VoLTE: Basics, market trends and use cases

white paper

EXFO

VoLTE: Basics, market trends and use cases

white paper

Nearly all VoLTE operators are committed to migrating existing mobile voice subscribers to LTE in order to refarm their 2G and 3G spectrum.

VoLTE basics

VoLTE (voice over LTE) technology allows a voice call to be placed over an LTE network. Powered by IMS architecture, VoLTE brings a host of **benefits** to mobile operators ranging from the ability to refarm legacy 2G and 3G spectrum to the ability to offer subscribers a differentiated service experience through capabilities such as enhanced call setup delay (less than 1 s vs. 5-10 s with circuit switched fallback), HD voice and video telephony. VoLTE provides the ability to multitask simultaneous voice and data, which means consumers can surf the web while being on a (video) call.

Prior to VoLTE, an incoming or outgoing voice call on LTE would force a radio fallback (**CSFB**) from LTE to the legacy 2G or 3G service. Any 4G data would stop at this point, limiting voice and texting to slower legacy 3G.

When subscribers using VoLTE calls move out of LTE coverage, they need to be able to continue to make and receive voice calls, so devices must interoperate with existing networks in order to guarantee this service continuity. **SRVCC** seamlessly maintains voice calls when a mobile user moves from an LTE to a non-LTE coverage area.

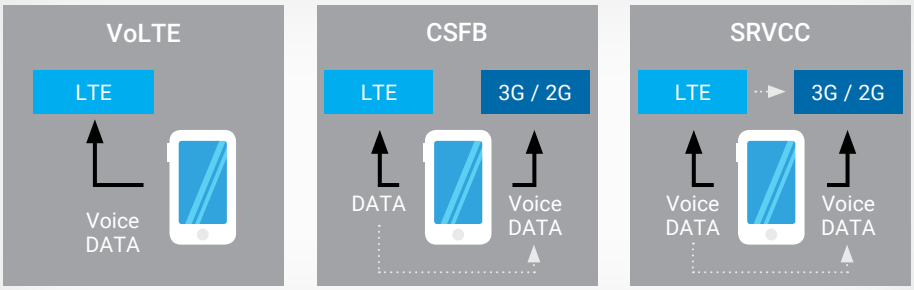


Figure 1. Devices interoperating with existing networks for service continuity

VoLTE market trends

First deployed by South Korean operators in 2012, VoLTE is gaining momentum globally. Adoption was slow initially due to interoperability issues, time to market of VoLTE phones and the need to migrate to Core IMS.

But according to the GSMA May 2016 update, more than 70 operators in 38 countries have now commercially launched VoLTE services. Around 228 smartphones currently support VoLTE, and the support rate will certainly further rise over time.

Nearly all VoLTE operators are committed to migrating existing mobile voice subscribers to LTE in order to refarm their 2G and 3G spectrum.

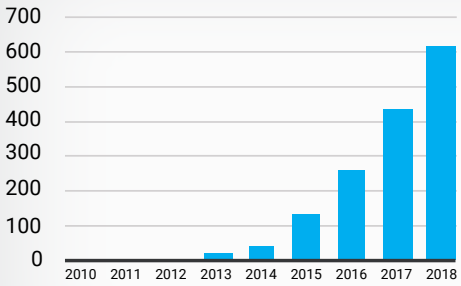
Since voice services have been around some time, quality expectations are very high.

Some operators are combining their VoLTE services with WiFi calling (VoWiFi) in a bid to offer voice services in areas where their licensed spectrum coverage is limited.

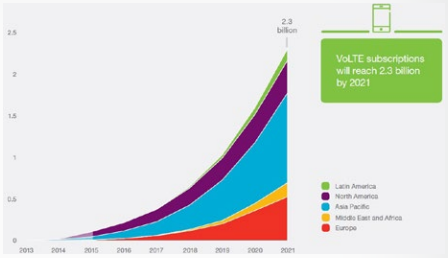
Since voice services have been around some time, quality expectations are very high. While consumers might accept some lag and drop with data sessions, they won't accept that with voice. So, unlike other IP traffic, the consequences of getting VoLTE wrong are probably much higher.

So far, **customer feedback** is really positive: super fast call connections, exceptional ringtone quality, virtually no background noise, crystal clear voice and crisp video call quality, which are key differentiators with Skype and other OTT apps.

Consumers clearly benefit from VoLTE, but the **business sector** is also an important target for service providers to hone in on.



VoLTE connections forecast
Source: Analysys Mason, 2015



VoLTE subscriptions by region (billion)
Source: Ericsson Mobility Report

Figure 2. VoLTE connection forecast and subscriptions by region

Challenges of deploying efficient VoLTE service

As with the introduction of any new network feature, VoLTE comes with a lot of challenges to tackle within very aggressive timeline.

VoLTE is a new voice service which relies on specific protocols (SIP, Diameter) and network elements (Core IMS CSCF, application server, etc.).

Multiple network subsystems are involved when establishing, maintaining and ending a VoLTE call (4G RAN, EPC, Core IMS, 2G/3G RAN and Core CS). This results in multiple interworking constraints.

VoLTE impacts several network operator teams and creates new challenges:

- Radio network parameters may have to be tuned to optimize VoLTE coverage.
- New types of bearers, controlled by the PCRF, need to be set up in the Core EPC to guarantee QoS.
- New IMS core voice and associated RCS services that rely on SIP protocol and IMS application servers, have to be installed and checked.

Different teams have to ensure the following tasks:

1. During the VoLTE **launch preparation** phase:
   - Geolocate and optimize areas that require VoLTE first
   - Troubleshoot interoperability issues end to end
   - Check if VoLTE quality promises are met: setup delays, handovers
2. Before and after **commercial service launch**
   - Troubleshoot customer complaints end to end
   - Highlight poorly performing locations (call drops, bad handovers)
   - Diagnose voice quality degradations
   - Check and optimize interoperability with other networks: legacy 2G/3G mobile voice or IMS networks from other national or foreign operators (e.g., AT&T and Verizon enable VoLTE calls between their networks)
   - Manage single radio voice call continuity (SRVCC)
   - Accelerate network virtualization
   - Manage the significant increase in signaling (SIP and diameter)
   - Check voice QoE (mean opinion score [MOS])
   - Detect handsets with performance issues
   - Benchmark and recommend handsets for VoLTE
   - Boost and follow up on service adoption
   - Measure the impact of marketing campaigns

Figure 3. VoLTE, a rich and complex ecosystem

Volte use cases

1. Troubleshoot interoperability issues end to end

It is important to have an end-to-end view of each call through a multi-interface correlation in a single call flow: Core EPC, Core IMS and 3G RAN with associated protocol layers (like S1C, S11, SGs, Sv, Gx, Rx, SIP, Diameter).

Being able to correlate service layer signaling (SIP) typically monitored at the Core IMS with lower layers (S1C, Iu/A in the case of CSFB or SRVCC) is key to diagnosing interoperability issues between different layers or different network subsystems.

Here, SIP response is not adequate for the handover from 4G to 3G (SRVCC) because the subscriber didn't have the right authorizations yet.

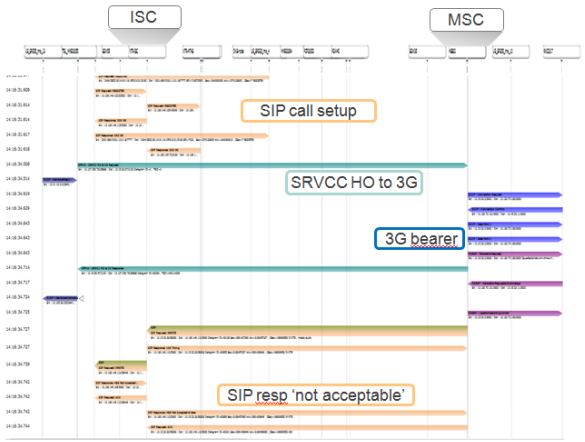


Figure 4. Intersystem mobility

2. Ensure seamless voice call continuity with SRVCC

For a good voice call experience, it is crucial to always be reachable and to get fast access to your respondent. With VoLTE, when a subscriber leaves the LTE coverage area, a handover to 3G/2G layer is automatically performed thanks to single radio voice call continuity (SRVCC), bridging the VoIP IMS Core with the legacy Core CS. This handover should take less than one second, which is much faster than CSFB.

Through E2E **subscriber-oriented** KPIs:

- Measure voice interruption time
- Highlight short call duration after SRVCC
- Evaluate dropped-call rates after SRVCC
- Check the return-to-4G delay

Through E2E **network-oriented** KPIs:

- Measure procedure delays
- Measure resource release delays

Figure 5. SRVCC delay and % of call drops after SRVCC

3. Geolocate low-performing VoLTE areas (dropped calls, bad handovers)

To improve customer service efficiency, position subscribers with complaints on a map by geolocating a single or a set of selected call detail records (CDRs).

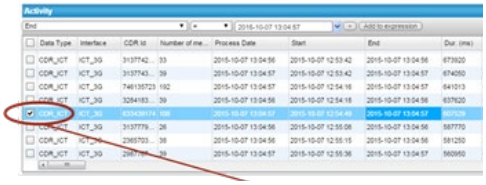


Figure6. Call data record geolocation selection

Figure 7. VoLTE drop geolocation

Problem

VoLTE calls have been dropped

Investigation

- Geolocation of CDRs of dropped calls
- Analysis of signaling traffic at the time of drop

Key findings

40% of VoLTE drops are located in a mobility blackspot with X2 handover failures (intra LTE eNodeB handover)

Professional service recommendation

- Downtilt some cells in order to improve LTE coverage
- Review A3/A2 configuration (Area within high HO to UTRAN)

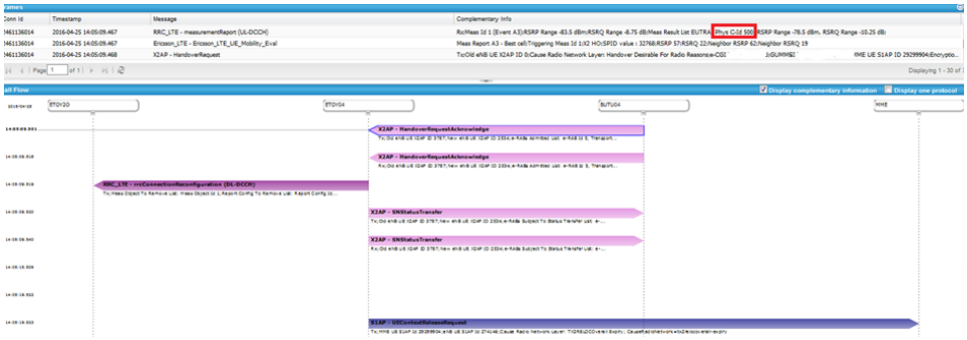
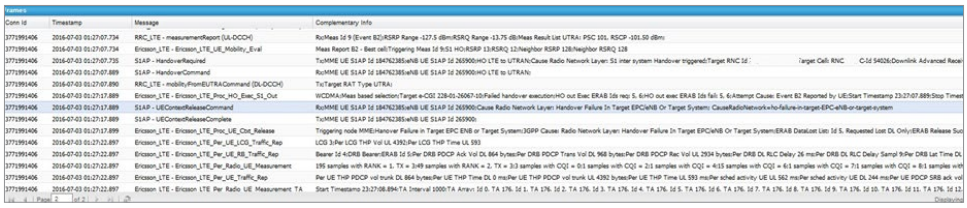


Figure 8. Signaling traffic



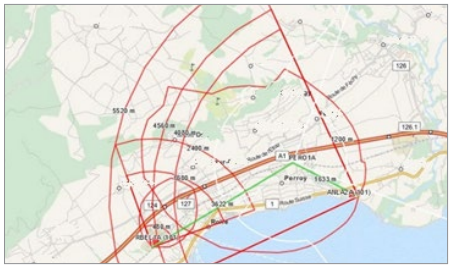


Figure 9. SRVCC attempt in LTE

Problem:

SRVCC attempt failures

Investigation:

- Geolocation of VoLTE calls
- Analysis of signaling traffic shows handover attempt to 3G cell

Key findings:

- Cell A and B are configured with the same primary scrambling code (PSC)
- Cell B is configured as 4G neighbor but the subscriber is in the area of cell A -> SRVCC failure due to UTRAN cell misconfiguration in E-UTRAN

Professional service recommendation:

- Configure neighbor A as neighbor instead of neighbor B (same PSC)
- Correct PSC clash (change PSC in cell A)

4. Ensure HD voice quality

Subscribers moving to VoLTE expect the best voice experience as HD voice is marketed. But they don't have a clue about how hard it is for operators to handle VoIP end to end down to the handset.

Mobile network operators should use **VoIP call quality metrics** including:

- Mean Opinion Score (MOS) with 5 second slicing of RTP streams
- Packet delay
- Jitter
- Packet loss
- Latency

R-Rating	< 60	≥ 60	≥ 70	≥ 78	≥ 80	≥ 90	≥ 100	≥ 103	≥ 110	≥ 116	≥ 120
R-Chart	Cl. 1	Cl. 2	Cl. 3		Cl. 4	Cl. 5	Cl. 6		Cl. 7		Cl. 8
NB-MOS Chart	Cl. 1	Cl. 2	Cl. 3		Cl. 4	Cl. 5					
WB-MOS Chart	Cl. 1		Cl. 2		Cl. 3		Cl. 4		Cl. 5		

Figure 10. Wideband MOS

5. Boost and follow-up service adoption

At VoLTE launch, it is important to identify the number of VoLTE callers and the number of VoLTE devices to evaluate service adoption.

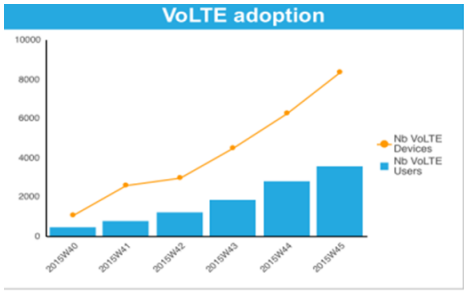


Figure 11. Number of active VoLTE subscribers

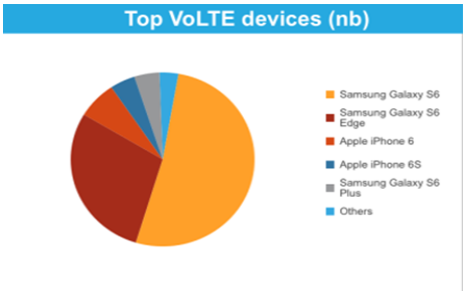


Figure 12. Top VoLTE devices (nb)

This improves the marketing team's efficiency by helping them identify those subscribers with VoLTE capable phones

- without a VoLTE subscription. They can send an SMS with an upsell promotion.
- which aren't configured correctly. They can send an SMS to correctly set up the phone and offer a true HD voice experience to their customers.

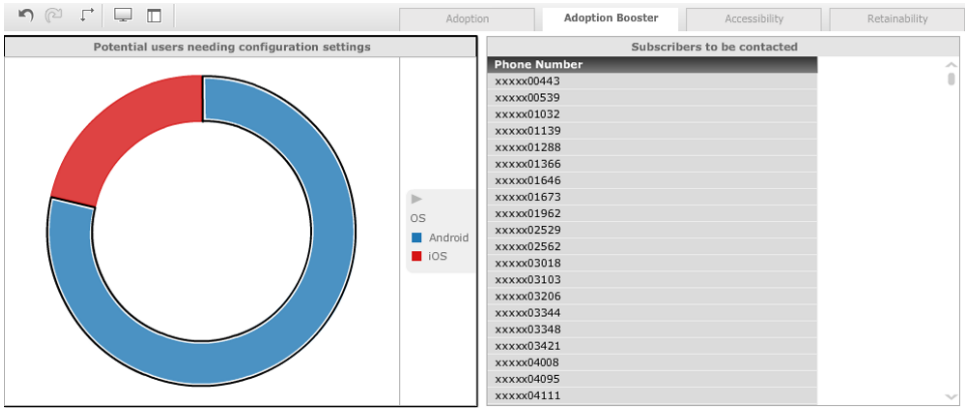


Figure 13. Potential users needing configuration settings

EXFO's E2E VoLTE solution

Mobile network operators are commited to delivering an exceptional voice experience in an LTE environment.

To support mobile network operators throughout the entire VoLTE lifecycle, EXFO provides an **end-to-end troubleshooting** solution with dashboards to efficiently **benchmark vendors,** detect malfunctioning **handsets** and assess **interoperability** issues between vendors. The multidimensional solution is also capable of **geo-locating** areas with a high concentration of VoLTE compatible devices.

EXFO provides **voice call quality metrics** such as mean opinion score (MOS) for each VoLTE call. EXFO's solution analyses a call every 5 seconds, from start to end, to depict the real quality of the voice service experience. This provides a much more reliable vision of the customer experience than that of competitors who calculate an average MOS.

In addition to its product portfolio, EXFO offers **professional services** consisting of on-site experts working with operator teams during lab tests, field interoperability and friendly user tests. They generate dedicated reports, pinpoint issues, find out root causes, and provide evidence to transfer tickets to the right vendor.