Evolution and deployment of VoLTE

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Four approaches to mobile broadband voice

In the near future and after the evolution from TDM to IP and from traditional switches to softswitches, mobile voice services will evolve to mobile broadband (MBB) voice services. In terms of network evolution, it will mean the evolution of GSM/CDMA/UMTS to LTE on the radio network side and the evolution of CS to IMS on the core network side. Over the last few years, there have been multiple views, technologies, and evolution paths for LTE voice services. At last, four approaches have been accepted as possible commercial choices.

The first approach is based on circuit-switched fallback (CSFB). LTE just provides data services, and when a voice call is to be initiated or received, it will fall back to the CS domain. When using this solution, operators just need to upgrade the MSC instead of deploying the IMS, and therefore, can provide services quickly. However, the disadvantage is longer call setup delay. However, in most cases, the CSFB solution is suitable as an interim solution prior to the deployment of IMS supported services. In addition, it can also be used to handle voice calls in the scenario of LTE roaming. For example, when the network in the visited network does not have the IMS or when the IMS roaming protocol is yet to be deployed, CSFB can provide voice-call service for inbound LTE roamers.

The second approach is based on simultaneous voice and LTE (SVLTE), which is the dual radio handset approach. In this approach, the handset works simultaneously in the LTE and CS modes, with the LTE mode providing data services and the CS mode providing the voice service. This is a solution solely based on the handset, which does not have special requirements on the network and does not require the deployment of IMS either. The disadvantage of this solution is that the phone can become expensive with high power consumption. Currently dual radio handsets featuring CDMA 1x and LTE are already available and used by some CDMA operators as an interim solution prior to the deployment of IMS, while dual radio handsets featuring GSM/UMTS and LTE are not yet available.

The third approach is based on the usage of over-the-top (OTT) services, using applications like Skype and Google Talk to provide LTE voice service. LTE boasts features like broad bandwidth, low latency, being always-online, and All-IP, creating natural convenience for the development of OTT and making OTT voice calls almost barrier-free. However, we should also note that now

and in the foreseeable future, the voice call service is, and will still be, the main revenue source for the mobile operators. So handing the LTE voice service over completely to the OTT actors is thus something which is expected to not receive too much support in the telecom industry.

Compared to OTT, telecom operators have their own unique advantages in providing LTE voice calls, such as user ID resource, standard-based interconnection, QoS assurance, the ability of handover to CS, and tariff package bundled with data service. In the future, the percentage of OTT calls may increase drastically, especially for the long-distance call. However, the call service provided by telecom operators will still be the mainstream for a long time.

The fourth approach is the IMS-based VoLTE. IMS has become the core network's standard architecture in the All-IP era because it supports multiple access modes and a wide range of multimedia services. After developing and maturing over the last several years, IMS today has crossed the chasm to become the mainstream choice for VoBB and PSTN network migration in the fixed-call field, and has also been identified as the standard architecture for mobile voice service by 3GPP and GSMA.

Of the above approaches, both CSFB and SVLTE rely on the CS domain to provide voice service and both have some limitations. They can be used as the interim choice and non-mainstream application, which we call pre-VoLTE. Only IMS can provide a voice solution with the QoS assurance based on LTE. In other words, the IMS-based VoLTE is the inevitable path for the development of the wireless and core network technologies.

For the operators, deploying VoLTE means opening up the road for the evolution toward MBB voice service. In the long run, this will create value for the operators in two aspects: One of which is increasing the utilization rate of wireless frequencies and reducing network costs, because for voice service, LTE's frequency utilization rate is far higher than that of the traditional systems – more than four times higher than that of GSM.

Another important advantage is that it will improve user experience, as IMS-based VoLTE service will be significantly better compared with a traditional CS based service. For example, the introduction of HD voice and video codec will significantly improve call quality. The call setup time of VoLTE will be dramatically shortened compared with the pre-VoLTE options. Tests have proven that the call setup time for a VoLTE-based call has decreased to more than half when comparing with call based on CS. Finally, the seamless integration with the Rich Communication Suite (RCS) offers the opportunity to generate many new and attractive services.

Development stages

Stage one: Pre-VoLTE applications emerge with LTE hotspot coverage

Initially, LTE focuses on hotspot coverage, mainly providing MBB data applications for users with data cards and tablet PCs. However, there will also be some early-stage LTE voice applications. The first is the voice service based on the soft clients, in the form of "LTE data card + soft client + PC", which can meet voice needs in some specific scenarios and help operators make preparations and accumulate operating experiences for the deployment of the handset-based VoLTE in the future. The second is the form of "LTE CPE + fixed phone". Some European countries, such as Germany, use this form to provide broadband access and voice call service for users in the remote regions. The third is the early-stage LTE phones supporting CSFB and SVLTE. Some operators have launched interim applications: For example, Verizon has announced that it will support SVLTE, while AT&T has announced that it will support CSFB.

Stage two: VoLTE applications on the rise with LTE continuous coverage

At this stage the operators will have increased the coverage of LTE, and be able to provide voice services, especially in cities and densely populated areas. Meanwhile, the advent of LTE smartphones in large numbers will have driven the development of VoLTE.

The operators will launch IMS-based commercial VoLTE services at this stage. However, prior to this, the operators need to have a long preparation period for the following reasons. On the one hand, VoLTE involves many new technologies and requires necessary tests and trials; on the other hand, the deployment and integration of IMS takes time, and some systems in the existing networks such as MSC, HLR, and IT systems may need a corresponding consolidation or upgrade. We think that it is necessary for the operators to begin preparing for VoLTE one year in advance or even before.

In addition, LTE coverage at this stage is still limited. The operators need to take advantage of the width and depth of traditional CS coverage to provide seamless voice service. This involves the interoperability of LTE and CS, and operators need to consider two technical issues here. The first issue addresses two options for the provision of service after LTE users have roamed to the CS domain – one is to process the voice call completely through MSC, and the other is to get connected to the IMS domain through MSC to provide the voice call service. The second option is the IMS centralized service (ICS) architecture defined by 3GPP, which needs to upgrade MSC to EMSC (enhanced MSC). The second issue is the handover from LTE to CS during a call – 3GPP has defined the single radio voice call continuity (SRVCC) technology for this.

Stage three: VoLTE becoming the mainstream with full LTE coverage

At this stage, either LTE coverage has become quite complete, or LTE and other MBB technologies such as HSPA can form seamless networks, to make the MBB voice service a mainstream application and gradually replace the traditional CS. Of course, this will be a significantly long process.

Network deployment strategy

Simplifying network architecture

IMS is more complex than the traditional softswitch technologies. Moreover, the introduction of VoLTE, especially its interoperability with CS, has further increased system complexity. Such complexity is reflected in the numerous network elements and complex interactions, and simplifying the solution architecture becomes the top priority. This can be achieved in the following ways.

First of all, adopt a common architecture. Huawei's SingleCORE architecture is based on this concept, enabling network elements such as CS and IMS to be designed based on the completely identical hardware and software platforms, making deployment more flexible, resource utilization more efficient, and operation management more convenient. It has natural advantages in supporting multi-network service integration and evolution.

Second, integrate numerous functions in a smaller number of network elements based on a common architecture. For example, Huawei's MSC-S is built in with MGCF, mAGCF, SRVCC IWF, CSFB Proxy, IBCF, and IM-SSF functions. MGW is built in with IM-MGW, IBGF, and VIG functions and the SBC equipment will support P-CSCF, ATCF, and ATGW.

Additionally, the operators should adopt the real FMC design to achieve converged and simplified networks in multi-service and multi-access scenarios. Although the IMS standard is designed for this, the real FMC and multi-service access still face many challenges in product implementation and commercial deployment, which should be taken into consideration at the beginning of IMS deployment. One challenge is the need to support multiple voice access modes and signaling protocols. Another challenge, which is especially of concern currently, is that the service processing unit, the telephony application server (TAS), needs to process multiple voice services under various mobile and fixed access modes, including VoBB, PSTN, and VoLTE as well as the customized services of some operators. As a matter of fact, some operators have already found that the IMS deployed previously cannot support VoLTE, so they have to replace some equipment.

Reducing the impact on the existing network

The deployment of VoLTE involves almost all the core network elements, instead of just simply adding an IMS.

After several releases including 3GPP R8/R9/R10, as well as the improvement by GSMA, VoLTE standards and technologies are already mature. In 2011, the industry has two significant developments: One is that more and more tests and trials are taking place, the other is the advent of the LTE smartphones.

Adjustment of or interconnection to the existing network's equipment is often the hardest part. To this end, we should think about how to reduce or even eliminate the adjustment of existing network equipment such as MSC/HLR on the one hand. On the other hand, we should also think about the coexistence and integration with the existing network equipment.

To support SRVCC for handover to CS and CSFB for inbound roaming, the operators should upgrade the MSC. However, large-scale network upgrade is difficult, involving a long cycle and high costs, and therefore should be avoided during the initial period of VoLTE development if possible. Functions such as SRVCC/CSFB can be centrally deployed to one or a small number of MSCs. If it's difficult to upgrade the existing network's legacy MSC, we suggest that a new MSC be introduced to serve as the MGCF, SRVCC IWF, or CSFB Proxy, to replace upgrading legacy ones.

In addition, although ICS is taken as the target architecture in the future, deploying ICS would require the upgrade of MSC-S throughout the network in the initial stage of VoLTE. This is too costly for many operators. Huawei's VoLTE solution provides two options: deploying ICS or not deploying ICS. In the model of not deploying ICS, after LTE users have roamed to the CS domain, the service is completely processed in the CS domain, and there is no need to trigger it to IMS. This can not only avoid MSC upgrade and shorten time-to-market, but also increase the equipment's processing efficiency.

For the deployment of HLR/HSS, we suggest that an overlapping solution is used initially, which is to overlap a converged HLR/HSS to manage LTE's user data, and to keep legacy HLR for traditional CS unchanged. This can avoid the huge work of upgrading HLR throughout the network at the very beginning.

In addition, the deployment of VoLTE involves many network elements such as IMS Core, TAS, SBC, and converged HLR/HSS, and some network elements may be already in existence for certain services such as VoBB. As such, the new equipment introduced to VoLTE should be easy to be integrated with the existing network's equipment. For example, CSCF and TAS may be from different vendors, and the IOT and integration between them should be addressed.

Enriching service experience

VoLTE will provide better voice and video call quality and faster call setup speed, but these reasons are not sufficient for replacing the traditional CS. More abundant applications beyond voice are required in MBB stage. On the other hand, facing the competition from OTT, telecom operators need to provide similar or more competitive services. RCS or the simplified one, RCS-e, introduced by some European operators can provide rich communication experiences, including IM, image and video sharing on the basis of voice service as well as the integration with the Internet services. Therefore, the RCS is expected to be widely adopted and deployed. In a sense, the development of VoLTE cannot do without RCS. Operators should consider the integration with RCS when deploying VoLTE, and because both of them are based on IMS, the seamless integration of VoLTE and RCS is also possible.

Accelerated commercialization

After several releases including 3GPP R8/R9/R10, as well as the improvement by GSMA, VoLTE standards and technologies are already mature. In 2011, the industry has two significant developments: One is that more and more tests and trials are taking place, the other is the advent of the LTE smartphones.

In the core network field, all the major IMS vendors have plans to support VoLTE, and are actively conducting tests and trials with the operators. What is especially worth noting is that in May 2011 IMTC (International Multimedia Telecommunications Consortium) organized the industry's first VoLTE IOT test in Hawaii, during which, Huawei exclusively provided an entire suite of the LTE/EPC/IMS network equipment and completed the test of interconnection with the terminals. In September 2011, MSF (Multi Service Forum) will also organize an IOT test involving multiple vendors.

In 2011, some terminal manufacturers such as Samsung and HTC announced the first LTE smartphones. This was an important milestone for the LTE industry. However, these terminals mainly support CSFB and SVLTE. Based on the progress of mainstream chip makers and handset makers, it is expected that smartphones that support the IMS-based VoLTE and SRVCC will become commercially available in 2012. Some operators in North America, Russia, Middle East, and Europe are expected to become the first providers of VoLTE services from 2012 to 2013.

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