Understanding VoLTE Interconnect
<table>
<thead>
<tr>
<th>Table of Contents</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>3</td>
</tr>
<tr>
<td>The State of the VoLTE Market</td>
<td>4</td>
</tr>
<tr>
<td>Why Mobile Network Operators Should Consider VoLTE Services</td>
<td>5</td>
</tr>
<tr>
<td>Defining VoLTE Interconnect and VoLTE Roaming</td>
<td>5</td>
</tr>
<tr>
<td>Understanding VoLTE Interconnect</td>
<td>6</td>
</tr>
<tr>
<td>IMS-Based Services</td>
<td>8</td>
</tr>
<tr>
<td>What Is Needed to Support VoLTE Interconnect Services</td>
<td>8</td>
</tr>
<tr>
<td>Interworking Function</td>
<td>9</td>
</tr>
<tr>
<td>Session and Policy Control</td>
<td>11</td>
</tr>
<tr>
<td>ENUM</td>
<td>12</td>
</tr>
<tr>
<td>Conclusion</td>
<td>12</td>
</tr>
</tbody>
</table>
Introduction

As the mobile world has concluded, the benefits of LTE are endless, but the ability to handle greater data amounts, along with signaling and overall faster speeds, has created a prime structure for the generation and development of supportive applications and services that continue to take advantage of these enhanced capabilities. Consequently, the challenges mobile operators face by not taking steps to implement new services are numerous and have direct implications on their future success.

For many of the world’s mobile network operators, the decision to implement next-generation mobile services with all-IP-based 4G LTE has been accepted. The continued growth of LTE supported by the further adoption of IPX networks globally has created the necessary platform to support the development of new IMS-based value-added services, including VoLTE. The introduction of VoLTE services within an existing LTE network has many challenges that go along with its many advantages, which tend to raise the ultimate question: What is needed to successfully support VoLTE interconnect services?

Although rather broad in scope, this question can be addressed by focusing on a few distinct areas that we feel are imperative to the successful rollout of VoLTE interconnect services. In this guide, we’ll explore these areas in greater detail, starting with the interworking function, then reviewing the elements necessary to support session and policy controls, and finally addressing a core foundational service in E.164 number mapping (ENUM), which has lived in the shadows of the IP world, yet has proven to be one of the more critical components to the successful implementation of VoLTE. To round out the guide, we’ll briefly introduce some IMS-based applications, including the resurgence of Rich Communication Services (RCS), as well as Video over LTE (ViLTE), Video over Wi-Fi (VoWiFi) and SMS over IP (SMSoIP).
The State of the VoLTE Market

With the rapid adoption of 4G-based LTE networks by global operators, the opportunities for the continued development of IP-centric mobile devices and the applications that run on them have grown exponentially. According to the GSA, as of August 2016, 537 operators had commercially launched LTE systems. With 771 operators having invested in LTE in 195 countries, LTE connections will touch an estimated 4 billion by 2020, excluding M2M, with the LTE global market share estimated to reach nearly 50 percent by 2020.

While the number of LTE deployments begins to level off in developed countries because of almost 100 percent adoption, the implementation trend will continue an upward trajectory for developing countries. LTE deployments in developing countries provide operators with an opportunity to bypass aging technologies such as 2G and 3G, skip the costly infrastructure of implementing intermediary networks, and instead focus on current, new, and even next-generation device and network support.

More than half of the countries with a live 4G network are in the developing world. The growing number of LTE rollouts in these markets is driving rapid migration to mobile broadband in the developing world.
Why Mobile Network Operators Should Consider VoLTE Services

The reasons for MNOs to consider developing a plan or taking the necessary steps to implement VoLTE services are numerous. In our VoLTE roaming guide, we previously specified various factors that operators will need to contemplate if they decide not to implement VoLTE services. These include managing revenue loss; maintaining balance within revenues, margins, and technology; not becoming stagnate in the industry by failing to move forward with newer technologies; understanding the costs associated from an infrastructure perspective to roll out VoLTE services; and letting the competition get an upper hand in capturing subscribers with the next-generation services they want.

Offering voice services over LTE has many consumer benefits that can impact an operator’s bottom line. Through an all-IP-based network, VoLTE provides a higher quality of voice that allows for much clearer calls than a typical cellular phone call. This call quality is supported by faster call setup times through VoLTE instead of 3G networks.

With the implementation of VoLTE supported by an IMS foundation, operators are able to deliver a new set of services. These include Rich Communication Services (RCS), which allow for the integration of additional value-added services, and include video calling, file transfer (for large files), language translation services, video voicemail, and instant messaging.

Defining VoLTE Interconnect and Roaming

The application of VoLTE is not a one-size-fits-all solution, as there are two distinct variations. Both VoLTE interconnect and VoLTE roaming have the same goal of connecting two VoLTE-enabled phones over LTE, but there are some critical distinctions between the two options.

VoLTE interconnect is defined as a subscriber calling another subscriber on a different network. More specifically, the action of interconnect is a non-roaming method where two VoLTE subscribers of different network providers place a call, video session, or media session to one another in their respective home markets. The interoperator interface designation between networks is called IMS Network to Network Interface (IMS NNI).

For comparison, if we look at non-VoLTE interconnect services, a call, video or media session has to typically run through multiple operator networks to facilitate the connection to a specific destination or destinations. The prime difference between non-VoLTE and VoLTE interconnect is that the VoLTE session can be handled over just one type of network between two wireless carriers — a secure IP network via IPX.
VoLTE roaming, on the other hand, requires the subscriber to move or travel to another operator’s service area and utilize that operator’s network. VoLTE roaming is also defined by two roaming scenarios: home routing (S8HR) and local breakout (LBO).

**Understanding VoLTE Interconnect**

Interconnect agreements are nothing new in the voice telecommunications industry. They have been in place to allow network traffic such as phone calls and data packets to be carried from subscribers on one operator’s network to a subscriber on another operator’s network. Typically, service providers that want to interconnect their voice and data networks would develop an agreement on the types of services to be provided over the interconnection, in addition to developing a variety of business and technical agreements on other issues, such as how to bill for the traffic, what levels of service must be provided, how best to route network traffic, and how to identify and resolve problems as they occur.

One of the key elements to successfully rolling out VoLTE services is the investment in an IMS core, which is designed to support multimedia sessions over an all-IP environment. This core includes a call session control function, or CSCF, and an interconnection border control function, or IBCF, which address communication between SIP applications, network topology hiding, appropriate signaling interconnect, and charging detail records.
Successfully rolling out an IMS infrastructure to support VoLTE comes with both advantages and challenges, including the following:

**Advantages**

- Faster call setup
  - Higher-quality voice and video calling, and class of service (using IPX)
  - IPX mediates the signaling and media components between the two networks and creates a better subscriber experience.
- Efficient use of spectrum, releasing extra capacity for data
  - Moving traffic from the 3G network (GSM or even CDMA) to the 4G network helps to free up additional spectrum that can be realigned to support the growth of 4G data.
- Optimization of network and service management while simplifying service delivery
- Security based on IPX
- Support for GSMA IR.92/IR.94
  - Drives the parameters and standards for allowing partner networks to communicate with each other.
- Ability to leverage an IMS core based in the cloud
- Real-time diagnostics and analytics
Challenges
- Supported IMS infrastructure
  - With the introduction of an IMS platform, there is also the introduction of additional components to the network and a myriad of new interfaces at both the home and the NNI interface or partner networks.
- Signaling protocol shift from SS7 to Diameter and SIP
- SIP normalization
- Ability to work with the variations in standards IR.34
- Bandwidth management
- Charging and accounting
- Emergency and priority calls
- Multimedia interworking between operators
- Voice transcoding
  - This includes delivering a call to a legacy voice network, which may not support the AMR codec.

IMS-Based Services
IMS, or IP Multimedia Subsystem, is an industry-standard service framework supporting IP-based services, and it is designed to be the supporting layer connecting both IPX and LTE, which supports Voice LTE (VoLTE), video over LTE (ViLTE), Voice over Wi-Fi (VoWiFi), Rich Communication Services (RCS), and SMS over IP (SMSoIP).

With support for all of these value-added services, IMS needs to be able to successfully route and deliver IP-based services across multiple operator environments.

Ultimately, IPX is the foundation for delivery of services with IMS sitting on top of the IPX framework, which supports the services and delivers a consistent and high-quality experience between operators.

What Is Needed to Support VoLTE Interconnect Services
Voice services, as we know, continue to decline in relation to other communication services, although even with this trend, voice services continue to be a significant revenue-generating service for global mobile operators. Mobile subscribers still expect high-quality voice services comparable to that of the stable legacy circuit-switched network they have become accustomed to. As a result, there is an immense amount of pressure on mobile operators to quickly implement a stable and high-quality VoLTE solution. With this, operators face the difficult task of implementing an expensive and relatively complex network technology with an unclear business case.
Unlike other forms of data services over an LTE network, voice services need to have the highest levels of quality assurance, along with a high level of performance, to ensure voice calls are free from latency, jitter and packet loss, all of which are detrimental to offering a positive user experience. In this way, a strong foundation needs to be in place in order to build a resilient VoLTE service, and this foundation is found within a solid and proven IPX solution. IPX offers the necessary environment geared to support voice by delivering an environment designed with quality-of-service and class-of-service support, a high level of security, and broadened bandwidth, all on a private network.

Built on an IPX network, VoLTE interconnect is supported by interworking function, session and policy control, and ENUM. In turn, these support the services built upon LTE, including VoLTE, ViLTE, RCS, SMSoIP and VoWiFi.

<table>
<thead>
<tr>
<th>Interworking Function</th>
<th>Session and Policy Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>• SIP normalization and mediation</td>
<td>• Network:</td>
</tr>
<tr>
<td>• Transcoding</td>
<td>• Session throttling</td>
</tr>
<tr>
<td>• Codec mediation</td>
<td>• Bandwidth utilization management</td>
</tr>
<tr>
<td>• VoLTE to CS interworking</td>
<td>• CoS prioritization</td>
</tr>
<tr>
<td></td>
<td>• Commercial:</td>
</tr>
<tr>
<td></td>
<td>• Black/white listing</td>
</tr>
<tr>
<td></td>
<td>• Service management control</td>
</tr>
<tr>
<td></td>
<td>• IWF control</td>
</tr>
</tbody>
</table>

**ENUM (IR.67)**

- Electronic Number Mapping
- Translation of E.164 to an IP address
- Supports migration from legacy to IP-based services
Interworking Function

As the name implies, the IMS interworking ensures that two entities or operator networks can work together to provide a successful outcome. Interworking for the successful delivery of VoLTE services can require SIP and codec mediation, SIP normalization, and transcoding.

SIP mediation is a process by which reconciliation and successful VoLTE communications are ensured by transforming inbound and outbound messages, specifically SIP header information, to ensure successful messages delivery across communications systems or environments. This is necessary because of the factors involved with different standardization groups working on SIP and developers interpreting the same specifications differently.

While SIP can be considered a standard language for VoLTE services, there can be several SIP “dialects” spoken by various communications elements. These interoperability issues can include compatibility between various SIP protocol extensions, deviations caused by noncompliant devices and operating procedures, and incompatibility. The solution is to mediate the SIP signaling by manipulating the content of SIP messages. This enables them to better fit the expectations of the receiving side by removing any SIP language barriers that could be encountered between disparate unified communications platforms, SIP trunk providers, and other SIP-oriented functions.

Operators seeking to quickly deploy VoLTE, VoWiFi and RCS services are challenged by the continually growing number of audio and video codecs as well as the need to maintain device interoperability between legacy and next-generation services. To accomplish successful interoperability, real-time transcoding needs to be implemented somewhere in the media path between devices.

Transcoding is the process of converting communications from one codec to another. Whereas SIP normalization relates to language dialects in the control portion, transcoding relates more to bringing together two different languages or media flow, and ensuring a smooth conversion among lots of codecs and codec types. For example, transcoding may be required to ensure a G.711 voicemail platform can appropriately receive HD calls, such as G.722. Like transcoding, transrating, the process of changing or normalizing supported transmission bit rates can also play a significant part in interworking among voice and video conferencing services.

With VoLTE networks, it has become more important that a service provider develop a comprehensive transcoding and transrating strategy that takes into account the following:

- Flexibility to offer new services by supporting either legacy or modern voice and video codecs.
- Intelligent network architecture to centralize, distribute or virtualize transcoding functionality appropriately.
- Robust quality of service that minimizes the number of transcoding events while balancing the bandwidth needed.
**Session and Policy Control**

With an all-IP-based LTE network, all data shares the same pipe, from web browsing, to social media, to VoLTE. A significant differentiator between voice services and other data apps is the emphasis on quality of service and a differentiated experience for the subscriber. As a result, the ability to manage speed, quality, and the Diameter signaling volume is critical to maintaining a superior voice experience.

For VoLTE, the Policy and Charging Rules Function (PCRF) is the critical network element that enables the reliable operation of VoLTE services. Policy management practices are needed to maintain an excellent quality of experience to the end user. The following are several practices that delineate the need to apply policy control:

- VoLTE uses a specific codec, AMR-WB as defined in IR.92, and interconnected partners need to manage the appropriate bit rate because there are multiple data rates offered for that codec.
- From the RAN to the core, operators need to apply the appropriate bearer type GBR (guaranteed bit rate) or non-GBR (non-guaranteed bit rate), and quality of service, EF marking.
- Operators need to consider if they will support video (ViLTE) or chat services (RCS) with their interworking partner, and if they need policy to either to allow or disallow such services either by the initial capability exchange or through the SIP INVITE offer exchanged between UEs.

One challenge for PCRFs to support VoLTE is session correlation from the network components, including these:

- Correlation of reserved bandwidth for the bearer and the utilization of this.
- Correlation of Diameter signaling, SIP, and bearer (RTP) traffic profiles for a single user.
ENUM

ENUM, or E.164 number mapping, is a standard to map telephone numbers to internet addresses. As the convergence of legacy telephone networks and internet-based services has advanced, a new challenge has emerged – how to not only convert long code phone numbers into IP-based numbers, and allow devices to be found and connected. Traditional telephone services are based on using standard telephone numbers (E.164) for addressing, such as +1-555-555-5555.

IP-based communications services, on the other hand, such as IMS, VoLTE or the SIP signaling that supports it, use a completely different addressing format. In order for the convergence of telephone services and those based on IP to continue, a mechanism is needed to translate standard telephone numbers into IP addresses. ENUM is simply reusing the well-known DNS technology, where the E.164 number is translated to a domain name, therefore allowing a mobile device supporting VoLTE to be found over the IP network.

In order for any IMS service to work, especially VoLTE, operators need to be able to determine the destination network operator and route session requests for the appropriate network interface of that operator, and ENUM is the critical component for this.

Additional information on ENUM can be found in the GSMA specification IR.67.

Conclusion

VoLTE is making a substantial impact on the market. Mobile operators continue to look for new solutions and services that help them to grow revenues, as well as satisfy the continually growing hunger by subscribers for new services for their mobile devices. Understanding the implications and opportunities of VoLTE, including the needed infrastructure for it and the advantages and challenges of it, will help operators make a better decision about how to best implement voice services over LTE.

The IMS foundation that helps to power the VoLTE interconnect service will continue to develop as a critical element in successfully interconnecting mobile operators and their LTE-based voice services, while also establishing the platform necessary for the continued evolution and launch of next-generation mobile solutions.

To find out more information on Syniverse’s VoLTE solutions or to listen to the webinar this guide supports, please visit https://www.syniverse.com/webinars.