WHITE PAPER

AVIAT NETWORKS

VOLTE and the IP/MPLS Cell Site Evolution

By Eduardo J. Sánchez, Aviat Networks Technical Marketing

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INTRODUCTION

As one of the most anticipated network technologies ever, Voice over LTE (VoLTE) has been discussed by operators for years. The expectation was that deployments would start in 2013, but rollouts in North America were delayed. Operators have faced a series of issues that include poor voice quality and long call establishment times. Once these problems are solved, it is expected that VoLTE will allow operators to provide voice and data services using an integrated packet network. As the problems described show, the implementation of VoLTE presents challenges for the entire LTE ecosystem including microwave backhaul. The purpose of this white paper is to describe some of the VoLTE requirements that must be met in order to overcome these technical challenges, which must encompass a flexible microwave backhaul as a key factor for a successful transition to all-packet voice and video VoLTE networks. A brief introduction to VoLTE is presented and then different VoLTE backhaul requirements are described with possible solutions.

Flexible microwave backhaul is a key factor for a successful transition to all packet voice and video VoLTE networks.

PROBLEM: DEPLOYING VOLTE FOR RELIABLE VOICE AND VIDEO

VoLTE is the emerging telecom standard for transporting voice and video communications. While it holds promise for simplifying the architecture for mobile network operators (MNOs) by running voice and video as just two more applications across a pure, flat IP network, it has yet to prove out on a large scale. Mobile operators are reluctant to broadly roll out VoLTE until it can meet the customer expectations for latency and Quality of Service (QoS) they have come to expect with 2G and 3G networks that still dominate much of the mobile market worldwide. It will take some time to build out the LTE infrastructure to support VoLTE at these customer expectation levels. What is needed is a transitional plan to ease the migration from hybrid TDM/IP network architectures of 2G and 3G mobile networks to that of the all-packet, pure-IP basis of VoLTE.

VOLTE EVOLUTION

As spectrum becomes scarcer, migration to technologies like LTE, which have higher spectral efficiency, becomes high priority for operators. A way to accomplish this goal is to move 2G/3G voice traffic to more spectrally efficient VoLTE. The problem is that the replacement of existing 2G/3G infrastructure with packet-based VoLTE will take time, because operators want to be sure that VoLTE meets customers' expectations. While this transition is occurring interim solutions have been put in place that will allow operators to provide LTE data services and keep their 2G/3G legacy networks running. Once the transition is complete, operators will be able to provide subscribers Rich Communications Services (RCS) including higher quality voice calls, video calls and bundled voice and data services.

CIRCUIT SWITCHED FALLBACK (CSFB)

Data services in a CSFB network are provided by the LTE portion of the network, and the 2G/3G portion of the network provides voice. Figure 1 shows the architecture for CSBF for a network. User equipment with CSFB functionality connected to an LTE network may use the 2G/3G network infrastructure to connect to the circuit domain. The SG interface between the LTE Mobile Management Entity (MME) and the MSC server enables the user to simultaneously register on a circuit or packet basis. A limitation of CSFB is that the ability to switch from LTE data to circuit voice is only available if the 2G/3G and LTE coverage overlap.

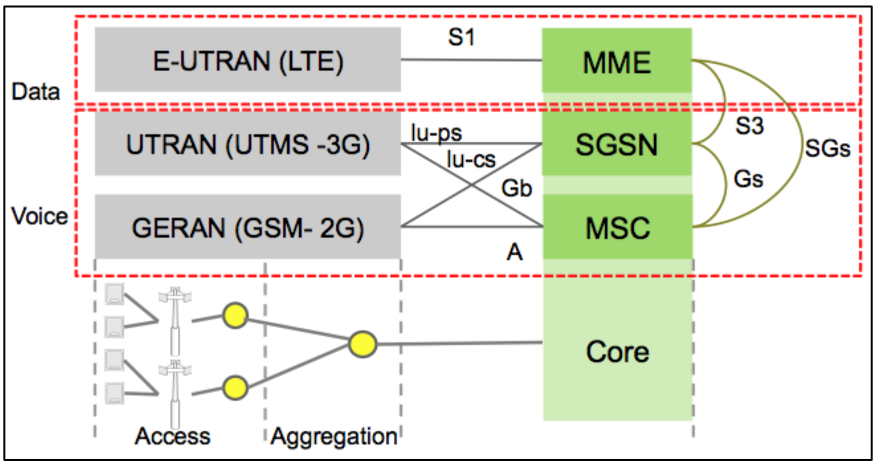

Figure 1. EPS architecture for CSFB

OVER THE TOP VOIP

Free VoIP Over the Top (OTT) applications are seen by many operators as a threat to their traditional voice service revenue. Different strategies are being implemented by operators to compete with this threat. Some of these strategies include adding free or low-cost RCS products by partnering with OTT vendors or copying their products. The popularity of these free and easily available apps is an overriding factor that is motivating operators to move to VoLTE. Although popular and easily available, these products lack Quality of Service (QoS) and hand-over capabilities, with voice and video only delivered on a best-effort basis. These and other limitations can be exploited by operators to provide RCS using VoLTE that can successfully compete against free OTT VoIP products.

VOLTE

Operators want to re-create on packet-based equipment the user experience callers have with circuit-based equipment. VoLTE holds promise for realizing this, thus making it transparent to the final user. This can be accomplished by leveraging the Integrated Multimedia Server (IMS) to deliver voice and SMS messages through the LTE packet-only network. As Figure 2 shows, a VoLTE network has many “moving” parts and that’s partially why its implementation has been slow.

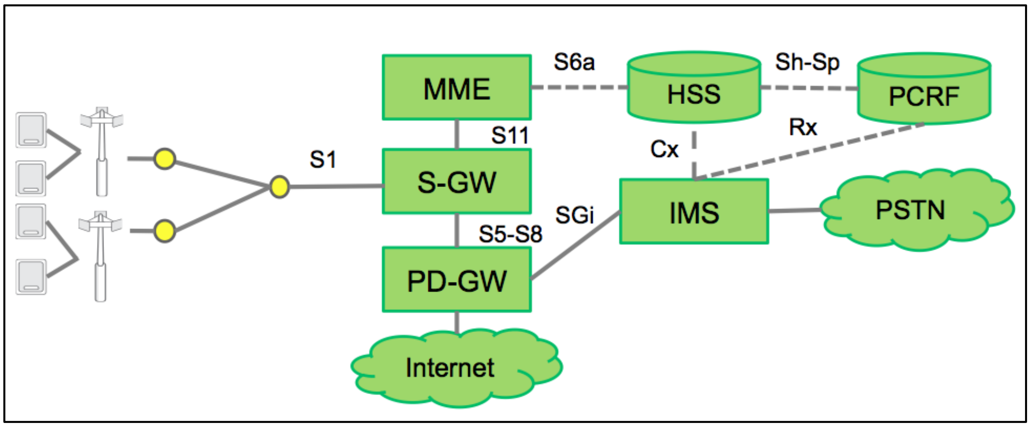

Figure 2. VoLTE reference network

BACKHAUL REQUIREMENTS

1. SMOOTH BACKHAUL TRANSITION

VoLTE in its final form could provide great benefits to operators because their 2G and 3G voice spectrum can be refarmed in favor of using more spectrally efficient LTE. But even as operators want to quickly migrate to this new technology, they are aware of the implementation difficulties and customers' expectations. The migration process will take time and effort. To get to the final all-packet solution, interim fixes are being implemented that imply running switched and data networks in parallel. Figure 3 shows two options, the first uses existing Circuit Switched Fail Backup (CSFB) in conjunction with Simultaneous Voice and LTE (SVLTE) to provide VoIP functionality.

The second option uses Single Radio Voice Call Continuity (SRVCC) that allows moving VoIP/IMS calls from the packet domain to a 2G/3G legacy circuit domain. The final stage of VoLTE deployment has full VoIP and video functionally. Figure 3 also shows the evolution of backhaul parallel to the VoLTE evolution. Circuit-based voice networks that used 2G/3G used hybrid TDM/IP radios. For both the interim and the final VoLTE implementation, the

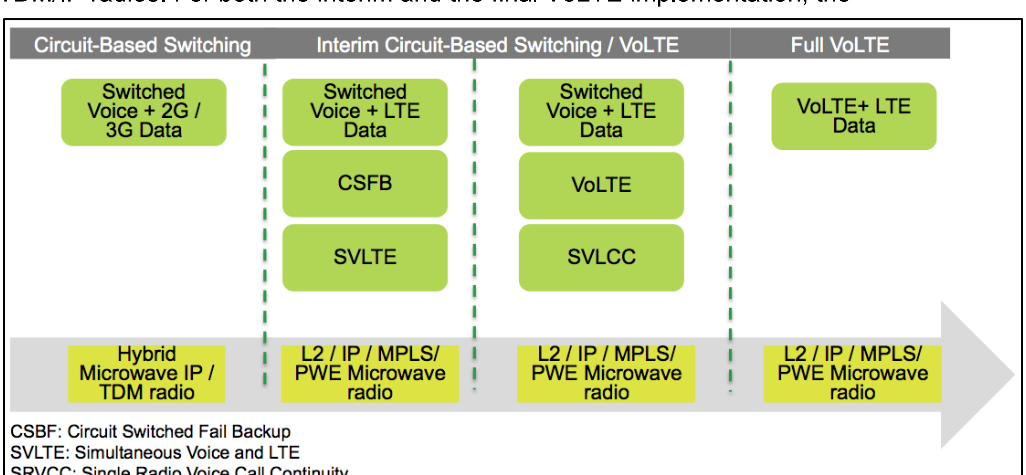

Figure 3. Evolution of VoLTE and microwave backhaul

use of a flexible Layer 2 IP/MPLS pseudowire (PWE) solution is needed. As the transition from interim forms of VoLTE are replaced by all-packet VoLTE and spectrum is refarmed for access, flexible backhaul radios can also free up spectrum for refarming for TDM circuit or PWE use in a flat IP network.

The transition from TDM to IP can be done with minimal CAPEX and OPEX. This is possible because capacity and technology updates can be performed with the same hardware. If additional capacity is needed to provide new services like video calls or file attachment forward, microwave radio features such as Layer 1 Link Aggregation (L1LA) can be used to increase capacity. Part of this transition implies that QoS is required as VoLTE uses a combined data and voice channel instead of dedicated circuits. The best way to meet these capacity and latency requirements is to use MPLS.

2. GUARANTEED QOS

QoS for VoLTE is the main differentiator against other VoIP services already available to LTE users. Currently, users of VoIP services now available over LTE networks can only expect “best effort” priority for their voice and video packets. But because most of these VoIP services originate in free OTT applications, these users get that for which they paid. On the other hand, paying customers who will use VoLTE should expect the same call quality that 2G and 3G networks provide, something that is not easy for all-packet networks. That’s why VoLTE QoS is a key element to maintain or improve the voice services provided by 3G networks and a key differentiator against OTT applications.

QoS is the main differentiator against free or low cost pre-installed OTT VoIP applications.

For VoLTE, the Integrated Multimedia Server (IMS) provides different wireless bearers for high priority voice + video and lower priority for data. This need for prioritized traffic is a key requirement for the backhaul. Figure 4 shows a backhaul implementation that uses cell site routers to classify traffic depending on QoS characteristics (i.e., traffic type and priority). The cell site router will use its MPLS capability to tag VoLTE voice and video packets with the highest priority labels in order to achieve circuit quality service of that found if running voice and video over parallel 2G/3G circuit infrastructure.

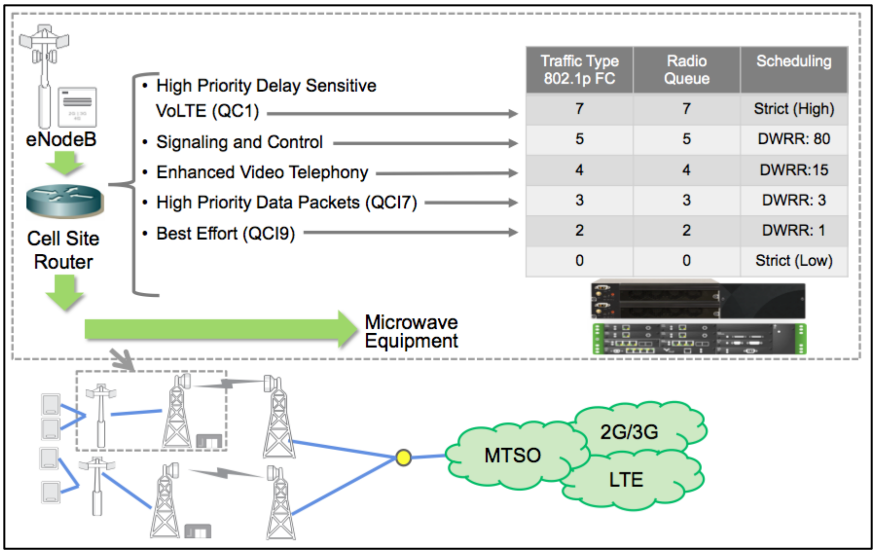

Figure 4 Cell site router traffic classification

This classification can be used by the microwave equipment to prioritize traffic using DSCP/802.1p. This type of architecture makes sure that available backhaul bandwidth is used efficiently and packets have prioritization policy consistent with LTE QoS priorities. Although this method is effective, integration of the microwave radio and the cell site router can provide additional benefits. Integrating the IP/MPLS engine with a purpose-built microwave router not only ensures consistent QoS policy across the network but also can reduce latency and jitter.

Consolidating the routing engine with the microwave equipment allows keeping a consistent QoS policy throughout the network.

3. DEALING WITH SMALL PACKETS

Many of the LTE data applications that will work with VoLTE including streaming mobile video, M2M, telemetry, P2P, Online Gaming, SMS and MMS will typically have packet sizes below 500 bytes, with the greatest concentration below 100 bytes. For most of the cases, less than 10 percent of the packets have lengths greater than 1200 bytes.

The industry expects VoLTE with voice and video that will bolster this trend with small packets for voice and video calls. As packet size will tend to be 64-100 bytes, with a great percentage of the packet content comprising headers this can lead to inefficient backhaul spectrum usage. A key requirement leading to small-packet optimized backhaul is to have a platform that uses multi-header compression. Different multi-header compression methods can be used including VJHC, IPHC or ROHC. For small-size packets, multithreaded compression methods can provide very efficient spectrum use.

IP/MPLS BACKHAUL FOR ENHANCED VOLTE PERFORMANCE

Network architectures are rapidly evolving to bring IP/MPLS to the cell site. Reasons for this are numerous such as ability to deliver new L3 services including enterprise services, unified transport across access and core networks and better network scalability. Bringing IP/MPLS to the cell site also has benefits for VoLTE. IP/MPLS at the cell site provides end-to-end QoS, fault redundancy and traffic engineering capabilities to ensure VoLTE applications meet end user requirements as outlined above. MPLS can guarantee that the capacity requirement for the non-GBR default bearer that connects the user's QoS of a call to the IMS core is met. Fast recovery from failures can be accomplished by using features such as Fast Reroute (FRR) to redirect tunnels that pass through congested microwave links.

MPLS simplifies traffic management of IP services such as VoLTE to meet QoS requirements for prioritizing critical traffic while offering the scalability to support VoLTE. With MPLS, "circuit switched" behavior can be supported for VoLTE by establishing label switched paths (LSPs) across the network. In this way, MPLS can be described as a "virtual networking" solution to meet the requirement of running multiple LTE applications over the same physical infrastructure. MPLS routing capability embedded directly within a microwave radio platform can maintain QoS for VoLTE services across the entire backhaul network.

MICROWAVE ROUTERS FOR HIGHER PERFORMING IP/MPLS BACKHAUL NETWORKS

Microwave routers, such as the CTR 8540 from Aviat Networks, are full featured routers purpose-built for microwave networks. These devices reduce the number of devices and simplify configuration management and maintenance, resulting in lower cost, higher performing networks.

Because IP/MPLS functionality is integrated into the microwave platform, routers will finally play nicely with your transport (because they are all in one box), which is especially important for the low latency, high reliability and strict QoS requirements of VoLTE. Microwave networks exhibit unique characteristics, and with CTR 8540, your network will perform at its highest level across all types of interface bandwidths, protection and diversity configurations and dynamic microwave path conditions.

The table below outlines some of the benefits of microwave routers for microwave backhaul networks.

SOLUTION OPTIONS SUMMARY

	RADIO PATHS	INITIAL COST (site)	LATENCY	FAILURE DETECTION (router aware)	POWER CONSUMPTION	QoS POLICIES	IP ADRESSES	MANAGEMENT PLATFORMS
CTR+ODU	**8**	**$34k**	**LOW 1X shaping, Scheduling**	**50ms**	**NP Configuration 96W**	**1**	**1**	**1**
ROUTER + ETHERNET ODR Cisco ASR + IP20c	5	$42k	HIGH 2X shaping, Scheduling	10s (minimum)	NP Configuration 96W	2	2	1
ROUTER + IDU + ODU Cisco ASR + IP20N + RFUc	5	$51k	HIGH 2X shaping, Scheduling	10s (minimum)	NP Configuration 131W	2	2	2

In summary, integration of MPLS functionality in a microwave router:

- Avoids need for expensive standalone router devices—fewer boxes to buy, deploy and maintain
- Simplifies operations
- Creates more flexible and ultimately better performing networks (routing and microwave all in one converged device)
- Transforms cell sites from low-speed base stations to multifunctional broadband delivery hubs for new services and multimedia content
- Supports latest microwave transport features such as 1024QAM ACM, XPIC co-channel operation and diversity options for high capacity and ultra reliability
- Ensures modular features that can be added through simple software upgrades as needed, protecting your investment

CONCLUSIONS

As the complete transition to VoLTE will take some time, microwave equipment needs the flexibility to support 2G/3G circuit traffic and allow a smooth minimal cost transition to all-packet networks. This can be accomplished by using packet microwave radios with PWE capabilities that can easily be reconfigured to support all-packet networks like VoLTE.

QoS for voice is the main differentiator that VoLTE has over free OTT applications. This means that QoS policies should be consistent on all elements of the network. The use of an integrated microwave router allows minimizing the necessary mappings between backhaul microwave equipment and cell site routers. This ensures that the QoS policies set in the eNodeBs are replicated in the microwave backhaul. The microwave router has additional advantages such as the use of a consolidated IP engine not only reduces latency and jitter but also allows the use of MPLS to guarantee that backhaul bandwidth and latency requirements are met under changing network demands.

VoLTE will exacerbate the issue of LTE networks using small packets. A microwave platform that uses MLHC will ensure that wireless backhaul spectrum is used in the most efficient way.

GLOSSARY

CSFB:	Circuit Switched Fall Back
Cx:	Interface between IMS and HSS
DSCP:	Differentiated services
EPS:	Evolved Packed System
E-UTRAN:	Evolved Universal Terrestrial Access Network
GERAN:	GSM EDGE Radio Access Network

HSS:	Home Subscriber Server
IMS:	IP Multimedia Subsystem
LTE:	Long Term Evolution
MME:	Mobility Management Entity
MPLS:	Multiprotocol Label Switching
MSC:	Mobile Switching Center
MTSO:	GBR
OTT:	Over the Top Applications
PCRF:	Policy Charging and Rules Function
PD-GW:	Packet Data Network Gateway
PSTN:	Public Switched Telephone Network
QC:	Quality Class
QoS:	Quality of Service
RCR:	Rich Communication Services
Rx:	Interface between PCRF and IMS
S11:	Interface between MME and S-GW
S5:	Interface between S-GW and PD-GW
S6a:	Interface between HSS and MME
Sgi:	Interface between PD-GW and IMS
SGSN:	Serving Gateway
S-GW:	Serving Gateway
Sh-Sp:	Interface between VoLTE application server and HSS
SVLCC	Single Radio Voice Call Continuity
SVLTE:	Simultaneous Voice and LTE
UTRAN:	Universal Terrestrial Access Network
VoLTE:	Voice over LTE
X2:	Interface between eNodeBs

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