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A Survey on Voice over Long Term Evaluation (VOLTE)

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ABSTRACT: Fast increment in data traffic throughout cellular network is essential deployment of Long Term Evolution (LTE) in the cellular operator's networks. While LTE offers effective high data rates and data traffic handling, it lacks native circuit switched voice ability. The GSM connection has standardized IP Multimedia Subsystem (IMS) based VoLTE solution along with Single radio SRVCC for handover. Migration to this solution needs operators to have complex and costly IMS deployments. This has yield to operators leveraging the available 2G/3G networks with VoLTE mechanisms i.e. Voice over LTE via Generic Access (VoLGA) and Circuit Switched Fallback (CSFB). This paper explains both, the long-term and interim, solutions for the operators and their respective advantages and disadvantages.

KEYWORDS: VoLTE, CSFB, Circuit Switched Fall Back, VOLGA, SRVCC, Single Radio Voice Call Continuity, IP Multimedia Subsystem, IMS, Evolved Packet Core, handover, MME.

I. INTRODUCTION

Multimedia applications are driving data utilization in the cellular networks. Long Term Evolution (LTE) and its true fourth generation expression, Long Term Evolution-Advanced (LTE-A), are techniques that operators are deploying, or designing to deploy, to support them tide over this evolutionary direction. Having developed from Universal Mobile Telecommunications System (UMTS), the specifications are called the evolved UMTS Terrestrial Radio Access network (E-UTRAN). The LTE first version was published by 3GPP as release 8. Table 1 indicates various releases however then and their significant characteristics [3GPP].

Table 1: 3GPP Releases

Release#	Year	Features
3GPP Release 8	2008	First LTE publish as all IP network System Architecture Evolution (SAE). proposed Multi In Multi Out (MIMO) and Single Carrier-Frequency Division Multiple Access (SC-FDMA) and Orthogonal Frequency Division Multiple Access (OFDMA),
3GPP Release 9	2009	Improved LTE to compute with WiMAX. Suggested femtocells.
3GPP Release 10	2011	LTE-Advanced specifications satisfying IMT-A needs. Backwards compatible with Release 8
3GPP Release 11	2012	Advanced IP Interconnection of facilities including national operators and also third party applications. Heterogeneous networks (HetNet) enhancements
3GPP Release 12	Planned for 2014	3-D MIMO beam making, machine type interaction and public safety
3GPP Release 13	To be Decided	Open

With LTE a move has been built towards a whole IP network composed of the Radio Access Network (RAN), the Evolved Packet Core (EPC) and the interlink. The primary objective of LTE is to offer a low latency, high data rate and packet optimized radio access technique supporting reliable bandwidth deployments. OFDM, utilized in downstream,

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permits simultaneous access by a no. of subscribers, MIMO, enhances reception by usage of several antennas and SC-FDMA is utilized in the uplink to allocate radio resources to various subscribers. Fig. 1 indicates the wide LTE architecture.

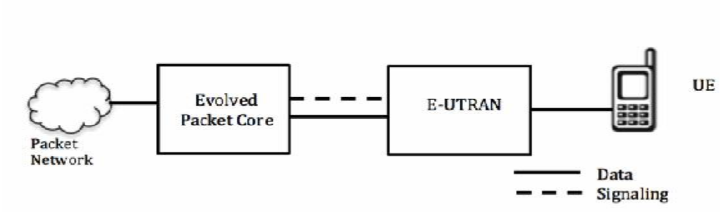

Figure 1: LTE Architecture

The User Equipment (UE) involves services of a Terminal Equipment (TE) for data streams, a Mobile Terminal (MT) that has responsibility for call functions, and Universal Subscriber Identity Module (USIM). The USIM saves subscriber information and network identity.
The Radio Access Network (RAN) part of the LTE is known as the Evolved UMTS Radio Access Network (E-UTRAN). It manages interaction between the Evolved Packet Core (EPC) and the UE and contains the base stations known as eNodeBs (eNBs).
To be capable to offer good performance at high data rates, LTE has been planned as an all-IP technique. The flip side of this is deficiency of native circuit-switched (CS) domain voice, which has been the average so far in the cellular networks. As operators deploy LTE they see for solutions to offer CS voice to their users. This has led in a no. of various solutions being introduced and attempted. The significant techniques are Voice over LTE over Generic Access network (VoLGA), Circuit Switched Fallback (CSFB), Single Radio Voice Call Continuity (SRVCC) and GSMA VoLTE profile. In the first migratory stage, all voice traffic is require to be managed by 2G/3G circuit switched networks and data traffic is handled by LTE networks. This stage would look CSFB introduction, VoLGA or OTT mechanism for offering voice. The operators decision will be supported by investment and subscriber satisfaction. In the next stage, IP Multimedia Subsystem (IMS) based Voice over IP over LTE (GSMA VoLTE profile) introduction depending on GSMA IR.92 standards, may look larger deployment. There is a probability that these will be further improved with video facilities utilizing MMTel/IMS and integrated with other improved services i.e. rich communication suite (RCS), location and presence based services and video share services. If this occurs, SRVCC is likely to be utilized for offering call continuity as subscribers move from LTE to non-LTE regions. In the final stage, operators may move to full IP networks to take benefit of improved capacity, rich communication facilities, inter-RAT interoperability and operational efficiencies relating to same or different operators.

II. VoLTE ARCHITECTURES AND PROTOCOLS

On one side, there are operators who have built substantial investments in 2G/3G deployments, on the other side, there are some who do not have any 2G/3G deployment but have obtained spectrum for LTE deployment. Then among the available operators there are those who have not deployed IMS with respect to cost or other considerations. It is due to this diversity that some solutions to offering voice over pure LTE and hybrid networks available. For the same cause, the GSMA mentioned IMS based VoLTE solution has not caught on. We shall talk about here significant mechanisms that are viewing deployment and developmental attempts.
***2.1 Circuit Switched Fallback (CSFB*)**:** CSFB has been standardized by 3GPP for offering circuit switched voice facilities to UE associated to E-UTRAN by reutilizing UMTS/GSM infrastructure. For deploying this technique, the operator should have UMTS/GSM deployment in the LTE coverage regions, or have schedule with other operators having these deployments. When an LTE user builds or gets a voice call, CSFB hands over the UE to 2G/3G network. This technique supports the available operators who have compensated for the spectrum and already invested in 2G/3G infrastructure. Novel operators with no cellular deployment would have to build costly arrangements with available operators. CSFB has become a suggested solution for operators who have not spread IMS.
The EPS CSFB architecture as indicated in 3GPP TS 23.272 is shown in Fig 2.

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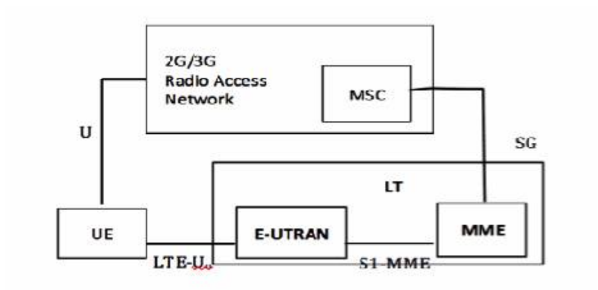

Figure 2: The EPS CSFB architecture

2.2 Voice over LTE via Generic Access (VoLGA): VoLGA depends on the available 3GPP Generic Access Network (GAN) standard utilized by cellular operators to increase coverage region of cellular with Wi-Fi offload. GAN standard increases 3GPP coverage by permitting dual mode mobiles, which can access the 3G facilities over Wi-Fi. The GAN concept is to propose a gateway between 3GPP and Wifi network, which transmit the signaling between the 3GPP network and the terminal. The objective of GAN is to increase mobile facilities over a generic IP access network. With VoLGA operators can combine LTE stepwise, utilizing 2G or 3G infrastructure. Moving between the two network techniques is fully transparent to the subscriber. The VoLGA is provided in Fig 3.

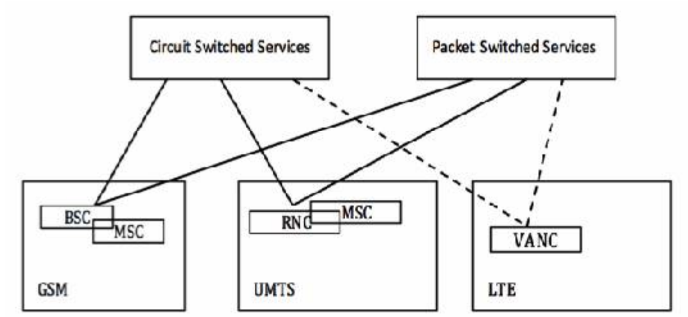

Figure 3: ***Voice over LTE via Generic Access (VoLGA)***

III. SEAMLESS VOLTE AND ROAMING

The present hybrid scenario with UMTS, GSM and GERAN along with LTE deployment is likely to proceed for a long time. Even LTE networks run in several frequencies. In either condition, the mobile user is likely to move out of the 4G LTE coverage region during a live voice call. Users would require such calls to remain linked. In this section we will talk about mechanisms implementing voice call continuity and call handover.

3.1 Interoperability among VoLTE architectures

Network interoperability is a significant problem for continuous mobility throughout heterogeneous radio access networks. When the user travels other networks, nationally or internationally, the inter-technology mobility should be seen to the user. The network and UE should, thus, support inter-RAT handover between LTE and several former generations networks i.e. UTRAN, UMTS, CDMA 1000 and so on. Media Independent handover (MIH) has been formulated by IEEE to make handover of IP sessions at layer 2 of one radio access technique to another. In situation of CSFB technique, voice calls are moved to the 3G network. VoLGA enables the available core voice network to behave as a packet service provided throughout the LTE access network. Generic Access Network (GAN) bridges the UMTS and LTE networks. As talked about before, both CSFB and VoLGA are assumed to be interim solutions. SRVCC since stands out as it is viewed to be more long-term as compared to the other techniques.

3.2 Roaming standards

3GPP Release 11 mentions VoLTE roaming and interconnection architecture. It appends standardized essential functions for carrying out roaming and interconnection in a way same as available circuit-switched voice on top of the available VoLTE interconnection and roaming and interconnection architecture.

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Available VoLTE Roaming Model: VoLTE depends on IMS, which is an IP-based system enforced utilizing the Session Initiation Protocol (SIP). The current model has a problem that GSMA has introduced to resolve in the future model. In situation of international roaming the call from an operator A to an operator B, the SIP signaling path and voice path are not essentially same. Signaling could go through one or more Internet Exchanges (IPX). In Fig 9 P-CSCF is with operator A while SIP server (AS and S-CSCF) which perform the real call control are carried out by Operator C. This generates an issue as the IPX operators, in the home network, only carrying voice and no SIP signals are not capable to charge and time calls.

3.3 Roaming Architecture for Voice over IMS with Local Breakout

The issue talked about in sub-section 3.2 was studied by GSMA and a work item known as Roaming Architecture for Voice over IMS with Local Breakout (RAVEL) was accorded upon in Rel 11 VoLTE Roaming Model. RAVEL has agreed on a model same as the CS network. A novel entity known as the Transit & Routing Function (TRF) has been proposed, which takes the SIP signals back from the network, where the caller is currently linked (Operator C), to the home network executing call processing (Operator A), and offers an anchor function that propagates the SIP signals and voice data throughout the same route so that the IPX operator can time and charge for the resource utilization. Fig 4 indicates the RAVEL improvement.

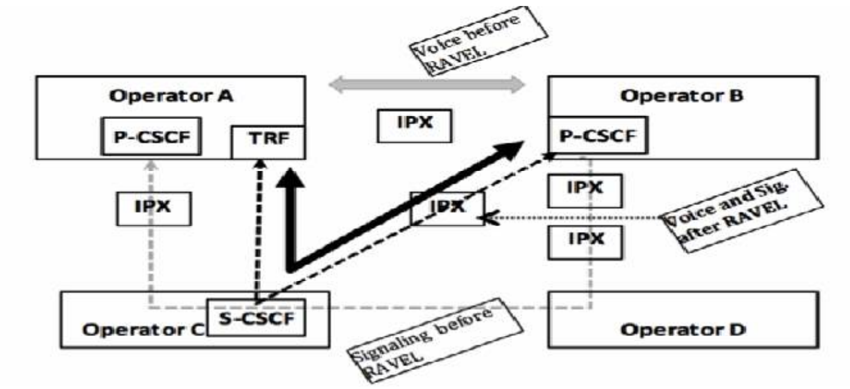

Figure 4: Roaming Architecture for Voice over IMS

IV. VOICE OVER LTE VIA IP MULTIMEDIA SUBSYSTEM (VOLTE)

Voice functionality is supplied by the IP Multimedia Subsystem (IMS) in this solution. IMS is a central network architecture that is incorporated on top of the LTE network as depicted in Figure 5. The IMS network is primarily utilized to supply all the basic voice facilities that are supplied by the subsisting CS networks. It also facilitates improved multimedia services i.e. real time gaming, video conference etc.

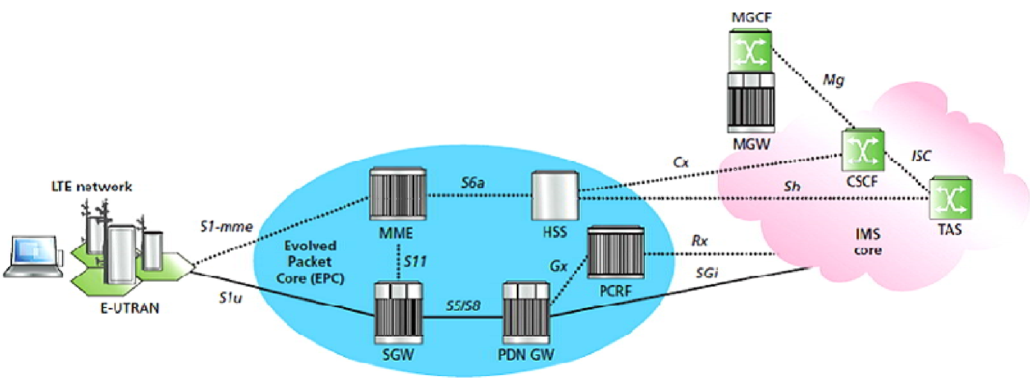

Figure 5: VoLTE

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The major benefit of utilizing an IMS based solution is that it uses the LTE architecture completely instead of using the existing CS networks for providing voice service. The IMS network can be integrated with the legacy 2G/3G networks then it can provide support to voice call continuity even when the user moves out of LTE range. Thus, the user can uses the same facilities in roaming also. This solution is being designated as the long term solution as it can provide improved features to the LTE network and also supports combination with the available 2G/3G networks.

V. CHALLENGES OF VOLTE

There are several LTE challenges. While 3GPP has standardized IMS depending VoLTE for voice over SRVCC and LTE for seamless call, IMS adoption has been very slow primarily due to the cost problems. IMS mass deployment is nowhere in sight putting a question mark on broad VoLTE adoptability. Among the non-IMS mechanisms, CSFB proposes call latency as the signaling load on HLR increases. In this section we would talk about the challenges introduced by multiplicity of protocols, technologies and implementation scenarios [anritrsu13].

6.1 Technology challenges: The operators need for clarity on standards in providing support to voice over LTE. Of the normally utilized techniques, VoLGA and CSFB, only the former has been signed by 3GPP. The operators utilizing VoLGA face the inter-RAT incompatibility prospect and possible problems in movement to GSMA VoLTE. Non-enthusiastic IMS deployment builds it complex for VoLTE to grow. There are several new protocols associated to IMS i.e. SigComp, IPv6, IPSec and P-headers that builds matters worse. LTE protocol stack integration with the IMS control layer is to be taken attention of and end-to-end IMS signaling must be checked throughout the LTE access network. Another problem is mobility implementation between the circuit switched networks and packet switched LTE. SRVCC should offer the subscriber experience comparable with the roaming experience in the 2G/3G networks. Regulations in most countries need emergency calls to be offered. While in LTE regions with legacy networks this can proceed to be offered throughout these networks but in LTE regions with no IMS the solution may not be important. While there is no easy solution, end-to-end IMS signaling throughout an LTE transport technique, addresses the challenges introduced by LTE protocol stack integration with the IMS control layer and all its several protocols.

***6.2 Implementation challenges*:** Standards for voice facilities over LTE depending on 3GPP IMS architecture are still growing. It would consume time for the users based on LTE to be anywhere nearer to 2G/3G networks. It is, thus, required that the operators would view for interim solutions before migrating on to full-fledged IMS architecture. For operators this builds economic sense. In the interim the operators would deploy VoLGA, CSFB or even OTT solutions. The data may be migrated earlier to the LTE due to built in efficiencies provided by LTE for data operations. Novel operators who have achieved spectrum from the digital dividend and do not have any legacy networks face complicated situation. If they do not want to go for OTT solutions for the user dissatisfaction fear, they would have to build costly sharing arrangements with other operators. Even the available 2G/3G operators who do not contain Generic Access Network and do not want to commit investment in IMS would have to go for CSFB. If the operators have GAN and are ready to invest in VANC would still have to manage their legacy networks.

6.3 User satisfaction challenges: Network performance for serious real-time facilities requires to be examined with real-time video and audio quality measurement tools. Network impairment simulation may be conducted to check voice call quality by appending errors in the application data stream. While migrating to more advance technique i.e. LTE, users need the service quality to be better as compared to what they achieve today. While this may be true for data facilities where users can view faster video download, the same cannot be said for voice facilities. Based on the voice over LTE solution spread by the operator, there may be delay in call establishment and reduction in quality. The service suppliers would thus face a complex choice in the long and short term. However, IMS based VoLTE provide support to 3GPP, the operators may be pushed to have a roadmap towards full IMS facilities. The VoLGA forum provides support to GSMA VoLTE initiative, which identifies VoLGA as the interim solution.

VI. CONCLUSIONS

Movement towards LTE is a former conclusion. Both the available cellular operators and the new ones who obtained spectrum in the ~digital dividend auction are viewing at LTE as the savoir technique in the exponential increase in data traffic era. 3GPP Release 8, 9 and 10 that covers with LTE and LTE-A describes how LTE has been analysed for data transmission. In the procedure the casualty is circuit switched voice. While there is an alternative of OTT facilities, cellular operators are against to this selection for several causes and it would also not go down well with users as the

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main voice providing. The GSMA has standardized 3GPP IMS based VoLTE as the extreme solution for circuit switched SMS and voice in pure and heterogeneous LTE networks. As this solution is costly and complex, operators are assuming VoLGA and CSFB, at least in the interim. In this paper we deliberate upon technical explanations of several VoLTE technologies, their downsides and upsides and the conditions in which they could be deployed. Future research and developments in the VoLTE area has also been talked about.

REFERENCES

[1] Rossitza Goleva and Maria Goleva, "VOIP traffic shaping analysis in Metropolitan Area Networks". International Journal Information Technologies and Knowledge, Vol 2, 2008.
[2] Ajith Kumar and Sheela Ganesh Thorenoor, "Analysis of IP Network for different Quality of Service", 2009 International Symposium on Computing, Communication, and Control (ISCCC 2009) Proc. of CSIT vol.1 (2011) © (2011) IACSIT Press, Singapore.
[3] Younes Labyad, Mohammed MOUGHIT and Abdelkrim HAQIQ, "Performance Analysis and Comparative Study of Voice over IP using Hybrid Codec",Complex Systems (ICCS), 2012 International Conference,Agadir
[4] S. P. Mehta, "Comparative Study of Techniques to minimize packet loss in VoIP," 2005. [Online]. Available: http://www.rh.edu/~rhb/cs_seminar_2005/SessionB3/mehta.pdf.
[5] J. Rosenberg et al., "SIP: Session Initiation Protocol", Internet Engineering Task Force (IETF), RFC 3261, June 2002.
[6] S. Brunner and A. Ali, "Voice over IP 101: understanding VoIP networks", Juniper Networks, white paper, Aug 2004.
[7] John F. Buford, "IP Communication Services", Special Issue, Journal of Communications, Volume 7, Number 2, February 2012.
[8] R. Dimova, G. Georgiev and Z. Stanchev, "Performance Analysis of QoS Parameters for Voice over IP Applications in a LAN Segment", International Scientific Conference Computer Science , 2008.
[9] Willis, Peter, "Core IP and MPLS Networks," IEEAnnual Course on Telecoms Networks - The Next Generations, London, United Kingdom, pp. 15-33, July 2005.
[10] Ian F. Akyildiz □, David M. Gutierrez-Estevez, Elias Chavarria Reyes, "The evolution to 4G cellular systems: LTE-Advanced", ELSIVER, Physical Communication 3 (2010)
[11] 3GPP TS 36.401, Evolved Universal Terrestrial Radio Access (EUTRA)and Evolved Universal Terrestrial Radio Access Network (EUTRAN) Overall description, Stage 2. June 2010.
[12] Emad Aboelela , NETWORK SIMULATIONS EXPERIMENTS MANUAL, Computer Network,3rd Edition.