, 3G, which solution will help optimize end users experience on LTE voice especially the improvement based on computing power per 12 seconds, current consumption for 12 seconds ,battery efficiency, billing per second,

spectrum usage, and call specific responses. So it was all those long winded stuff that basically said "Are we basically making it so that I can only have a five-minute phone call and then I need to recharge." So anybody want to talk about what their expectation is as we move to LTE as what the impact is to the device in general battery life?

**Manuel Vexler:** Carl, I can address that but I think we should look at end-to-end and let's look at the devices for a second, I'm sure Intel can go much deeper in the CPU and the components .But if you look at the device the software running on it, especially over the top applications and so on, [inaudible 77:07] using again and again and again the same network services such as presence, location, and so on. So [inaudible 77:19] by GSMA RCS. [inaudible 77:26] system level and start to look on how you optimize these functions [inaudible 77:35]. This is my view and we're discussing that quite a lot internally at Huawei. I'll turn over to you .

**Carl Ford:** Gang, have you got any thoughts on the Intel guide? Are you guys sitting there saying "Holy cow, look how much power I'm saving because I don't have all these stupid radios "?

**Geng Wu:** Well, here's the situation. Basically if you look at the mobile platform the biggest power consumption, source of power consumption actually is the display. So the display - that's the biggest one - and then you have a whole bunch of similar links going on, for example messaging and you basically keep waking up the radio and the application processor and that's another source. It depends on how much optimization we do together with folks like Huawei and Ericsson, we actually [inaudible 79:01] with that part. And then there's really the radio itself. The radio itself actually with the silicon processor continues to improve. It is actually becoming less and less an issue and nothing is not an issue but it's just a naturally going down. So far at this point there's not the main problem from power consumption point

**Carl Ford:** So you're saying that software-defined radios are going to make it so that all these issues kind of

**Geng Wu:** Software defined radio is probably not we expect to continue to see the device side to be harder than the design -in other words [inaudible 79:49] and the reason is that the users 'expectation and the requirements are actually going up even every time silicon improves we actually have this - how the room basically moved at all to the application to application to improve the other experience and all for new capabilities. On the pay station side we basically see that is becoming softer and softer.

**Manuel Vexler:** And Carl, if I can just add, and I think also in the definition of the VoLTE profile, the IR 92, I think it was a really good move to mandate all the different day 1 DRX in order to improve the battery life time so looking at the voice aspects you have mandated functionality in order to get superior lifetime.

**Carl Ford:** Okay, so I -- [inaudible 81:07] sent us a note about the exact standards on QCI. We definitely have to get him to come out and talk in the future, Anatoli. Let me end this with a very interesting question for you. Back when I was involved in coming up with the internet strategy for a major carrier, remain anonymous, but we're in their footprint right now, the backbone looked like it was important and there were all these ISPs in this world, now you look and most people are getting their services from the major carriers. What is our expectation for over-the-top folks like Skype, like Google Talk, like iChat, it could be BlackBerry Messenger? Do we expect that the carriers are going to regain control our over-the-top experiences or do we expect that they're going to interconnect or do we expect that the worlds will basically co-exist in different ways? Anybody want to be the lead to answer that question?

**Anatoli Levine:** I think they will co-exist. It's too difficult at this point to - the merging ground was not in the books right now and their interest in saying is the way I see the generation which is really using those, they used the ideas that they have to use, different tools for different purposes. So they'll use one messenger type for one group of friends and then another type of communication platform to talk to the other friends. My son is 13 years old, he's using Skype when he's doing one kind of activity then he is doing the FaceTime at the other time - he really doesn't care. I expect that this trying to put it all together will be difficult, if not impossible. I'm sure there are other opinions here .

**Carl Ford:** Are there other opinions?

**Manuel Vexler:** I share the view that for sure there will be a combination that to a large degree I believe that it's about creating a competitive service bundle and there you need to on one side perhaps have control of the really important stuff and add additional components that is more service as seen from other directions so no isolated island but at the same time perhaps see what it's there to control.

**Carl Ford:** Geng, do you have any thoughts on this?

**Geng Wu:** No further addition.

**Carl Ford:** Manuel, we saved the best for last, you were speaking about RCS what do you think the future is?

**Manuel Vexler:** If we look at the ecosystem, again coming from an end-to-end approach and coming from the terminal side, I'm seeing that terminal is becoming more like general purpose devices like laptops and tablets and so on. I cannot see how carriers will continue to exercise control over such a multitude of devices and functions and I agree with my colleagues - we have to start to look at the value added in the quality of service. One thing we talked at RCS but the other thing is while service providers are called service providers because they offer 24/7 support ,they offer billing support and all these. Who called the Skype support line and got a live person answering the call? Have anybody experienced that with Skype yet ?

**Carl Ford:** No, not yet, although I do call some of them directly but that's a different issue . Sometimes they can't hear me on Skype .

**Stefan Svensson:** But how often do you need to call Skype for support ?

**Carl Ford:** Sure enough. I think it will be interesting to see if we get a VoLTE implementation like Skype for mobile that Verizon did. It would be a fun way for people to work and I think Manuel's got it right that the question really is what's our device for the future. I have my tablet here, I've got my computer here, and I've got my phone here - one day I expect that I'm going to choose one and not carry all three. I'm supposed to be a wireless expert but mostly I'm a guy who knows how to find power ports. Anyway, with that said I want to thank the panel. I want to thank Manuel Vexler from Huawei, Stefan Svensson from Ericsson, Geng Wu from Intel ,Anatoli Levine from Radvision, and of course Dan Warren who had to run away from us from the GSMA. Please remember that this is available for viewing after this call and share it with the people who are interested. And if you have devices or are participating in any way, shape, or form with the network of the future consider working with the IMTC to make it so that you're interoperable with the rest of us. Thank you all for your time.