

The Smart VoLTE Solution

Fast track to carrier-grade voice

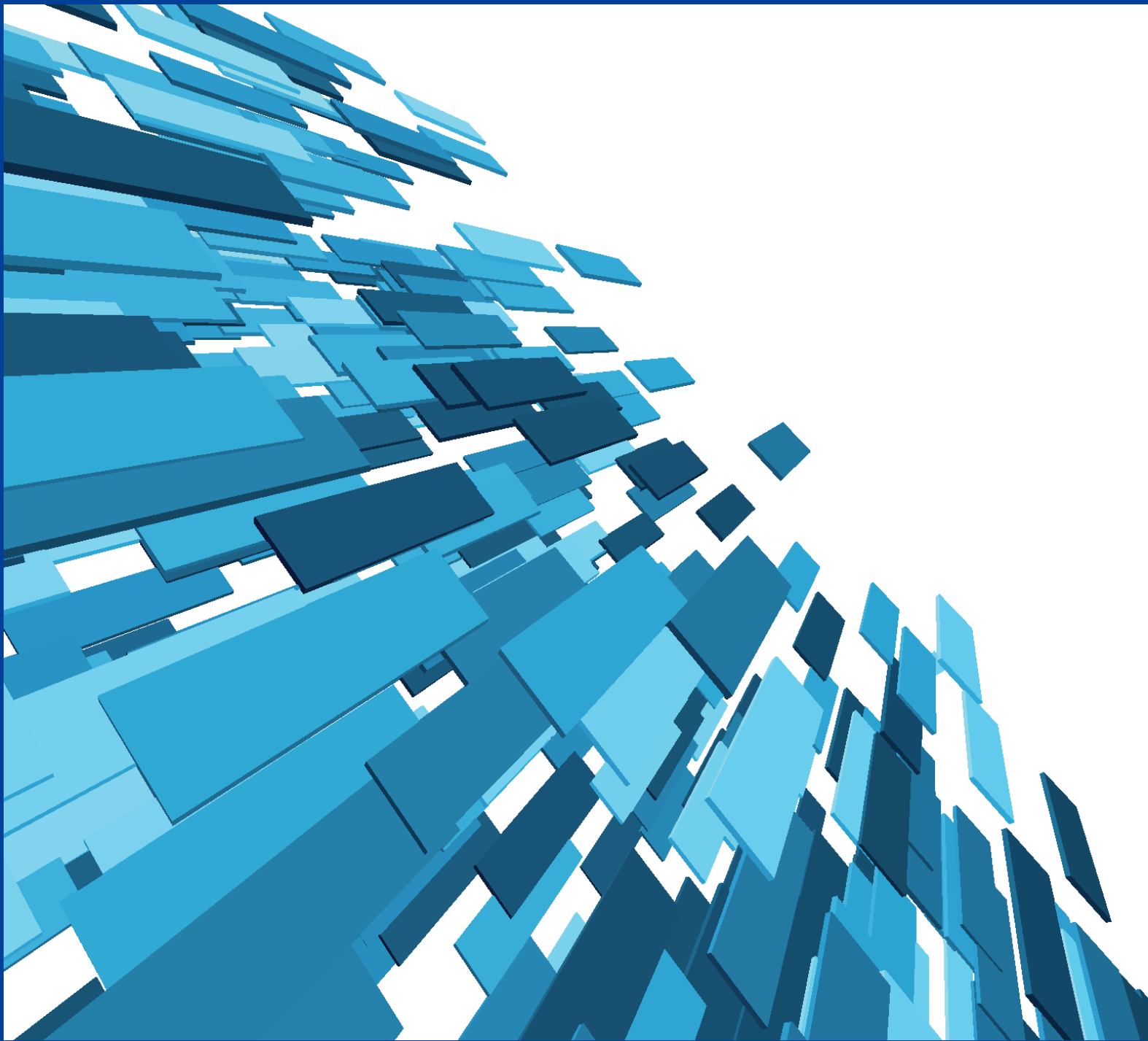


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Executive Summary

This white paper is an overview of the history, benefits and current status of Voice over LTE (VoLTE). The highlights are presented below:

VoLTE is the evolution of voice and data in a single call...

Through complementary work of two separate organizations, VoLTE has emerged as the leading standard for seamlessly combining voice telephony and data connections without quality compromise.

The Rich Communication Suite (RCS) follows naturally from VoLTE...

RCS, a complementary standard for easy and secure media sharing and discovery features, is tremendously facilitated in the case of carriers who have already deployed VoLTE.

VoLTE benefits both communication providers and their user bases...

Through spectral efficiency, simplicity and reliability, VoLTE offers better user experiences, greater cost efficiencies and accelerated technology paths.

VoLTE is growing and Samsung is driving this with Smart VoLTE...

Commercial VoLTE deployments are following the global LTE wave, with the end goal of ubiquitous coverage via Voice Call Continuity (VCC). Samsung is at the forefront of these developments, pioneering its *Smart VoLTE* solution for optimal performance in scarce spectrum.

VoLTE: Origins and Structure

In everyday situations, people use voice together with other types of communicative activity. In the world of mobile operators, the voice telephony call has however remained a single isolated exchange between sender and receiver. Part of the evolution for this interaction should naturally be the mixing of voice and data in a single call, and this evolutionary path is what we see today as Voice over LTE (VoLTE).

The development of VoLTE can be better understood by first considering its underlying technology, Long Term Evolution (LTE). The packet-switched (PS) domain of LTE lacks the voice-supporting circuit-switched (CS) elements of its predecessor technologies, 2G (GSM¹) and 3G (CDMA/WCDMA²). For this reason, integrating voice into LTE presents a technical challenge.

It is worthy of note that VoLTE has proven the most promising against two other techniques aiming to achieve the same:

- Simultaneous Voice-LTE (SV-LTE), where the handset hosts two radios that activate at the same time (one for LTE data and the other for 2G/3G voice). This has been an early solution for CDMA operators who cannot combine LTE data into the same design, but the dual radio operation drains the handset battery
- Voice over LTE via GAN (VoLGA), which is an evolution of voice-over-WiFi, allowing CS voice to connect over an Internet Protocol (IP) connection on an LTE bearer. This solution was however not accepted widely enough to gain necessary standardization

VoLTE itself has developed through the complementary efforts of the the 3rd Generation Partnership Project (3GPP) and the GSM Association (GSMA). Between 2002 and 2007, 3GPP Releases 5-7 introduced the *IP Multimedia Subsystem* (IMS; see insert overleaf), which was later to become a key VoLTE component. Nonetheless, it was not until 2010 that the GSMA (in IR 92) defined IMS-based VoLTE, using the Session Initiation Protocol (SIP). This marked a turning point, with subsequent updates addressing VoLTE interworking, roaming and video services.

¹ GSM: Global System for Mobile Communications

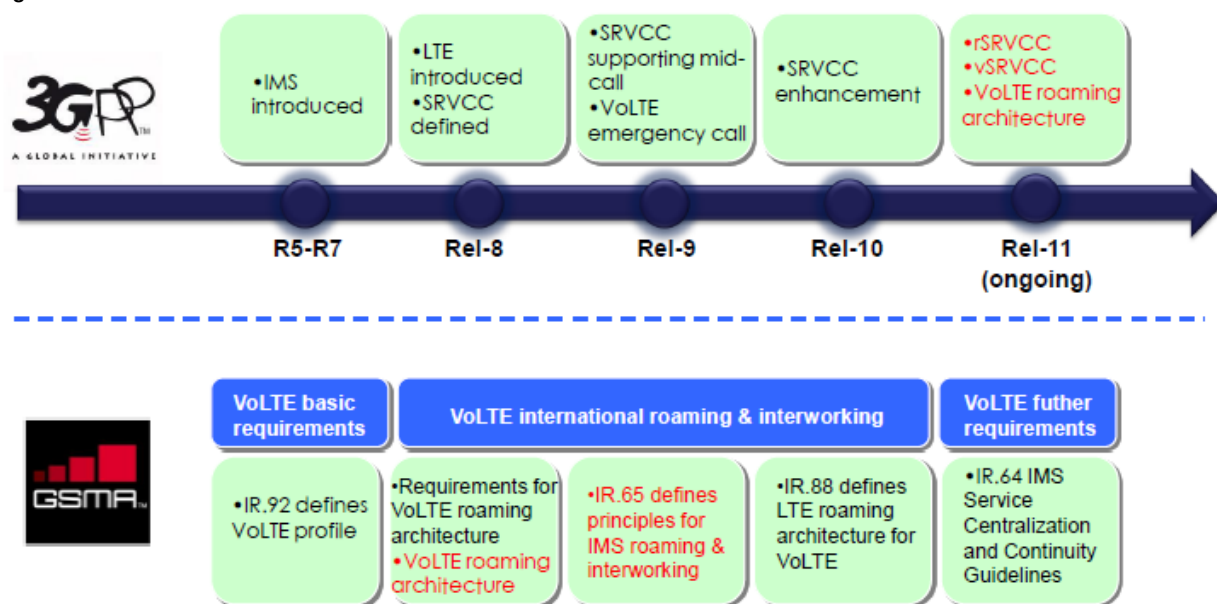
² CDMA (short for CDMA2000) and WCDMA (Wideband Code Division Multiple Access) are different 3G mobile radio technologies

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Launched in 1999 by carriers who needed to expand their service offerings into multimedia while still maintaining customer service and quality, IMS is the convergence of the Internet and the telecom world into a single package. It provides an enabling framework to help roll out multiple applications from multiple sources with short market lead times. IMS does this by applying common elements to diverse problems and products while remaining access-independent, thus creating a single rich user environment.

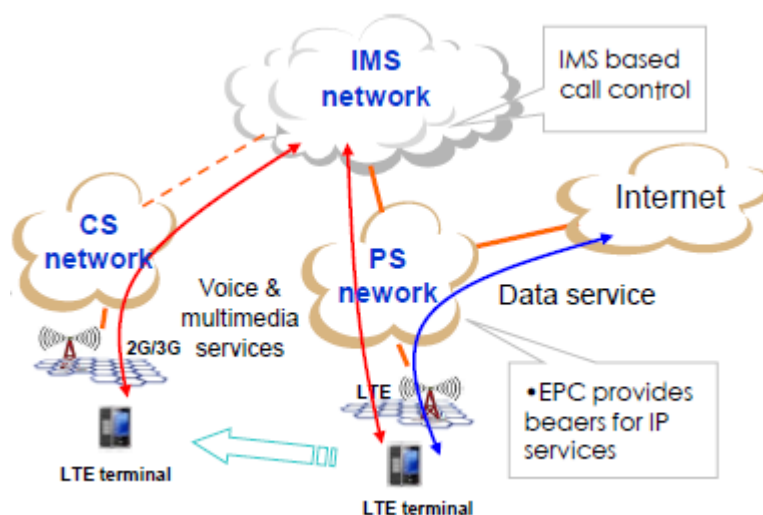
Figure 1 shows the key milestones in the 3GPP/GSMA standardization of VoLTE.

Figure 1. VoLTE standardization status



The reason that VoLTE requires IMS is to provide the essential call control function (see Figure 2 overleaf), which does not exist in the LTE core. Such functionality is needed for expanding VoLTE deployments, and IMS provides this in an architecture that is flexible enough to be re-used for other services.

Figure 2. Role of IMS and LTE cores in VoLTE



The VoLTE complement: Rich Communication Suite

The Rich Communications Suits (RCS) is another GSMA-led initiative that was started in 2008. As with VoLTE, RCS uses IMS, but in this case to merge picture & video messaging with phone calls and to show online contacts in a user's phone book (a process known as discovery). As IMS supports multiple services, RCS users can have a single Instant Messaging (IM) client that works across for all phone contacts via a single sign-on to all services, including OTT³.

RCS as a native feature of user devices can appeal greatly, because it avoids the need for manual settings or downloading applications prior to using services. Just like VoLTE, RCS promises ubiquity, i.e. the ability to communicate any files to any device on any network.

Like VoLTE, RCS also guarantees carrier-grade Quality of Services (QoS), leading to benefits such as:

- **Improved experience:** Lower battery consumption, direct dial-pad usage, excellent video qualities and quick handovers via SR-VCC
- **Security:** Denial of Service (DoS), fraud prevention and encryption features
- **Enterprise appeal:** Multi-device support for business users

³ OTT: Over The Top

- **Regulatory compliance:** Mobile number portability, emergency call and lawful intercept

Above all, RCS is dependent on interoperability between operators and on native handset enablement. VoLTE may be seen in this context as a spearhead for the deployment of complementary RCS services.

VoLTE Benefits

The reasons for using VoLTE instead of separated voice/data solutions are numerous:

1. **VoLTE is simple and reliable:** With its guaranteed QoS, VoLTE offers an operator's subscribers a robust alternative to OTT VoIP in an easy-to-use mechanism. Users know that they can rely and enjoy carrier-grade services without disruption or uncertainty.
2. **VoLTE exceeds OTT VoIP and even 3G voice quality:** Through the use of Adaptive Multirate Wideband (AMR-WB) codecs (12.65kbps or 23.85kbps) and QoS Class Identifier (QCI) SIP signalling, VoLTE provides "HD Voice" for a noticeably better end user experience compared to OTT VoIP and even 3G
3. **VoLTE reduces the work to provide rich media services:** As explained previously, in VoLTE, operators have a foundation for using RCS to enable video and file sharing, presence, instant messaging and enhanced phonebook services. An operator who has already implemented VoLTE is closer to implementing RCS than a non-VoLTE operator.
4. **VoLTE is spectrally efficient:** Because of LTE's all-IP architecture and new features in 3GPP releases (such as MIMO antenna technology), voice requires less bandwidth in LTE spectrum than it does in 2G/3G networks. Consequently operators have more available data capacity in their bands for a given voice load.
5. **VoLTE reduces operator Opex:** VoLTE simplifies the network by providing data and voice services on the same IP network, allowing operators to integrate network resources, optimize network and service management, and simplify service delivery.
6. **VoLTE accelerates evolution to LTE:** With VoLTE, an operator can offer voice service in its LTE spectrum while harvesting its 2G/3G spectrum for re-deploying additional LTE bandwidth. This migration process is easier for subscribers and limits operator upgrade costs.

Path to IMS-based VoLTE

As an interim step to full IMS VoLTE, some GSM/WCDMA operators (and also some CDMA operators who do not use SV-LTE) consider a solution known as *Circuit-Switched Fallback (CSFB)*. In CSFB, the radio falls back to the 2G/3G connection before a circuit switched call is initiated. CSFB is performed without IMS.

The appeal of CSFB lies in possibly low required investments, as only an extra interface between network elements is required. Additionally, for CDMA operators, the concern of battery drain under SV-LTE no longer applies, as this is a single-radio design. CSFB is also currently a technical requirement for certain operators to support incoming roamers, as IMS lacks a defined roaming architecture at present.

Such easily attained advantages with CSFB are nonetheless offset by multiple drawbacks, chief of which are:

- **Longer call set-up times:** Extra time (2-3 seconds on average) is needed to make or receive calls, largely because of the 2G/3G radio initiation and subsequent connection
- **Dropped data connections:** Concurrently running LTE data connections usually do not survive the handover to 2G/3G, so users may experience a break in “always-on” services such as streaming media or push email
- **Operator deployment difficulty:** CSFB is operationally complex as it requires continuous update of subscriber locations when falling back to the CS network

In face of CSFB's limitations, many operators aim to move quickly or even directly to the more elegant *Single Radio Voice Call Continuity (SR-VCC)*. In SR-VCC, ongoing voice calls undergo a virtually uninterrupted handover from LTE to 2G/3G. This provides lower call set-up times, in addition to quicker and more robust handovers than CSFB. SR-VCC relies on the earlier mentioned call control functionality of IMS, and requires at least mid-level LTE coverage before it is justified.

Consequently for a mobile operator, the choice of CSFB versus SR-VCC (or a mixed environment of both to manage inbound roaming) depends on user mobility and coverage patterns. It is evident that true IMS-based VoLTE is fast becoming the “final goal” for carrying voice traffic with LTE data to provide a seamless end user experience.

Growth of VoLTE

With the combined work of 3GPP and GSMA on standardization, VoLTE is rapidly gathering commercial pace.

In the second half of 2012, a US operator and two Korean operators have commercially launch VoLTE. At least three other US operators have publically stated their intentions to deploy VoLTE towards the end of 2013, and there is now also considerable interest from operators in other regions. The market is being led by North American operators (with their CDMA heritage) and advanced Korean ones, with UMTS operators in the Rest of the World following the release of compatible chips and terminals.

Samsung VoLTE status

Samsung has been providing services through its upgradeable IMS core since 2005, and has been active in VoLTE deployments, using an approach of close cooperation with interested operators for end-to-end optimization of networks and handsets. By virtue of this, Samsung supported a World's First launch of VoLTE in Korea in August 2012 to much public attention, and won the Best of 4G Award in October 2012 in the "Solution for Spectrum Optimization" category.

Named *Smart VoLTE* under Samsung's *Smart Engine* banner, Samsung VoLTE capabilities are also evident from technical considerations:

- **Support of high user density:** Up to 365⁴ active VoLTE users per cell are supported
- **Smoother handovers:** Success ratio of VoLTE handovers is up to 3% higher than in conventional cases due to improved cell edge performance

Conclusion

VoLTE represents the evolutionary path for voice communication in the LTE era, and is highly accessible to operators at different stages. By moving towards VoLTE, carriers and their users can enjoy immediate and longer term benefits of ubiquitous, reliable

"The success of these [initial launches] will very likely influence the continued adoption of VoLTE by other operators."
CHRIS DEPUY, ANALYST,
DELL'ORO GROUP

⁴ Using AMR-WB 12.65kbps in 800MHz LTE band

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and high quality service, together with the immersiveness of rich media.

Samsung has been active on all fronts of VoLTE, working closely with partner operators to ensure quick and successful commercial deployment, as well as high performance. As a true end-to-end provider, Samsung's synergies come into play most tangibly with *Smart VoLTE*, delivering substantial benefits to customers.

The Smart VoLTE Solution

About Samsung Electronics Co. Ltd.

Samsung Electronics Co., Ltd. is a global leader in semiconductor, telecommunication, digital media and digital convergence technologies with 2011 consolidated sales of US\$143.1 billion. Employing approximately 222,000 people in 205 offices across 71 countries, the company operates two separate organizations to coordinate its nine independent business units: Digital Media & Communications, comprising Visual Display, Mobile Communications, Telecommunication Systems, Digital Appliances, IT Solutions, and Digital Imaging; and Device Solutions, consisting of Memory, System LSI and LCD. Recognized for its industry-leading performance across a range of economic, environmental and social criteria, Samsung Electronics was named the world's most sustainable technology company in the 2011 Dow Jones Sustainability Index. For more information, please visit www.samsung.com.

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