Evolve to richer voice with Voice over LTE (VoLTE)

Winning the revenue advantage with LTE smartphones
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Voice will become data

The adoption of LTE is following the example of 3G in early the 2000s, but at a much faster rate. For operators evolving to LTE, providing voice on one network and data on another does not make financial sense. Instead, voice is set to become an integral part of LTE as it is today with 2G and 3G. As this evolution continues, LTE and Voice over LTE (VoLTE) are becoming the mainstream technology and by 2016, VoLTE will account around 10% of all LTE subscriptions.

The implementation of Voice of Over LTE (VoLTE) will have far-reaching implications and will bring many advantages for operators, including higher efficiency and lower costs. As voice becomes data, VoLTE will enable a rich multimedia voice experience, helping to improve the competitive position of operators against OTT players.

The evolution to VoLTE will proceed down several paths, with both the technology choices and timing dependent on existing technologies, the spectrum available, current and future voice strategies, and local market conditions. As operators decide on the appropriate LTE strategy, whether to opt for hot spots or nationwide coverage, for example, they are also choosing their approach to VoLTE. In some cases, they will start their evolution to VoLTE with Circuit Switched Fallback (CSFB) and once have nationwide LTE coverage, they will implement full-fledged VoLTE service. Making the optimum choice will be crucial to compete successfully in an environment where change is the only constant and subscriber expectations will only increase.

Executive summary

- Why implement VoLTE?
  Explosive demand combined with increasing price pressure and competition from OTT players are driving the evolution to LTE, which opens up new business opportunities for operators and helps them improve the customer experience.

- What are the timelines for the introduction of VoLTE?
  The mass market introduction of LTE smartphones has begun, and by 2016 VoLTE is projected to account for 10% of all LTE subscriptions.

- What are the key advantages of VoLTE?
  VoLTE supports higher spectral efficiency, OPEX savings from consolidation and optimization, better voice call quality, and new opportunities for more sophisticated voice-based services.

- What are the main factors behind the decision to implement VoLTE?
  When operators are making the decision to implement VoLTE, there are several key factors to bear in mind, including their existing mobile technology, the LTE spectrum and coverage available, local market and competitive conditions and their business objectives.

- What are the main approaches to implementing VoLTE?
  Operators can implement full IMS VoLTE and multimedia, start with CSFB for voice and IMS for multimedia, or rely on CSFB over the longer term and target LTE for data.

- VoLTE from Nokia Networks
1. Why implement VoLTE

Explosive demand for data, greater demand for quality, and intense price competition are three good reasons for adopting VoLTE. Capacity needs are projected to increase 1000-fold by 2020 as average daily usage rises to 1GB. At the same time, market developments such as OTT voice are squeezing price-per-minute and putting unprecedented pressure on costs. For their part, subscribers increasingly want faster, more reliable and richer services, and they are ready and willing to swap providers to get what they want. Some 40% of high value customers are likely to change operators in the next 12 months.

These escalating demands are driving the introduction of high-capacity, all-IP networks, with LTE providing the radio access for mobile connectivity. As LTE smartphones come on the market and more high-bandwidth applications such as HD video are introduced, these trends will only accelerate.

As the first radio technology that is fully packet-based, LTE provides faster access rates and lower latency, as well as enabling operators to enjoy a lower cost-per-transmitted-bit by using network resources more efficiently. LTE is the key to providing cost-effective capacity to cater to growing demand for high-bandwidth services such as mobile video.

By September 2012, more than 290 operators had committed to LTE in 93 countries and more than 90 commercial networks were up and running. In fact, LTE is “the fastest developing mobile system technology ever,” says the GSA.

1.1 LTE provides the foundation for richer voice and data services

LTE-based all-IP networks open up opportunities to introduce new business models, offer richer services and enhance business performance. They also make it possible to improve the customer experience with voice services, which is a top priority of many operators. During the recent launch of VoLTE in Korea, for example, operators SKT and LGU+ stressed superior voice quality in their marketing campaigns. As voice services are the dominant source of revenue for mobile operators, accounting for around 60% of their total revenue, there is every reason to ensure a positive experience. Going forward, Voice over LTE (VoLTE) is the logical choice to provide high-quality voice services over the same technology that is driving the data revolution.

1.2 VoLTE subscriptions will grow in parallel with LTE

Once VoLTE capable smartphones are introduced on a mass market scale, which is widely expected in 2013, the number of VoLTE subscriptions and the introduction of VoLTE services on LTE networks
are projected to grow quickly. ARCchart predicted in May 2012 that there will be as many as 74 million VoLTE-enabled subscribers by the end of 2016, representing approximately 10% of all LTE subscriptions. Taking into account revenue, quality and OPEX drivers, VoLTE is the right technology choice for operators to maintain their existing revenues and more significantly to enable new business opportunities (see section 2). The underlying question is not whether to implement VoLTE, but how and when, which is discussed in section 3.

**Phone / technology**

Figure 1: Although voice revenue is projected to decline slightly, it will continue to be significant. (Infonetics June 13.2012)

Figure 2: LTE phone uptake will grow steadily as the LTE rollout continues. (Yankee Group 2012)
2. **VoLTE offers key advantages in four main areas**

VoLTE will typically be adopted in parallel with CS voice with a gradual transition to IMS VoLTE. The timing of the transition will be crucial for operators to avoid losing out to OTT players and take full advantage of the advantages of VoLTE, which cover four main areas:

- **Spectral efficiency:** Spectrum refarming makes it possible to significantly reduce deployment costs and handle twice as many calls with the same spectrum.
  - Reuse of existing 2G and 3G spectrum reduces the need for new spectrum
  - Significant reduction in deployment costs compared with spectrum purchase
  - Network and planning optimization cuts costs and enables future-proof network modernization
  - Better voice call quality: Shorter delays and faster call set-up times improve the customer experience
  - Richer voice: Creating a multimedia environment that includes voice enables competition with OTT players

### 2.1 Higher spectral efficiency

Improved spectral efficiency makes it possible for VoLTE to handle twice as many calls, helping to optimize the use of radio resources and reduce costs. LTE offers twice the spectral efficiency of 3G/HSPA and more than 6 times the efficiency of the latest GSM technology. This frees up more capacity for data, which in some networks already outpaces voice volume by a factor of 50-100. As both data volumes and LTE device penetration grow, spectral efficiency to carry more voice with less bandwidth will become a key advantage.

It is possible to use new frequencies for VoLTE. Regulators have reallocated in many markets new lower frequency bands (700, 800 MHz, often called “digital dividend”) which can now be used for LTE. Because of their good coverage characteristics these frequencies are extremely suitable for LTE voice implementations.

Re-farming further improves spectral efficiency. When operators introduce new technology like LTE on the same frequency spectrum they are using for 3G, for example, they can refarm the spectrum to use it more efficiently.
2.2 Simplification

Consolidation is the key to OPEX savings with VoLTE. By integrating the voice and data domains on the same LTE network, operators can significantly reduce their operating costs. The integration of network resources, the optimization of network and service management, and the simplification of service delivery all help to reduce costs.

By relying on one radio technology and using re-farming, operators can adopt smart spectrum allocation to reuse existing spectrum and reduce operational costs for the radio network. In addition, transitioning to full all-IP technology results in significant savings on transmission costs.

According to our calculations, the consolidation of the core network enables further cost benefits: 60% lower operations & maintenance costs, 75% lower site support costs and 65% lower energy costs.

2.3 Better voice call quality

The low latency of LTE provides clear benefits for VoLTE. Shorter delays and faster call set-up times enable high quality voice and data connections, helping to improve the customer experience. High Definition (HD) voice is the default with VoLTE, and as past experience has shown, improved quality encourages longer talk time and reduces churn. Much lower delay and high capacity also enable HD video quality for video calls, and the call set-up time required for switching between communication methods such as chat and voice is much shorter.
Internet-based VoIP services tend to generate a greater load on mobile networks, which has an adverse effect on quality. Because OTT voice apps typically use more network resources, operators need to invest in more capacity to handle OTT voice traffic. In addition, the quality of OTT voice is often variable, and operators enjoy an advantage here because subscribers often consider their mobile voice services more reliable.

Figure 4: Refarming LTE to current voice frequency

Figure 5: Internet-based VoIP services generate a higher load on mobile networks.
2.4 Richer voice

VoLTE and Rich Communications Service (RCS) are based on the same IP Multimedia subsystem (IMS), so VoLTE is much more than an IP-based variant of existing CS mobile service. By enabling sophisticated voice-based services, it offers new revenue potential as well as a customer experience that cannot be matched by OTT providers or CS-based voice services alone. IMS-based VoLTE supports an RCS multimedia service portfolio, including privacy, buddy lists, presence, video share, video call, multimedia messaging, chat, file transfer, and many more.

Some of these services, in particular the ones included in RCS-e, or enhanced, were launched recently in Spain. RCS/RCS-e are both based on IMS, which enables a fast launch of rich VoLTE services when sufficient LTE coverage is available.

By implementing VoLTE, operators can take full advantage of the capabilities of smartphones that have an RCS client. All service capabilities are available by default, which makes it much easier for subscribers to find and select attractive new services, significantly lowering the threshold for adopting them. With OTT voice services, subscribers need to download defined OTT client software and select the service. This can be an involved process that many will forget or forgo.
3. How to evolve to VoLTE: Approaches to consider

The evolution to VoLTE is a process that can be made in several steps and implemented in several ways. Some operators will make the decision to offer, either initially or over the longer term, a combination of CS voice and LTE data on LTE devices. Eventually, however, the revenue-generating opportunities from enriched voice services for LTE smartphones are likely to be so compelling that most, if not all, operators will adopt full IMS-based VoLTE. Providing voice and data simultaneously over the same network will allow operators to ensure an optimal customer experience.

The factors affecting this choice as well as the pace of deployment of VoLTE will depend on the existing mobile technology, whether 2G/3G/HSPA or CDMA; the LTE spectrum available in a given location, which will have an impact of LTE rollout and coverage; local market conditions; and the operator’s business objectives, whether to stick to basic voice and sms services or offer advanced services.

Taking all these factors into account, there are three main approaches to introducing voice services for LTE subscribers:

- **Implement IMS VoLTE and multimedia.** The target with this approach is an all-IP architecture and advanced services. With this approach, 3G coverage and/or capacity are inadequate to provide the level of service required, and LTE coverage is already good and growing fast.

- **Implement CSFB for voice and IMS for multimedia, e.g. RCS** in the initial stage and evolve to VoLTE when LTE coverage is nationwide. This approach requires good 3G coverage and capacity and supports a strategy of offering advanced services. LTE can be used to provide extra data capacity in congested areas.

- **Implement CSFB over the long term** and evolve to VoLTE only when the market demands it. In this case, there is no requirement to go beyond voice, SMS and basic data. LTE coverage is limited, and LTE is targeted only for data. Nationwide CS coverage is based mainly on 2G.
The most common way to introduce voice service in early phase of the LTE is CSFB, which can be used also for roaming as long as necessary. In CDMA markets, such as North America and Japan, CDMA operators are rolling out LTE and for example offering CDMA voice with Simultaneous Voice and LTE (SVLTE). First commercial IMS VoLTE networks have been launched in South-Korea and US. In other markets commercial launch of IMS VoLTE is expected in 2013 and onwards.

Figure 6: Facts affecting choice and timing of operator’s VoLTE deployment
4. Options for providing voice services to LTE smartphone subscribers

As described above, there are several different options, based on either CS, CSFB or full VoLTE technology, for providing voice services to LTE smartphone subscribers.

4.1 Use CS technologies to provide voice

CS voice makes the introduction of voice services in an LTE environment fast and easy as it is based on the operator’s existing voice core environment. The first LTE-capable smartphones already support voice with CS and data with LTE, and thus enable a bridge towards LTE.

4.1.1 Implement Simultaneous Voice and LTE

When LTE is an overlay to a CDMA network, the current approach to delivering voice is Simultaneous Voice and LTE (SVLTE). In this case, voice service is deployed as a CDMA CS voice service running in parallel with LTE data services. This solution is enabled by dual-mode handsets and no additional network functionality is needed. Dual-mode handsets can conduct simultaneous LTE data sessions and legacy voice calls.

4.1.2 Use Circuit Switched Fall Back (CSFB) as a bridging technology to VoLTE

With this approach, CSFB establishes a signalling channel between the circuit-switched voice core (Mobile Soft Switch) and the Mobility Management Entity (MME) in the LTE packet core network (Evolved Packet Core). This allows handsets attached to the packet-switched LTE network to change over to a CS network for incoming and outgoing voice calls. Ongoing data sessions in LTE will also switch over to 3G/HSPA network, and when the voice calls ends, the handset returns to LTE. SMS messages are delivered directly over the signalling link, so no fallback mechanism is required.
4.2 Implement IMS-based VoLTE

VoLTE puts IMS at the heart of the voice core network, managing the connectivity between subscribers and the implementation of policy control. The Telephony Application Server (TAS) manages voice services and supplementary services such as call forwarding, call wait and call transfer.

IMS-based VoLTE also enables a Rich Communications Services (RCS) offering. For operators running both fixed and mobile networks, a VoLTE solution can bring further value by enabling a single voice solution for both the fixed and mobile domains and making it possible to create a unified voice core solution that provides service for all access domains.

4.2.1 Deploy VoLTE without full LTE network coverage

When LTE networks are not ubiquitous, devices are often connected to the CS network rather than the LTE network. Call continuity and service synchronization between the networks are therefore important issues to bear in mind.

The core network must enable VoLTE-capable LTE handsets to continue voice calls when subscribers leave an LTE coverage area. The 3GPP-standardized Single Radio Voice Call Continuity (SRVCC) function hands over any call started in LTE to the legacy network in order to ensure a continuous voice connection.

IMS VoLTE and circuit-switched networks are expected to provide the same voice services. In addition, service manipulation, e.g. call forwarding activation, needs to be an access agnostic. When a service is activated with an LTE handset, it has to be activated on all mobile networks at the same time (2G/3G/LTE). Depending on demand, it may be unnecessary to load IMS and HSS as the majority of voice services may continue to be provided by the CS network. Until LTE network coverage is ubiquitous, the re-use of current network registers could provide opportunities for cost savings.
5. **VoLTE solution: Part of Nokia Networks Liquid Net**

Nokia Networks’ VoLTE solution reuses existing investments and provides a seamless experience for subscribers when 2G/3G and LTE networks are used in parallel and handovers are a common occurrence. This solution is based on the ability to provide full IMS on an existing circuit-switched voice roaming ecosystem, enabling re-usability that minimizes investment and operational costs. The solution is provided with the Open Core System, part of Nokia Networks Liquid Net architecture, which is built on COTS ATCA hardware and allows dynamic resource handling between current and new network functions and services.

In the Open Core System, core virtualization is used to bring more flexibility to the core by running all the key components on a single, common platform. Liquid Net manages and delivers services and content, dynamically providing the capacity needed to ensure the best customer experience at the lowest cost.

Operators can therefore run the MSS, IMS and EPC on the same physical ATCA platform, which cuts OPEX by reducing footprint and energy consumption. Capacity can be dynamically allocated to LTE subscribers using either CSFB voice calls controlled by MSS or VoLTE controlled by IMS. Further OPEX savings come from more efficient network management of fewer network elements.

For hybrid operators, the VoLTE solution can bring even more value by providing a single voice solution for both domains. In this case, it is possible to build a unified voice core solution capable of providing service for all access domains. The Nokia Networks VoLTE solution is fully compliant with GSMA IR.92 and IR.94 specifications, also commonly known as the GSMA’s VoLTE initiative.

Nokia Networks GSMA specification-compliant VoLTE solution will make interworking straightforward and also ensure the widest choice of devices for end users. This solution enables the following:

- **Mobile Core transition to full IMS architecture via Open Core System**, ensuring optimized expenditure in CAPEX and OPEX.
- **Full reuse of existing backend infrastructure investments with a CSFB and VoLTE deployment strategy.**
- **Voice feature parity across 2G/3G and LTE access to maintain high of end-user satisfaction.**
- **Flexible solution that is MSC vendor-agnostic and can be deployed in any market.**
- **Open Core architecture that promotes a gradual migration of subscribers to the new IMS-based domain.**
- **Most efficient way for 3GPP providers to shift existing 2G/3G voice services to an IMS architecture, which, in turn, enables operators to tap into the emerging value-added RCS ecosystem.**
6. Conclusion

LTE is raising the game for mobile broadband. It is the first ever global mobile broadband technology, and measured in networks, devices and subscribers, LTE is achieving the fastest ever uptake of any mobile technology. It is also the first radio access technology that is 100% packet based, which combined with the all-IP network core, translates into greater efficiency.

VoLTE, which does much more than merely replicate CS voice, will have a similar impact, enabling a rich multimedia portfolio that includes browser-based apps for voice calls, chat, communications for location-based services, video conferencing, etc. In a nutshell, VoLTE will help operators maintain existing revenues and more significantly, create new business opportunities and revenue streams.

In most markets, operators will adopt VoLTE in parallel with CS. Their go-to-market timing will be crucial. They need to have their VoLTE offering in place at the right time as the LTE smartphones are already in market and for the right segments to compete successfully with OTT players, gain new revenue with rich multimedia and voice services and achieve the full OPEX benefits of VoLTE.

Glossary of abbreviations

ATCA – HW platform is based on a series of AdvancedTCA™
CAPEX – Capital expenditure
CDMA – Code Division Multiple Access
COTS – commercial off-the-shelf product
CS – Circuit Switched
CSFB – Circuit Switched Fallback
EPC – Evolved Packet Core
GSMA – Global System for Mobile Communications Association
HSPA – High Speed Packet Access
HSS – Home Subscriber Server
IMS – IP Multimedia Subsystem
LTE – Long Term Evolution

MME – Mobility Management Entity
MSS – MSC Server
NVS – Nokia Networks mobile VoIP Server (TAS)
OPEX – Operating expenditure
OTT – Over the Top
PS – Packet Switched
PGW – Packet Data Network Gateway
RCS (-e) – Rich Communication Suite (-enhanced)
SGs – Interface between MME and MSC server
SGW – Serving Gateway
SRVCC – Single Radio Voice Call Continuity
SVLTE – Simultaneous voice over LTE
TAS – Telephony Application Server