VoLTE ROAMING PLAYBOOK

V.1

Industry Extract

VoLTE ROAMING LAB

INNOVATIVE OPERATORS

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1 Introduction

1.1 What is VoLTE?

VoLTE is the acronym for Voice over LTE and does exactly what it says; it is the process of voice going over a 4G LTE (Long Term Evolution) network.

Within the telecoms industry, 4G is primarily known for the improvement of data streaming, however, it can support voice, and whilst doing so can improve the quality of voice traffic. In addition, a VoLTE network has up to three times more capacity to manage voice and data traffic.

1.2 Why the focus on VoLTE?

Whilst VoLTE can provide numerous benefits to the management and quality of voice traffic and is seen as a natural stepping stone before the implementation of 5G (5G Stand Alone), the need for VoLTE has practically come from another direction.

Technology sunsets, in particular 2G and 3G decommissioning, have become more common since North American operators started to announce their 3G network shutdowns. 3G decommissioning refers to the process of phasing out and discontinuing the use of the third-generation (3G) cellular network infrastructure. As newer and more advanced technologies emerge, such as 4G and 5G, it becomes necessary to decommission older infrastructure to make way for these advancements.

Implementing VoLTE Roaming has proven to be a challenge for mobile operators over the past 4 years. Whilst domestic VoLTE was open for a while, the implementation of VoLTE Roaming was not really engaged by Mobile Network Operators (MNOs), likely because:

> **1. Business driver:** There was no real business driver to open VoLTE Roaming, not to say there could have been some reluctance to move voice to data because of fearing a deterioration of business value on the wholesale side, by significantly dropping costs from “good old MOC” to data traffic.

> **2. Lack of awareness:** There could have been an understanding, or a hope, that once domestic VoLTE is available, then this is just about opening routes like for any service.

What actually happened:

> **1. Technical driver:** A technical driver filled the lack with the business driver, when US operators, starting with AT&T, announced back in 2017 that 2G and 3G networks would have been shut down in 2022, bringing a sudden obligation for other MNOs to implement VoLTE Roaming.
>
> **2. Implementation challenges:** Despite important work and reference documents delivered by GSMA and 3GPP, the effective implementation was not really a "plug and play" journey, and everyone had to learn and tune in to make it work.

Innovative Operators is an organisation that was created to provide operational support between operators for implementing VoLTE Roaming, complementing the extensive work for standardization held by GSMA and 3GPP.

The VoLTE Roaming Lab, formerly known as the VoLTE Roaming Taskforce, was established in November 2019 with a simple and shared goal to learn together, to share experiences for technical implementation (excluding the commercial discussions).

Today, we can see a growing number of VoLTE Roaming agreements that are live, demonstrating that there are challenges, but everything needed is available.

The key point for all operators to succeed in implementing VoLTE Roaming is anticipation. Experience shows that such a project is in general an 18-month story, at least and sometimes (much) more, mainly because the whole integration involves multiple parties:

Network Teams

Legal Teams

IT Teams

Network teams: of course, with challenges to secure roadmaps with network vendors, and manage priorities with other priorities for the MNO (new services like 5G SA, domestic versus roaming, ...).

Legal teams: due to the evolution of technology, and mainly the Home Routing, there are several implications for Lawful Intercepts and Emergency Calls, that require upfront discussions with local authorities, even before launching a technical project, to educate on challenges brought by the evolution of technologies and align on requirements, as soon as possible, and hopefully as simple as possible.

IT teams: the dependency between network and IT is getting stronger, and several topics for VoLTE roaming require evolutions for IT Systems that need to be anticipated, to secure costs and priorities as part of more global roadmaps (where roaming could not be seen as the biggest priority). To name but a few: billing systems, mediation systems, and global integration with existing IT systems.

2 Objectives

2.1 Main Drivers

The goal for this Playbook is to share across the Roaming Industry, and more particularly across MNOs, a recap of 4 years of collaborative work between MNOs to exchange **best practices** when it comes to operational implementation.

It does not aim to replace the standard documents held by GSMA and 3GPP, and it rather comes as a complement, making reference to those documents in the different sections.

For some topics, there are different options that can be considered: the Playbook has no intention to say one needs to be adopted, but it will bring considerations to have in mind for each MNO to select the best options as per their local context and challenges.

This Playbook comprises the collective insights of Mobile Network Operators from the IO community. They have deliberated on their challenges during the VoLTE Roaming Lab meetings and workshops, raising fundamental questions about the path towards a successful global adoption of VoLTE Roaming.

2.2 Addressing the main challenges

Although progress has been made and evidence of this is the increasing number of roaming agreements that are live, **implementation** between roaming partners still presents challenges.

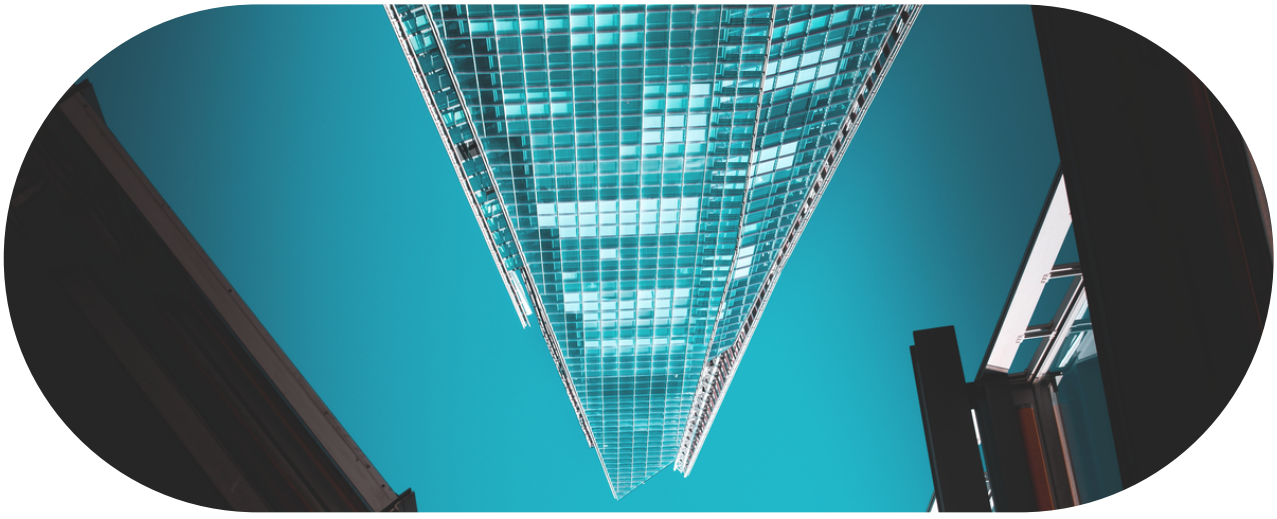
Many operators are mature enough to open VoLTE Roaming, however, this is often on a unilateral basis due to technical limitations or regulatory challenges.

Some operators launch VoLTE but don't move their **SMS on IMS,** this can also hamper launch. On the other hand, some operators have already seen success in providing Roaming to their customers despite not launching VoLTE Roaming, this has been done by using a third party to launch a hosted IMS core.

Using a hosted solution can be less challenging. Smaller operators can struggle with **IMS Core issues,** this is why having a vendor with experience in the challenges can help. Operators can also benefit from the learnings of working with a third party in the future if they decide to move to a native solution. However, this hosted solution can also have cost implications and networks may want to use this as a short-term solution only.

Several **operators are decommissioning their 3G networks**, allowing their 2G networks to provide circuit switch services. This strategy however has its own challenges: major OEMs do not support 2G and will not support 3G in the future (handsets and IoT devices), this will lead to more outages in 2G networks and much longer resolution times. This has a real and substantive impact on the quality of service.

Mobile Network Operators members of the VoLTE Roaming Lab pinpointed the key areas that represented a challenge for VoLTE Roaming implementation: **Service Testing, Lawful Intercept, and Emergency Calling,** amongst others.



3
Service Launch

3.1 VoLTE Roaming Service Launch Overview

1. Agreement: When launching VoLTE roaming services, it may be requested by the roaming partner to establish a specific annex to address VoLTE-related clauses, which means operators may require the signing of Annex C.14, which supplements the existing AA.13 agreement. This annex typically includes provisions related to VoLTE roaming architecture, APN/QoS, emergency calling, and Lawful Intercept (LI).

2. Implementation: After the necessary agreements are in place, the implementation phase begins. This involves configuring the network infrastructure, including the necessary elements such as IMS, signalling protocols, and interconnection interfaces, to enable VoLTE roaming functionality.

3. Service Testing: To ensure a seamless user experience, thorough testing of the VoLTE roaming service is essential. This typically involves two main types of testing:

3.1. IREG Testing: IREG testing verifies the interoperability and compatibility between the home and visited networks. It focuses on aspects such as call setup, call completion, emergency calls, and other key performance indicators to ensure a smooth transition for subscribers while roaming.

3.2. TADIG Testing: TADIG testing validates the accurate exchange of billing and charging information between the home and visited networks. This testing ensures that the proper charging and invoicing mechanisms are in place for VoLTE roaming services.

4. Launching: Once the service testing phase is complete and the VoLTE roaming service is deemed ready, the operator prepares to launch the service. This includes sending the necessary Commercial Launch Letter (CLL) to inform roaming partners about the upcoming VoLTE Roaming service launch. Additionally, operational tasks and preparations are carried out to ensure a successful and smooth introduction of the VoLTE Roaming service to subscribers.

3.2 Implementation: QoS Values

In the context of VoLTE Roaming, there are several critical parameters that operators must implement to enable seamless interoperability. In this section, we will highlight the specific parameters that often lead to confusion between operators during the implementation process.

When implementing VoLTE, adhering to GSMA recommendations is crucial to ensure a seamless testing process. However, some operators still face challenges in setting the correct ARP (Allocation and Retention Priority) PL (Priority Level) value. In previous versions of IR.88, it was suggested to disable ARP-PVI (Priority Value Indication). However, in the updated version, this recommendation has been revised.

Despite the updated guidelines, certain operators do not implement or accept recommended PL values or may not accept ARP-PVI being disabled. This discrepancy can lead to differences in how operators handle ARP values and could potentially cause issues during VoLTE implementation and testing.

Table 1. GSMA Recommendation for QoS values and Corresponding services according to IR.88v25.0

Parameter	Minimum recommended roaming QoS values							
Service	IMS Voice		IMG Signalling		IMS Video		Internet	
QCI	1		5		8		9	
ARP-PL	12		12		14		14	
ARP-PVI	Disable[5]	Enabled[5]	Disable[5]	Enabled[5]	Enabled[5]		Enlabled[5]	
ARP-PCI	Enabled[5]	Disable[5]	Enabled[5]	Disable[5]	Enabled[5]	Disable[5]	Disable[5]	
MBR-UL	156[3]							
MBR-DL	156[3]							
GBR-UL	156[3]							
GBR-DL	156[3]							

3.3 Service Testing

Service testing for VoLTE roaming differs from the testing conducted for 2G/3G networks due to the transition to an IP-based environment. In VoLTE, voice calls are carried as data traffic, which needs a shift from minute-based records to volume-based data records. These data records can be distinguished from regular data traffic records using specific identifiers, such as Access Point Name (APN) or QoS Class Identifier (QCI) values.

Additionally, in compliance with regulatory requirements, some operators may need to conduct Lawful Intercept (LI) testing to ensure that traffic can be intercepted as mandated. For this purpose, the HPLMN needs to switch off IPsec encryption in their IMS core. This action allows the IMS signalling and media packets to remain unencrypted, as specified in Section 20.1.1 of 3GPP TS 33.107. It is a prerequisite condition for a successful interception in S8HR that the VPLMN does not encrypt the IMS signalling and media packets.

IREG Testing

IREG testing, an essential component of service testing, can be performed using various solutions.

The most common approach involves traditional IREG testing, which entails the exchange of SIM cards between Public Land Mobile Networks (PLMNs). In this method, IREG teams from each roaming partner conduct the tests. Previously, handset exchange was necessary, which incurred high costs. However, modern handsets equipped with global firmware or the capability to be used for IREG tests have mitigated the need for costly and time-consuming handset shipments. Examples of such handsets include iPhones 7 and above with iOS 15 or Samsung series S20 and above with Android 12.

To enhance traditional IREG testing, automation solutions can be implemented to streamline the process. Automation of IREG testing or the utilization of eSIMs instead of traditional SIM shipping are among the approaches that can be considered. Several vendor solutions, such as Mobileum, Infovista TEMS, Segron, and iQsim, offer options for optimising the IR.25 test set through automation.

Another alternative is the utilization of home testing solutions provided by vendors like GSMA, Mobileum, Segron, and others. These solutions enable operators to conduct testing within their own networks, simulating the behaviour of roaming scenarios without the need for physical SIM card exchange.

Additionally, operators may opt to connect to Roaming Hubs, which act as intermediaries for launching roaming services. By utilizing roaming hubs, operators can bypass the agreement and SIM exchange procedures, as the roaming hub performs the necessary testing on behalf of the operators.

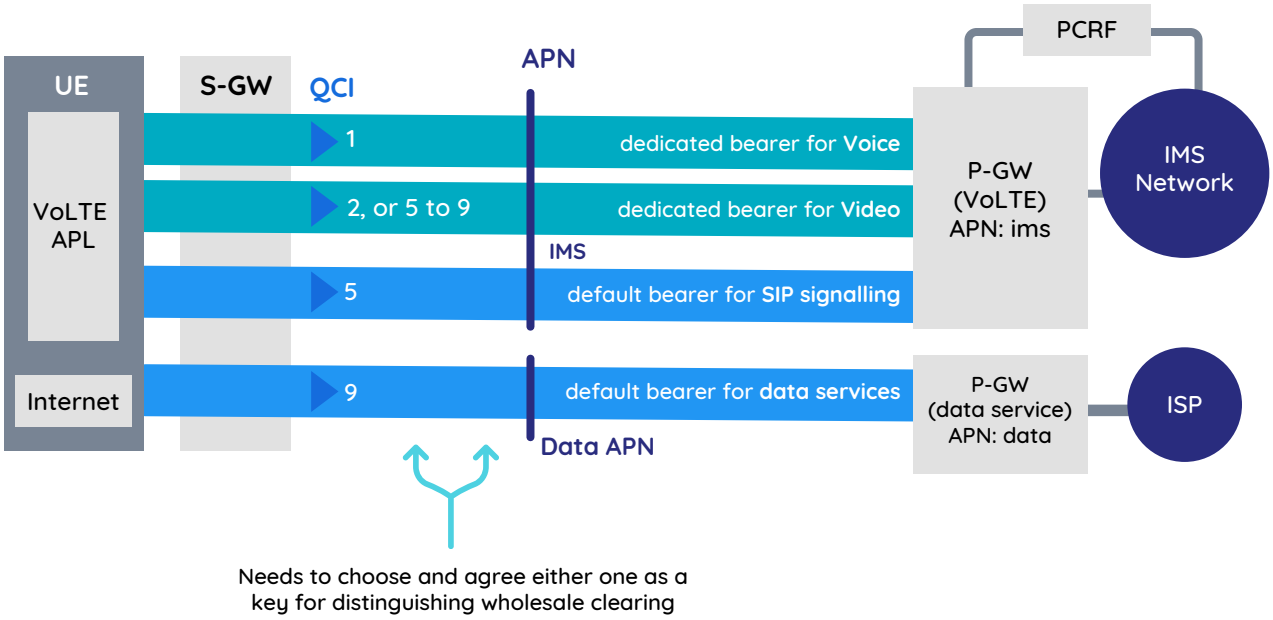
By considering these testing approaches, operators can ensure efficient and thorough IREG testing for VoLTE roaming services.

TADIG Testing

TADIG testing for VoLTE can also differ from the testing approaches used for 2G/3G networks. When validating VoLTE Call Detail Records (CDRs), several considerations need to be taken into account.

To distinguish VoLTE CDRs from regular data CDRs, specific identifiers such as Access Point Name (APN) or QoS Class Identifier (QCI) values are assigned to data bearers. The below picture reflects these two identifiers as shown in the “GSMA VoLTE Implementation Guide”.

Image 1. VoLTE CDRs identifiers: APN/QCI



Access Point Name (APN):
The "IMS" APN is typically used for VoLTE CDRs, and this designation is reflected in TAP files. In addition, the emergency APN, commonly referred to as "SOS," should be free of charge according to BA.27 guidelines.

QoS Class Identifiers (QCI):
Different QoS Class Identifiers (QCI) play a role in S8HR VoLTE Roaming. The QCI values have specific meanings:

QCI=1 is used for voice traffic (Mobile Originating Call or Mobile Terminating Call).
QCI=5 is assigned for SIP signalling or SMS.
QCI=2 usually is associated with Video over LTE (ViLTE) services.

In TAP files, different QCI values are mapped into Call Type Level 2 (CTL2) indicators:

CTL2=21 represents a voice call in an LTE network (Mobile Originating Call or Mobile Terminating Call).
CTL2=25 signifies signalling traffic or SMS.

It is important to note that not all operators may display CTL2 values in their TAP files.

These considerations highlight the nuances involved in TADIG testing for VoLTE, particularly in terms of accurately identifying and categorising VoLTE CDRs based on APN or QCI values. By adhering to these guidelines, operators can ensure the proper validation of VoLTE CDRs during the testing process.

3.4 Checklist for initiating testing

Inbound

1. Configure the MME to send IMS VoPS supported indications for the roaming partners to test IMSIs.

2. Ensure that VoLTE roaming has been provisioned for the test SIM cards from the roaming partner.

3. Have a UE available from a vendor that has enabled VoLTE roaming for the roaming partner. E.g. if Samsung has enabled VoLTE roaming for the roaming partner then has a Samsung S10 available for testing.

4. Test how Emergency calls work, including calls to local emergency numbers, if applicable. The call should be routed to a local emergency center either via IMS (local breakout to VPLMN PS-core and E-CSCF) or CSFB.

Inbound

5. Ensure the partner has disabled SRVCC for roamers. It will work for all networks and there may be an issue with long-distance SRVCC. Charging will be more difficult. STN-SR numbers are generic and not part of the customers' subscriptions, so there will need to be a correlation to get the charging correct.

6. Check that CTL2-field of TAP is populated corresponding to the QCI-values.

7. Check the quality of the domestic VoLTE services, e.g. based on the % of VoLTE calls being handed over to CS.

Outbound

1. EPC and P-CSCF needs to be configured to support Network Provided Location Information (Netloc/NPLI).

2. If the roaming partner requires encryption on Gm-interface to be switched off, this should be configured in P-CSCF.

3. In case of local emergency-numbers are used by roaming partners, make sure to configure CSFB-trigger (by the use of SIP 380 Alternative Service) in case of UE non-detectable emergency calls reaching HPLMN P-CSCF.

4. Ensure that VoLTE roaming has been provisioned for the test SIM cards sent to the roaming partner, also check that HSS has no rule to block the sending of IMS APN abroad.

5. If PCRF is checking MCC/MNC, the roaming partner should be allowed.

6. To ensure SRVCC will not happen, configure HSS to avoid sending STN-SR in case of roaming.

7. Inform the roaming partner which UE has VoLTE roaming enabled.

Outbound

8. Check that the VPLMN and event timestamp are available for retail charging.

9. In the case of duration-based retail charging, the billing system needs to update to charge roaming calls based on CDR from its own IMS, and not TAP from the roaming partner. You might also want to ensure that TAP from roaming partners for the data usage on IMS is not charged to end-customers.

10. Local integrations to OCS / IN / SMSC / MVNO's / legal requirements/etc. need to be analysed for the possible impact of the change in the call flow.

11. Today (CS): i) calling to local numbers in VPMN without int'l prefix, and ii) calling to HPMN requires int'l prefix. VoLTE is genuine Roam Like At Home (RLAH) with S8HR i.e. calling home from VPMN without int'l prefix, calling to local numbers in VPMN with int'l prefix. In order not to confuse customers on what to use based on partners supporting VoLTE and others only providing CS voice → educate the customers to always use int'l prefix.

4
Lawful Intercept & Data Retention

4.1 The need

The LTE Service Provider in the visited country needs to comply with the country's Lawful Interception and Data Retention regulations, including the VoLTE communications involving inbound roamers targets.

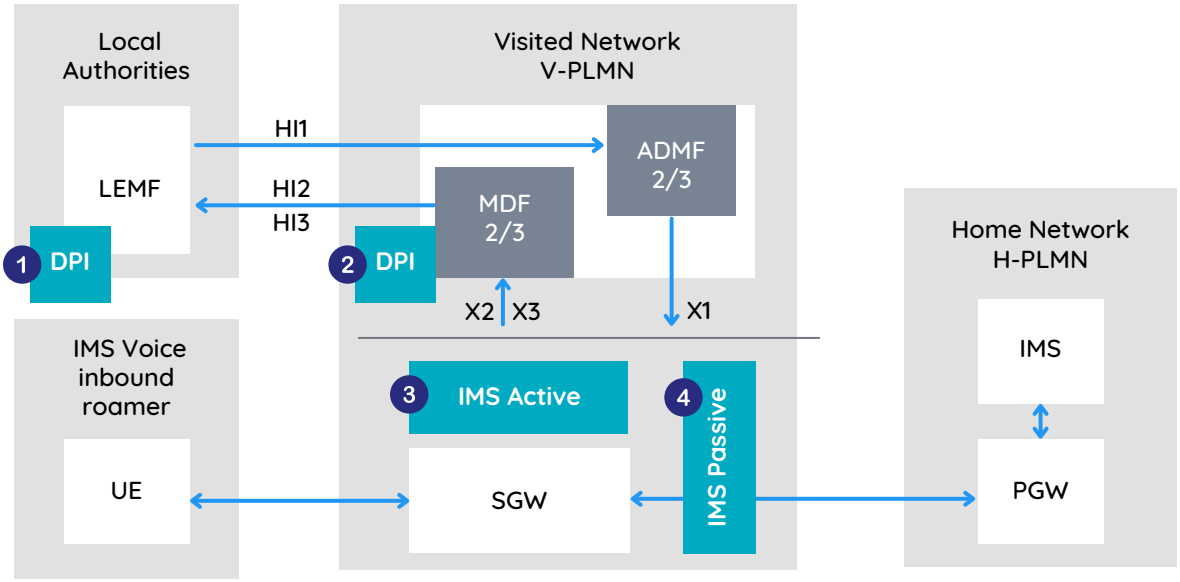
Lawful Interception (LI) refers to the real-time interception of voice calls whereas Data Retention (a.k.a. Retained Data) capability to record data that is related to the communication traffic (e.g. location/date/time/duration information, calling and called party identities, etc.).

4.2 The challenge & the solution

Lawful Interception and Data Retention must rely only on data extracted from nodes in the visited country. In the visited network, the issue is that no IMS nodes are traversed by the VoLTE inbound roamers' traffic, lawful interception and data retention sources for VoLTE traffic are only possible in the Evolved Packet Core (EPC).

Regarding the solution, different options are possible:

Image 2. Lawful Intercept Scenarios



1. In this case, the VoLTE calls are delivered to the local authorities as data streams, just like the OTT voice applications like WhatsApp. It's up to the authorities to transform these data streams into voice calls they can listen into.

2. In this case, the DPI capabilities are at the Visited network side to extract the voice related signalling and user data.

3. This solution is adding an active IMS component in the mobile data part to mirror the IMS signalling and user data.

4. The final solution is passed on passive probing on the S8HR interface and duplication the IMS signalling and user data.

To provide the VPMN the ability to tap a VoLTE call in their network, IMS encryption needs to be disabled. This does not impact communication integrity protection. It should also be noted that IPSEC is still used, albeit with a null encryption algorithm.

However, it is clear that the visited country's regulations must be followed, otherwise roaming will not happen. Thus, the HPMN must support the requirements of the VPMN and thus should be part of the roaming agreement. This means that the HPMN will, on a per VPMN basis, decide to use or not, null encryption.

4.2.1 Limitations

The overall agreement in the industry to use the S8HR solution for VoLTE roaming comes with some limitations induced by of this solution. These limitations should be communicated to the legal authorities in the VPLMN.

- Called number format in national format may escape from Lawful Intercept. The visited network cannot cope with all national numbering plan formats.
- Callers that activated CLIR (Calling Line Identification Restriction), can escape from Lawful Intercept.
- For certain call-forwarding cases, no intercept is possible. i.e. When a roamer-in gets an incoming call, conditional call forwarding occurs to a destination C. We have no trace nor can intercept the incoming call.

5
Commercial Implications

4.1 The changes

The move to VoLTE Roaming is greater than purely a change to the underlying technology. In addition to altering the format of the traffic and providing a solid backbone to a move to an all IP world, VoLTE Roaming also brings a number of changes to the traditional commercial set up.

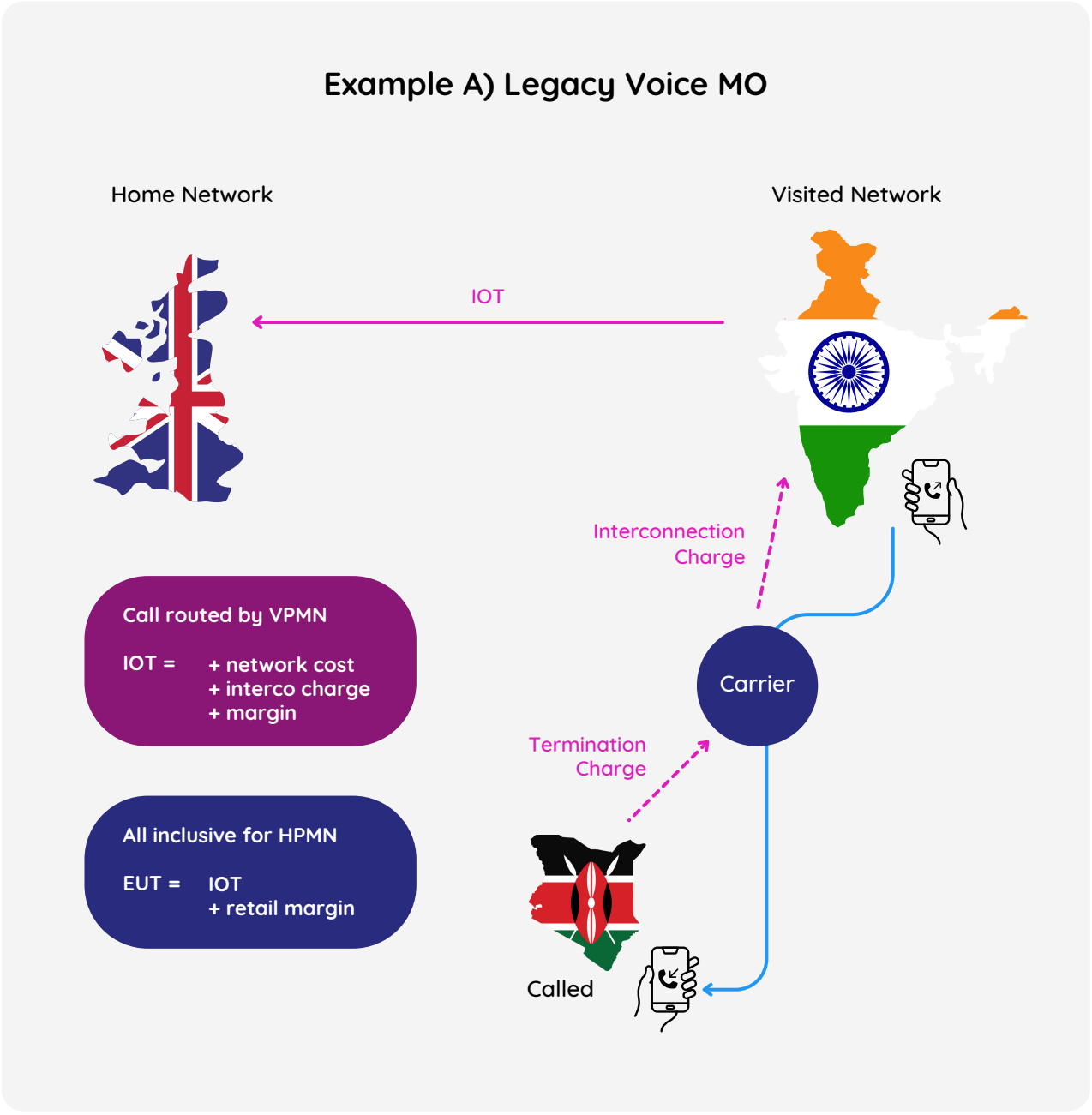
Historically not only has roaming traffic been identified as voice, SMS, and data, and rated accordingly on a per minute, per message, and per Mb/Gb, but there was also a standardized approach to how this traffic is routed.

VoLTE Roaming changes the above and delivers what could be described as a simpler routing and commercial set.

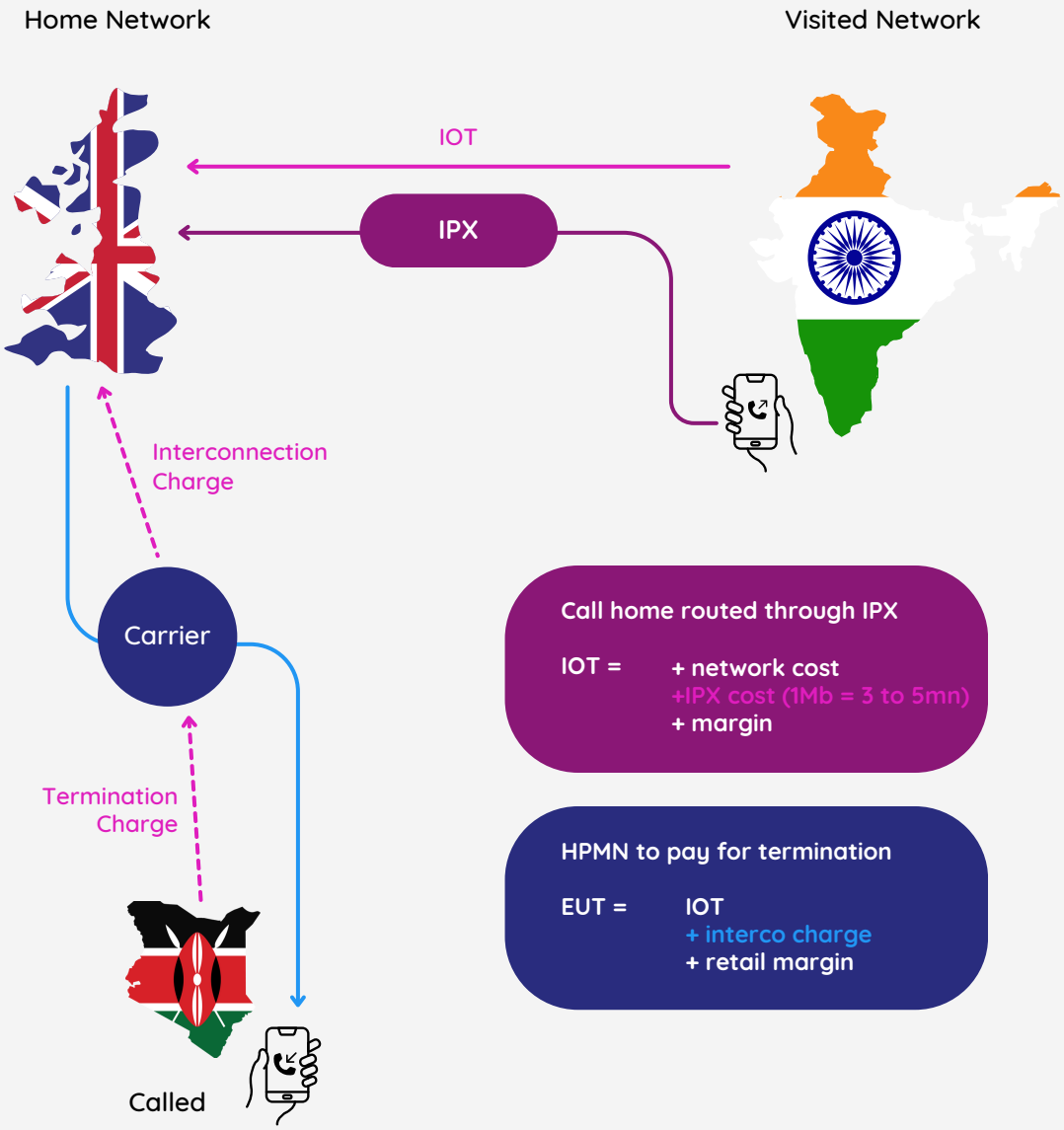
So, what is changing?

- The impact primarily affects voice and SMS, which, under the circuit Switch (CS) environment, are routed and managed by the VPMN.
- With VoLTE enabled, voice and SMS would be managed as IP (data), and as such following the current routing mechanism, and sent back to the HPMN to manage (onward route etc.).
- The result of this is that, unless specifically specified and agreed between the roaming parties (HPMN and VPMN), such traffic would be rated as ‘data’, applying the agreed ‘normal’ data rates.

4.2 Operators Examples



Example B) VoLTE MO



Additional Questions

Does that mean that, at a wholesale level, VoLTE is now charged at the same rate as data?
No, an operator has the option to negotiate and agree on different rates for VoLTE traffic, as long as they agree on charging by APN or QCI. The vast majority of operators have not applied a different rate to VoLTE traffic than that applied to data (at the time of publication of this document).

Will my Interconnect business be impacted?
Yes, an important point to note is that, as an HPMN, not only is your MO voice outbound roaming generated traffic now coming back into your network to manage (as a data stream, so no MTR), but as the VPMN, the network will also no longer be managing the inbound roaming MO generated traffic (no interconnect costs).
Depending on a network's balance of traffic, i.e. outbound roaming MO voice Vs inbound roaming MO voice, the impact will vary.

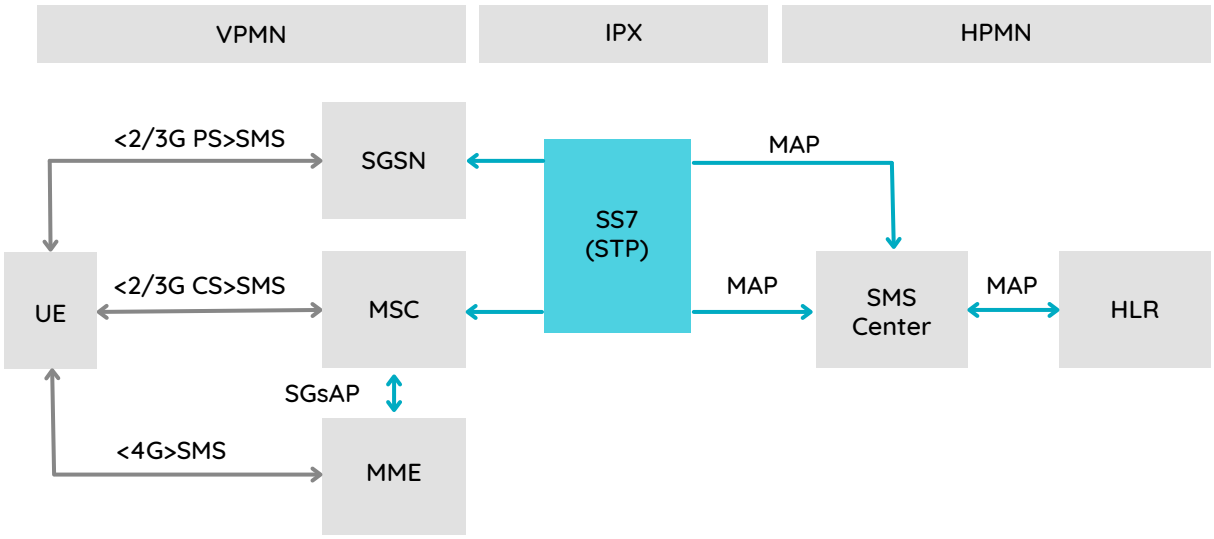
6
SMS, what's the impact?

6.1 SMS for VoLTE

SMS in 4G can be done using two technologies: SMSoNAS or SMSoIP.

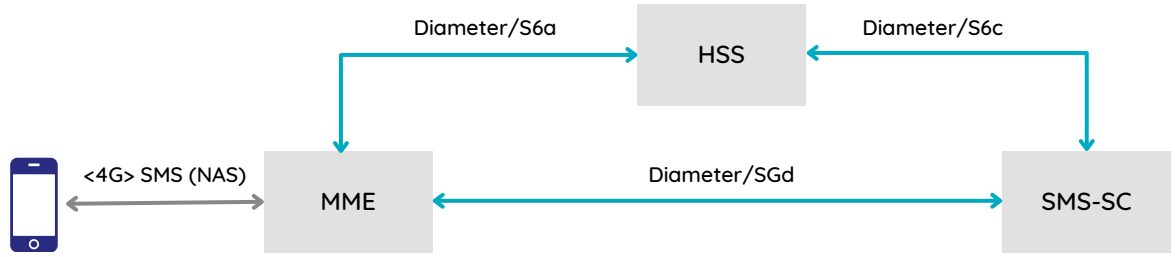
In the case of SMSoNAS, SMS is based on SGs interface, reusing 2/3G MSC, for mobile originating and terminating SMS. This requires however that the VPLMN still needs to keep legacy technology like the MSC in the network.

Image 3. SMS Architecture



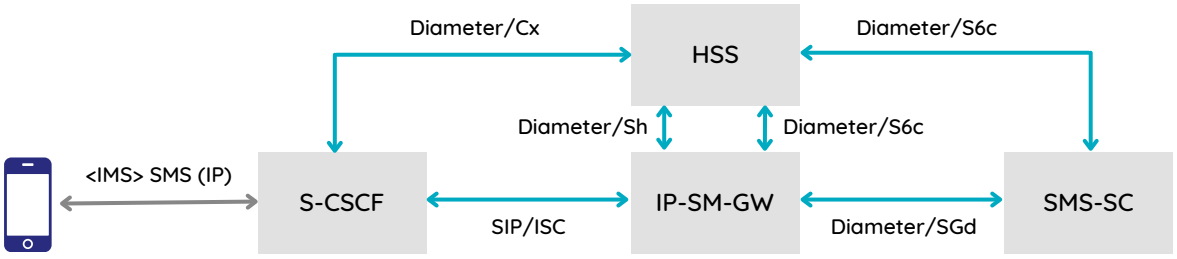
To avoid this, the better option is to use Diameter signalling between the visited MME and the home SMS-C as shown in the following picture. This requires that the HPLMN components will support Diameter messages. In the transition phase, eventually, a Diameter-to-MAP IWF could be used to facilitate the 2G/3G sunset in the VPLMN.

Image 4. Diameter Signalling



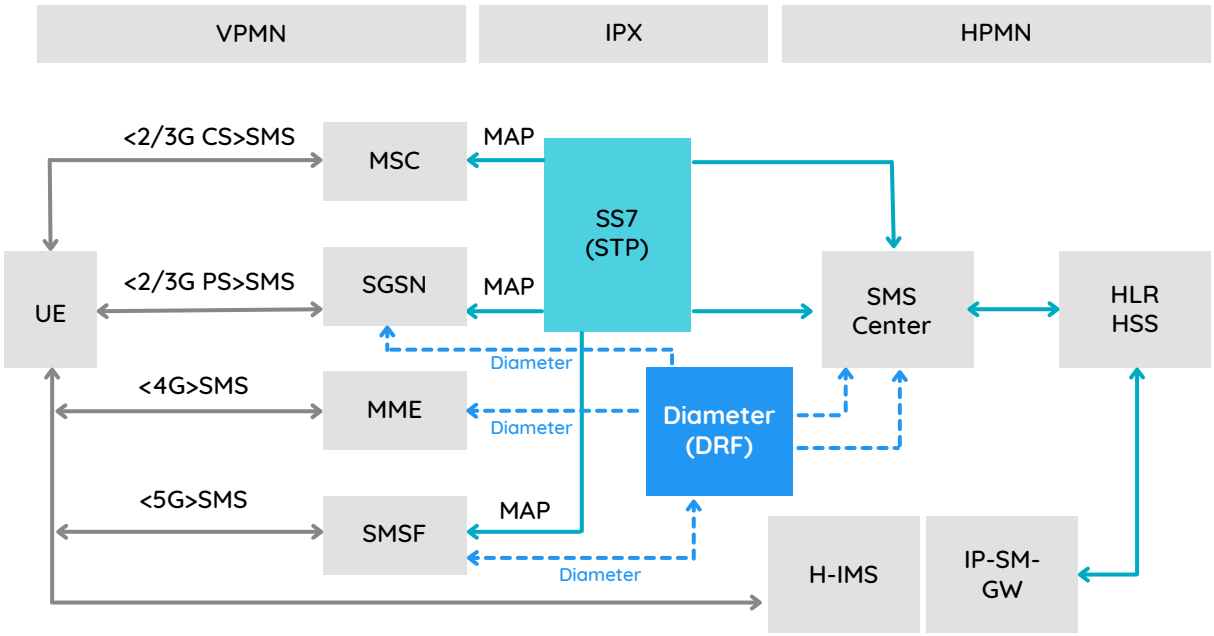
For Volte devices, the better option is to use SMSoIP or SMSoIMS. In this case, you use the S8HR of the IMS session and use the IP-SM gateway to interface with the home SMS-C.

Image 5. SMSoIP SMSoIMS



In summary the SMS roaming architecture, that is future architecture, proof for 5G, will look like this:

Image 6. SMS Roaming Architecture



7
VoLTE Solutions

7.1 What is the issue?

Hosted IMS solutions enable making/receiving voice calls and sending/receiving SMS for inbound roamers from roaming partners who don't support VoLTE.

As operators progress with the phase-out of their 2G/3G networks, a challenge emerges regarding the cessation of 2G/3G services and circuit-switch (CS) fallback support for voice and SMS to in-roamers. This situation not only poses a potential revenue loss risk as subscribers from the home network might shift to competitor networks for voice and SMS connectivity but also endangers service continuity for Home Public Land Mobile Networks' (HPLMNs) outbound roamers in foreign networks.

Furthermore, LTE operators seeking to decommission their 3G networks aim to capitalize on advantages like reclaiming frequency bands for 5G deployment and streamlining operation and maintenance costs associated with SS7/circuit-switch core network functions.

For operators reliant solely on 4G networks, inbound VoLTE roaming offers prospects for increased revenue and enhanced negotiation leverage for outbound tariffs with roaming partners, bypassing the need for comprehensive VoLTE roaming implementation. However, the broader adoption of VoLTE roaming remains limited, presenting obstacles to numerous operators striving to establish such services.

Notably, a significant hurdle arises due to several non-VoLTE operators declining to invest in costly IMS systems crucial for VoLTE roaming. In the absence of CSFB or VoLTE roaming, operators confront potential constraints in inbound roaming revenue and negotiating inter-operator tariff agreements with roaming partners.

While non-VoLTE Home Public Land Mobile Networks (HPMNs) necessitate a solution to maintain outbound roaming services and prevent premium subscriber attrition to competitors, HPMNs with VoLTE capabilities must allocate time and resources to establish VoLTE Roaming Agreements. As an interim measure, a stop-gap solution is imperative to bridge the gap between current capabilities and full VoLTE roaming implementation.

In summation, operators navigating the transition away from legacy networks and those aiming to optimize roaming revenue and subscriber satisfaction confront the complex task of providing seamless voice and SMS services amid evolving circumstances. This challenge necessitates a holistic strategy encompassing interim remedies and strategic collaborations to adeptly address these complexities.

7.2 Hosted IMS Solution

One possible solution to address the challenges posed by the removal of 2G/3G networks and enable VoLTE service without VoLTE roaming is to implement a 3rd party solution acting as an Interworking Function (IWF) between HPLMN and VPLMN. This solution (PRD NG.121) offers several advantages, including enabling VoLTE for all VoLTE devices, even without a VoLTE roaming agreement, and operational efficiency with limited configuration changes and touchpoints to VPLMN.

The 3rd party solution serves as a true interworking function, allowing VoLTE (S8HR) roaming towards VPLMN and 3G (or 4G-CSFB) roaming towards HPLMN. It efficiently converts IMS data service of TAP files from VPLMN to CS voice service for HPLMN billing, supporting both MO/MT voice and SMS services.

However, this solution may introduce complexity, requiring VoLTE-compliant user equipment (UE) and careful management of multi-tenant platforms supporting multiple HPLMNs. By implementing this interworking function, operators can ensure a smooth transition to VoLTE while maintaining service continuity for their subscribers and optimizing operational efficiency in the absence of full VoLTE roaming agreements.

Various third-party solutions are available to assist operators undergoing the sunset of their 2G/3G networks or those operating exclusively with VoLTE technology. These solutions enable the facilitation of inbound roaming between networks that are VoLTE-enabled and those without VoLTE capabilities or IMS infrastructure. Notably, two noteworthy solutions in this domain are offered by Syniverse and Mobileum.

8
Conclusions

Implementing VoLTE roaming has been quite a challenge for almost all mobile operators over the past 4 years.

As we can see in this Playbook, the reason why it is so is that multiple changes and prerequisites must be all in place and aligned to enable an end-to-end service:

- More than moving voice to data, the introduction of home routing brings several implications for roaming, notably on Lawful Intercepts and Emergency Calls – and they only come when opening roaming, they don't exist when opening domestic VoLTE.
- More than a core network upgrade, the IT systems also need to be upgraded (Lawful Intercepts is again an example), with different roadmaps to be prioritized and synchronized for smooth integration.
- More than an MNO topic, VoLTE roaming has also demonstrated an increasing dependency on the device itself and its configuration (Emergency Call is the key example).

The roaming industry has tackled these challenges collectively, thanks to the leadership of the GSMA and 3GPP in tuning or developing standards, thanks to collaboration between MNOs and vendors, and the Innovative Operators VoLTE Roaming Lab (VRL), that has provided a unique forum for MNOs to share experiences and support each other in implementation.

This Playbook shares the significant experience of the MNOs participating in VRL. Summarizing four years of extensive work in just a few pages was challenging, but the VRL team wanted to convey that VoLTE Roaming is now a concrete reality.

While MNOs beginning their journey may encounter challenges, it's important to note that solutions exist for all of them. Anticipation plays a key role in achieving success. We trust you will find this Playbook valuable, and remember that the IO community is always here to offer support.

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10
Definitions

APN	Access Point Name
ARP	Allocation Retention Priority
CDR	Call Detail Records
CLIR	Calling Line Identification Restriction
CLL	Commercial Launch Letter
CS	Circuit Switching
CSCF	Call Session Control Function
CSFB	Circuit Switched FallBack
CTL	Call Type Level
DL	Uplink Traffic
DPI	Deep Packet Inspection
DRF	Data Recovery Field
EPC	Evolved Packet Core
GBR	Guaranteed Bit Rate
HLR	Home Location Register
HMPN	Home Public Mobile Network
HSS	Home Subscriber Server
IMS Core	IP Multimedia Core Network Subsystem
IP-SM-GW	IP Short Message Gateway
IPSEC	Internet Protocol Security
IPX	Internet Protocol (IP) Packet eXchange
IREG	International Roaming Expert Group
IWF	Inter-Working Function
LEMF	Law Enforcement Monitoring Facility
LI	Lawful Intercept
LTE	Long Term Evolution (Radio)
MAP	Mobile Application Part (protocol)

MBR	Maximum Bit Rate
MCC/MNC	Mobile Country Code/Mobile Network Core
MDF/AMDF	Main Distribution Frame/Access Main Distribution Frame
MME	Mobility Management Entity
MO/MT	Mobile Originated/Mobile Terminated
MOC	Mobile Originated Call
MSC	Mobile services Switching Centre
NPLI	Network Provided Location Information
OCS	Online Charging System
OTT	Over The Top
PGW	PDN (Packet Data Network) Gateway
PL	Priority Level
PRD	Permanent Reference Documents
PS	Packet Switching
QCI	QoS Class Identifier
QoS	Quality of Service
RLAH	Roam Like At Home
S8HR	S8 (reference point) Home Routing
SGSN	Serving GPRS Support Node
SGW	Serving Gateway
SMS	Short Message Service
SMSoIP	SMS over IP
SMSoNAS	SMS over NAS (Non-Access Stratum)
SRVCC	Single Radio Voice Call Continuity
STN-SR	Session Transfer Number for Single Radio Voice Call Continuity
TADIG	Transferred Account Data Interchange Group
TAP	Transferred Account Procedures
UE	User Equipment
UL	Downlink Traffic
VoLTE	Voice over LTE
VPMN	Visited Public Mobile Network

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VoLTE ROAMING LAB

VoLTE Roaming Playbook

V.1

Industry Extract