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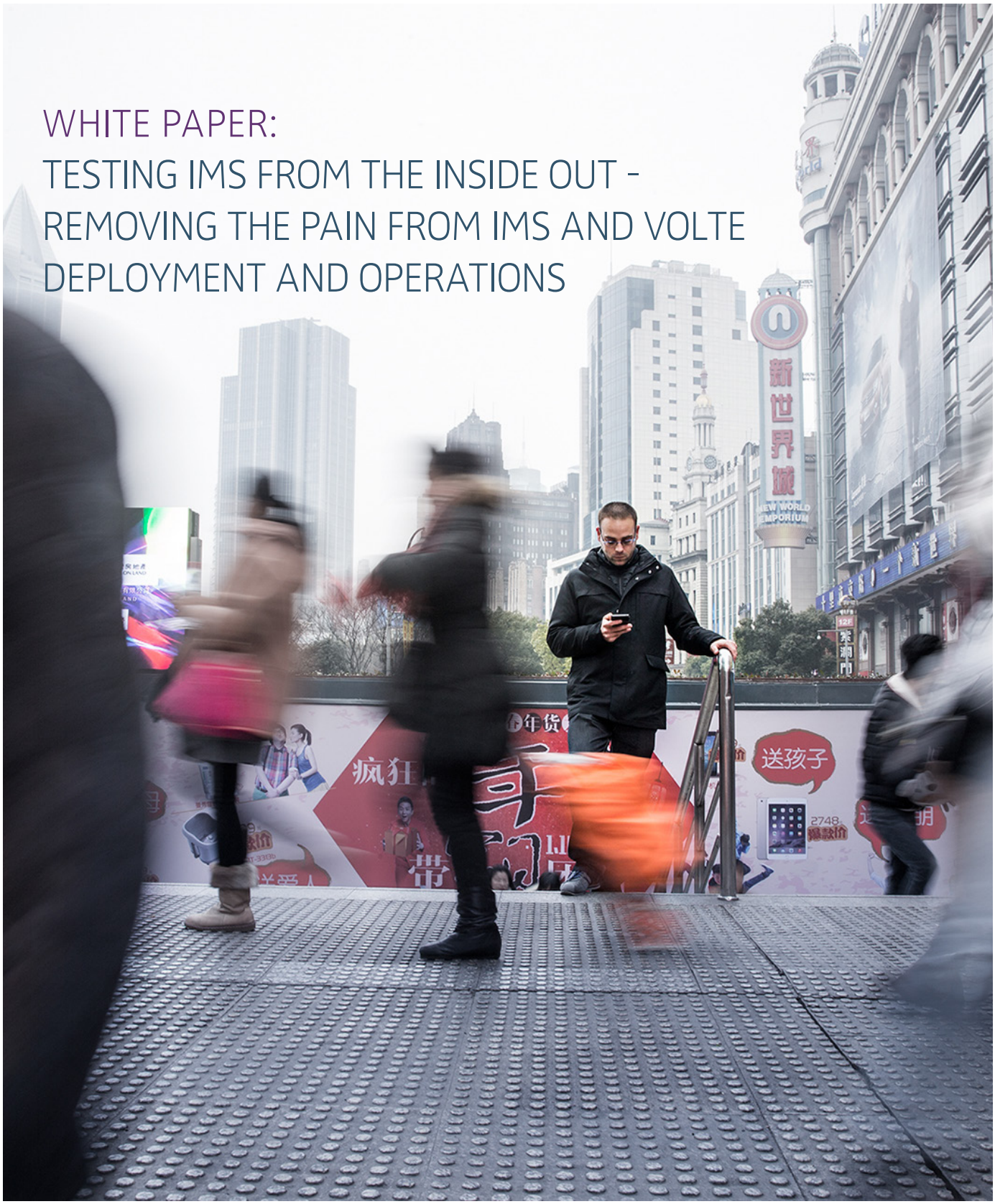
TEMS™ PRODUCTS

WHITE PAPER:
TESTING IMS FROM THE INSIDE OUT - REMOVING THE PAIN FROM IMS AND VOLTE DEPLOYMENT AND OPERATIONS



ASCOM NETWORK TESTING

SOLUTIONS FOR TODAY'S AND TOMORROW'S MOBILE NETWORK CHALLENGES

Ascom Network Testing leads the world in providing best-in-class solutions to measure, analyze, and optimize mobile networks.

The TEMS™ Portfolio offers a complete set of trusted solutions for drive testing, benchmarking, monitoring, and analyzing network performance. These state-of-the-art offerings facilitate the deployment, optimization, and maintenance of mobile networks. We are the industry leader, and our products are supplied to the world's top mobile operators, equipment vendors, and professional service providers.

With a global presence and unparalleled experience, we enable operational excellence, cost efficiency, revenue growth, and user satisfaction. These competitive advantages help our customers to navigate the constant evolution of technology and thrive in the ever-changing telecommunications environment.

We have over 450 employees in 20 countries dedicated to serving our customers.

Technology Leadership

Proven Experience

Quality-driven

World-class Support

Global Presence

ABOUT ASCOM NETWORK TESTING

Ascom Network Testing offers the TEMS™ Portfolio, the world's most widely used network testing, monitoring and optimization platform. Ascom Network Testing is a division of Ascom, a global solutions provider with comprehensive technological know-how in mission-critical wireless communication. The company focuses on the Wireless Solutions (an international market leader for high-value, customer-specific on-site communication solutions and workflow optimization) and Network Testing (a global market leader in testing, monitoring, post processing, and performance optimization for mobile networks) divisions. The Ascom Group is headquartered in Switzerland, has subsidiaries in 17 countries, business activities in more than 130 countries, and employs around 1,600 people worldwide. Ascom registered shares (ASCN) are listed on the SIX Swiss Exchange in Zurich.

INTRODUCTION:
WHAT IS THE KEY TO SUCCESSFUL IMS AND VoLTE IMPLEMENTATION?

IMS and VoLTE have both been characterized as being inherently complex. Difficult to plan, difficult to implement and difficult to validate. In other words, a pain. At least, that's the perception. However, the fact is that IMS and VoLTE implementation, deployment and operations do not have to be painful. There are clear steps through which the associated pain can be mitigated, so that mobile network operators can more quickly secure the expected operational benefits and deliver the requisite customer experience.

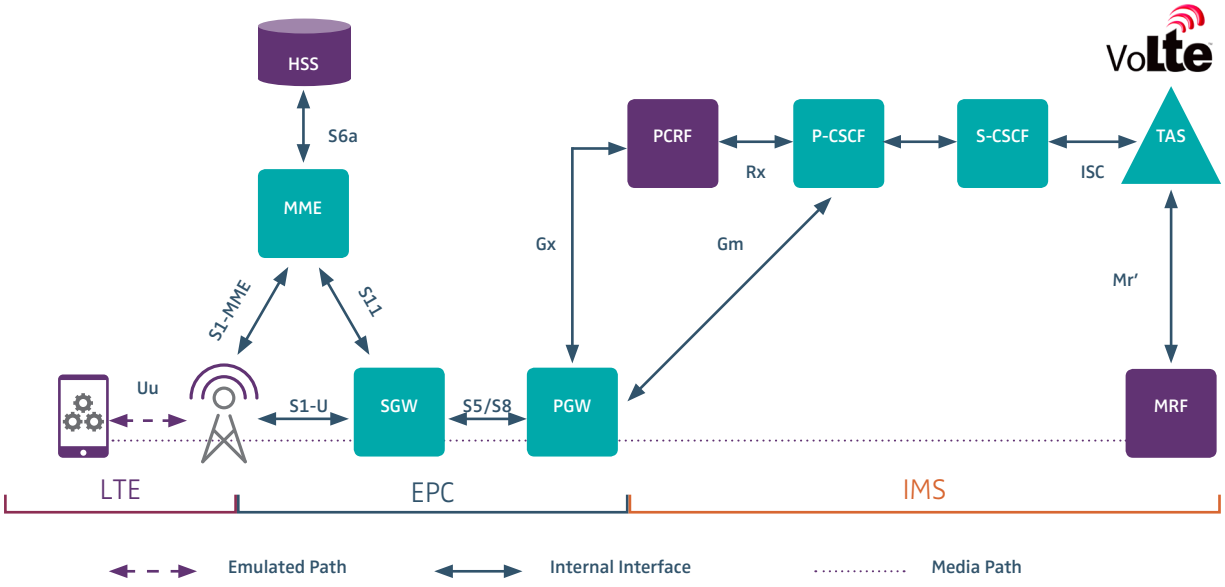
What's more, the life-cycle management of VoLTE deployments, which will involve periodic upgrades and enhancements, as well as interoperability challenges, can also be simplified, delivering additional operational and performance benefits.

The key to the successful implementation, deployment and operation of IMS and VoLTE is a carefully considered test and monitoring strategy and an automated framework that can support such a plan. By taking the right steps, mobile network operators can safeguard their investments, reduce deployment time and ensure their smooth, pain-free operation.

This paper describes how.

WHY UNDERSTANDING THE LOGICAL AND FUNCTIONAL SEPARATION OF DOMAINS IS THE KEY TO A SUCCESSFUL TEST AND MONITORING STRATEGY

Figure 1: The VoLTE service domains



VoLTE is a service that is deployed on an IP Multi-Media Subsystem (IMS) core. However, the IMS is just part of the story. It is part of a chain of elements and domains which, together, are required for the successful delivery of a complete VoLTE service. The IMS provides session control and service capabilities for the Evolved Packet Core (EPC), as well as providing the platform for the deployment of VoLTE (and related) services.

The EPC is responsible for transporting and sorting traffic from user equipment and devices. Individual devices and User Equipment (UE), connect to the EPC via the Radio Access Network (RAN), which, for example, controls resource allocation, handover between radio towers and so on. It is through the RAN, that users can connect to and experience the LTE network and its associated services, of which VoLTE is just one.

This is a complex chain. It spans both logically defined domains, as well as a multitude of different logical and functional solutions. It also encompasses different organizational teams and departments, with differing responsibilities. Any single event, such as a simple voice call, may require the services of many of these elements and impact different departments within the organization. Since each element has a defined interface to its peers and other entities involved in the service chain, the number of possible permutations for any one service can rapidly grow. Even in the case of a simple voice call, as many as 10 separate network elements with 28 different network interfaces may be involved. Worse, there may also be up to six subscriber and service databases required, as as each call requires input for the purposes of authentication, payment, profiles, location and more. Ultimately, this complexity translates into millions of possible call flow scenarios. It is for this reason that there's a lot that can go wrong!

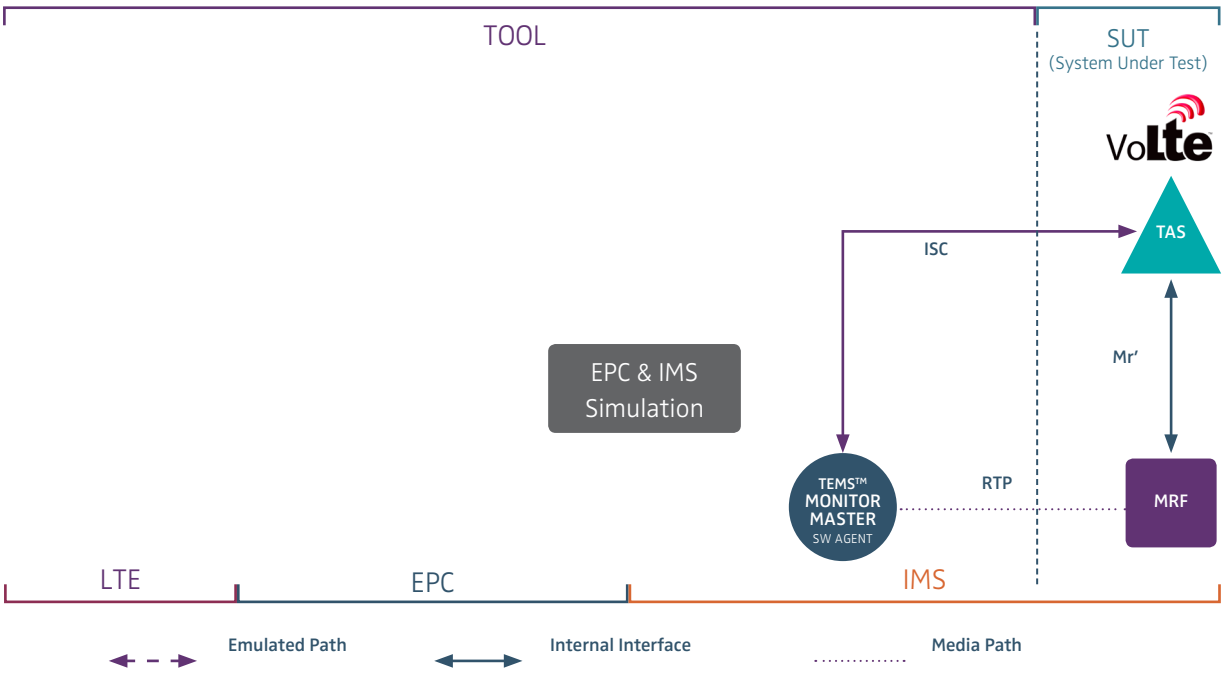
In this context, it's obvious that the successful operation of a VoLTE enabled network requires the smooth and simultaneous operation of all of these many elements – and that's the challenge for any test program. How can operators successfully test the functionality of each element, separately and collectively, and pre and post launch?

Despite this apparent complexity, paradoxically, the logical separation of domains also creates the conditions in which a successful test and monitoring strategy can easily be realized. The domains that are required for the delivery of a complete VoLTE service are shown in Figure 1.

Since each domain is clearly defined, with similarly well-defined functional elements and interfaces, it is possible to devise two mutually compatible and powerful approaches to ensure the successful deployment and operations of VoLTE networks. First, taking each domain in isolation and considering the individual elements each contains, enables an operator to decompose each service and the steps that go into each service to ensure that every link in the chain can be examined and verified.

Second, once each domain and its associated elements and interfaces has been tested, a complete service that spans both different domains and multiple entities can be tested from end-to-end. In this way, the logical and functional separation of domains creates the conditions for a step-by-step approach that dramatically simplifies the complexity of testing VoLTE and associated services.

Figure 2: Testing individual network nodes



STEP BY STEP FROM THE IMS TO EPC

At the heart of all VoLTE services is a Telecoms Application Server, or TAS. Such platforms host the application and logic that drives VoLTE, but the service is realized through the capabilities of a range of supporting entities acting under the instruction of the TAS. For example, voice processing, such as the mixing of different voice streams, is handled through the Media Resource Function (MRF), which operates under the control of either the TAS directly or else via the Serving Call Session Control Function (S-CSCF). According to the model adopted, there is a different interface to the MRF in each case.

The right approach is to use a suitable test and monitoring platform to connect to the TAS and verify that it supports the required interfaces, such as ISC and Mr', as illustrated in Figure 1. Figure 2 illustrates how this can be achieved in practice. The same technique can be applied to other entities in the IMS core. By connecting to each such entity and interface in sequence, the complete range of required capabilities can be tested, according to pre-determined test schedules to ensure compliance with the relevant standards and specifications, such as IR.92, which is provides the core definition for VoLTE services. In addition, there are also test cases that have been defined to prove the desired functionality. Collectively, these are known as IREG documents and are issued by the GSMA.

However, there are several versions of IR.92, which means there are multiple test suites that can be applied. Operators have to verify that the services they offer are compliant to necessary specifications – which means they must test compatibility with, not only VoLTE standards, but also for other related services, such as MMTEL (which is the basis of the VoLTE service), as well as extensions to VoLTE, such as Voice over WiFi (VoWiFi) and Video over LTE (ViLTE), and compatibility with legacy services and previous generations of mobile network technology.

For each service extension, there is another set of specifications and test cases – for example, ViLTE is defined under IR.94. Of course, there are also multiple versions of this, each of which must co-exist with versions of the base VoLTE specification. This means that operators must be able, not only to test and monitor elements within their IMS core, but also to test different versions of the services they offer, ranging from VoLTE to enhancements such as VoWiFi and ViLTE.

TEMS™ Monitor Master is able to support different standards of the relevant specifications, as well as different, pre-written test cases, which means that operators can easily test their version of VoLTE. It helps them to cut through issues of compatibility regarding solutions from different vendors and to ensure that they can verify the correct functionality of the IMS core and related VoLTE services.

It can run automated series of tests, covering IR.92 and IR.94, as well as additional standards for legacy circuit switched voice (IR.24) and packet switching services (IR.35), which considerably accelerates the test process and means that more can be accomplished with fewer resources. Since some services depend on legacy signaling procedures, such as CAMEL, IR.32 can also be supported for interoperability and roaming performance.

In addition, since a VoLTE voice call, for example, is initiated by user equipment at the edge of the network, the test and monitoring solution must be able to emulate such functionality in isolation – in other words, it should be self-contained so that the operator can test specific VoLTE call cases from a single solution, covering the complete IMS core. This is critical. If VoLTE can only be tested from the edge of the network, then only the complete service chain can be tested, not the functionality of individual functional entities. Both need to be covered. Figure 3 illustrates how the complete IMS infrastructure can be tested, either directly or from the cloud.

Once the complete IMS core and its constituent entities have been tested, the same steps can be taken for those within the EPC. It's the same process: connected the TEMSTM Monitor Master to each of the relevant platforms and running the same test cases. Because each can be viewed in isolation, its functionality can be verified before moving to the next element. In this way, interfaces such as S8 and S11 can be tested separately.

This approach allows operators to confidently test networks that have been assembled with solutions from different vendors, identifying any interoperability issues and ensuring full compatibility, not just compliance with the relevant specification. It allows operators to revalidate performance in the event of software updates to new versions of supported standards – of which there are many!

USER DEVICE CONNECTIVITY: INTO THE RAN

The collected entities of the EPC and IMS are necessary for the delivery of a service but they are not sufficient. Subscribers access services and resources via their user equipment and devices. As a result, the connectivity of such devices needs to be verified within the RAN. This means that operators must test and monitor device performance and connectivity when accessing specific services, such as VoLTE.

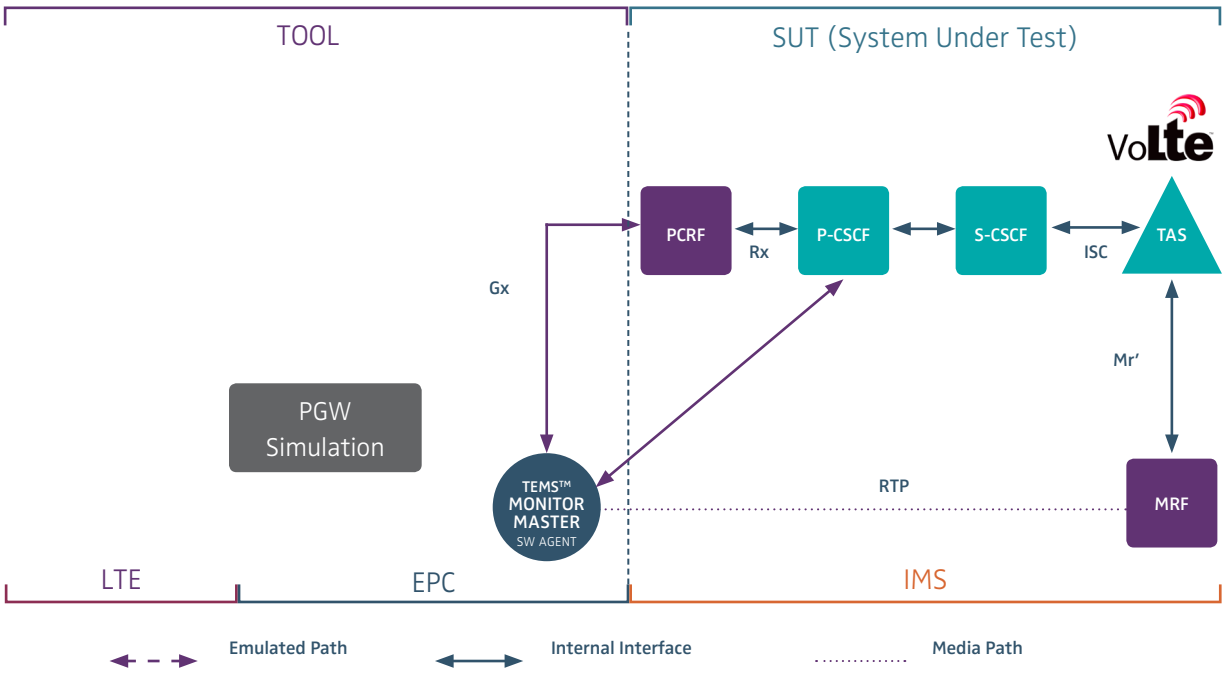
Although LTE introduces coverage benefits, there will still be variations in the available coverage, which must also be taken into account when testing service performance. Similarly, from the user perspective, there are both mobile originated sessions (I call you) and mobile terminated sessions (you call me). Obviously, both cases need to be validated under different scenarios and in different locations to take into account geographical variations in coverage.

What's more, there is considerable variation in the performance of different VoLTE devices, as well as issues with their availability. The ability to test with both real and virtual devices is highly desirable, as it provides the means to ensure the widest possible device coverage even as new IMS clients and VoLTE capable devices are released to the market. The absence of test devices is a significant impediment to both the successful deployment of VoLTE and its in-service maintenance and management.

Finally, VoLTE is not an isolated service; it must co-exist with other services, such as messaging, voicemail and internet access. The performance of VoLTE in the context of the complete operator service portfolio is a key consideration. To summarize, testing VoLTE performance in the RAN demands solutions that:

- Emulate or monitor VoLTE services
- Enable other services to be accessed
- Allow testing from different locations

Figure 3: Testing the IMS core



The TEMS™ Monitor Master solution provides a complete test and monitoring framework that enables the emulation of multiple IMS client devices, including those that are commercially available and those that are in the process of release to network operators. The VoLTE clients used for test purposes can be manipulated to cover different VoLTE procedures, such as IMS Entry Point Discovery, or specific client configurations. It also means that operators can provide valuable feedback to device vendors that enables user equipment to be optimized for their networks – an invaluable asset when considering the service performance benefits promised by VoLTE. Unless operators can be sure that these can be delivered, they will not be able to achieve differentiation from any alternative providers from the cloud. TEMS™ Monitor Master means that operators can use a single solution to verify how user equipment performs in the real radio conditions of their network. Both real and virtual IMS clients can be used, providing maximum flexibility.

It goes far beyond simple service emulation to replicate the experience of users accessing VoLTE services, in real-time and with the required scale that allows full load testing. Crucially, TEMS™ Monitor Master can be used in different geographic locations, enabling the continuous evaluation of user experience and device performance across the complete network.

END-TO-END AND IN-SERVICE

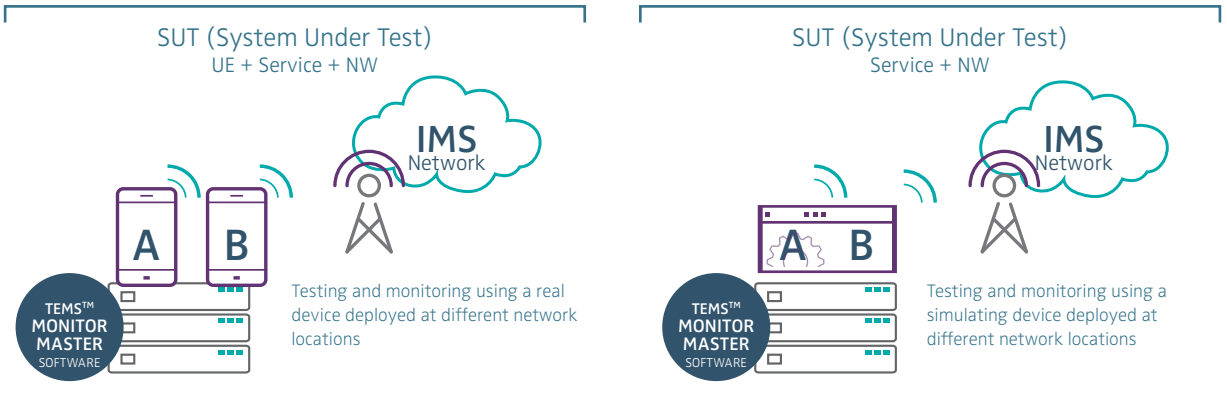
Testing each element or entity and each domain separately enables the graceful realization of a comprehensive test strategy. Each specific service must also be tested end-to-end so that the simultaneous performance of each element involved can be thoroughly validated.

Services are tested by the use of real and virtual devices and VoLTE clients. Figure 4 shows how this can be achieved from a single platform. End-to-end testing enables the isolation of the fault domain, providing the focal point for analysis and improvement activities. It is the only way to capture the complex interplay dynamics between all the components that make up the service chain, including parts that are outside of the operator's control.

This flexibility makes it possible for operators to test a complete service chain, end-to-end, both pre-launch and in-service. End-to-end testing is illustrated in Figure 5.

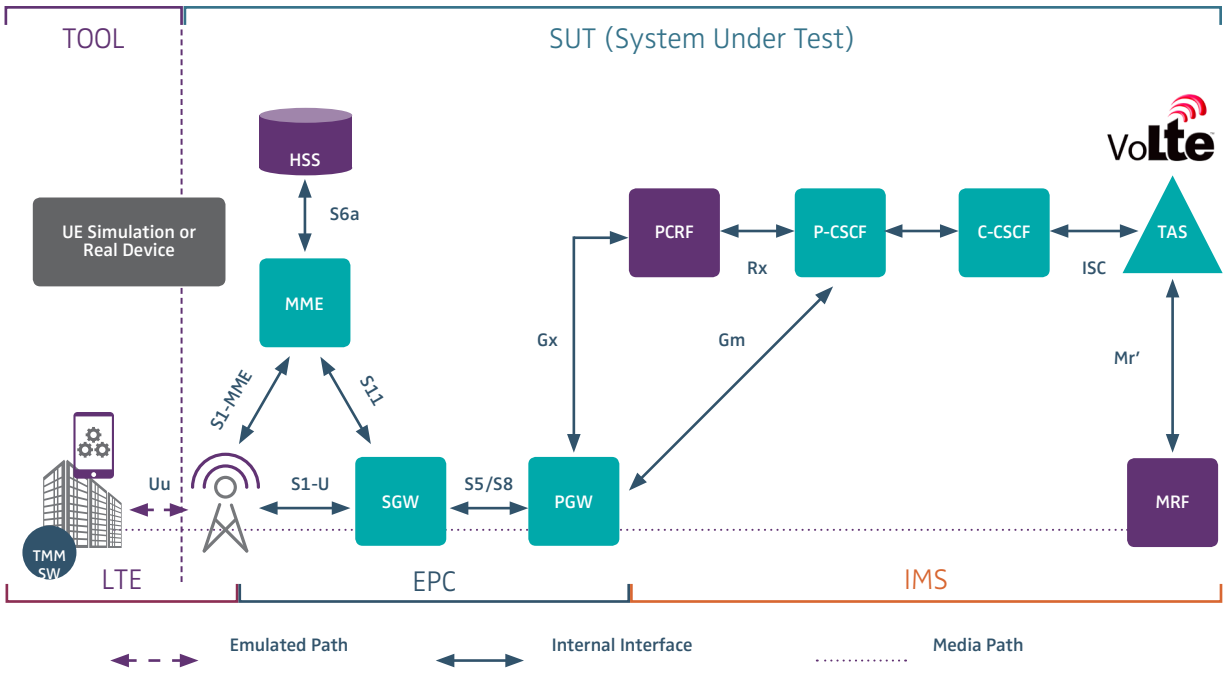
Once a service has been launched, it must be continuously monitored for multiple different scenarios and across different locations. Continuous monitoring enables performance issues to be highlighted before they have an impact on users so that they can be thoroughly investigated and resolved without service degradation.

Figure 4: Real and virtual device testing.



MOVING FROM VERIFICATION TO ASSURANCE – THE QUALITY CONTROLLED NETWORK

Figure 5: End-to-End Service Testing



Making a network function correctly is a formidable task, but the hard work doesn't stop once a service has been launched. Services must operate continuously, delivering the right levels of performance to all users. Service disruption is costly and has significant negative impacts on subscriber satisfaction. News spreads fast, so operators must take all reasonable steps to ensure the smooth operation of their networks. With services such as VoLTE this is particularly important: as has been seen, it touches upon many elements and domains within the network.

As such, operators need to move beyond service verification to continuous service assurance. They need to ensure their network is full quality controlled at all times. Active monitoring and testing from solutions such as the TEMS™ Monitor Master are essential to meet this goal. It is the foundation of an active approach that continuously performs testing across the network, driving operational performance improvement and helping to build a better user experience.

Active monitoring also allows mobile operators to adopt a proactive approach to the identification and resolution of network problems. Better still, an automated active test solution enables the continuous monitoring of subscriber experiences, based on settings and parameters under the full control of the mobile operator. Active monitoring is essential for building a fully quality controlled network and for ensuring its smooth operational performance and maintenance.

The quality controlled network can automatically perform the following key tasks:

- Call flow pre-launch testing and validation
- Load testing
- VoLTE / ViLTE / VoWiFi service monitoring
- Latency monitoring
- Regression testing
- Audio quality testing
- Differences in performance between sites

The quality controlled network requires constant monitoring and assurance but this is only possible with the right tools that have the flexibility to perform the required tasks. These tasks require complex functionality to be supported and to be combined to support a wide range of use cases, such as:

- Troubleshooting detailed end-to-end SIP signaling for Mobile Originated and Mobile Terminated VoLTE calls across a wide geographical area.
- Ensuring IMS infrastructure correctly balances presented load.
- Validation of well known services, such as voice, mail and messaging in the context of VoLTE
- Assuring supplementary and emergency services function correctly in the context of VoLTE
- Monitoring 24x7x365 calls between VoLTE and circuit switched end points and between VoLTE and land line destinations.

A successful active monitoring strategy incorporates a programme of continuous operation of different test scenarios with a distributed approach that allows the same tests to be run at different points in the network. As new capabilities are launched, new test scenarios can be implemented and then automatically deployed to the different test solutions. A combination of real and virtual devices means that the diversity in the user device fleet calso be taken into consideration. This allows for both the devices that are currently available in the network and new devices that are released to be included in the simulation programme.

CONCLUSION

VoLTE is indeed a complex technology. Its introduction requires upgrades to a host of devices and functional entities, across all domains of the mobile network, to function correctly. Coordinating VoLTE service launch is complicated and time consuming. Ensuring it continues to launch in the face of growing user adoption, new feature and service upgrades and through evolution of interconnection with other networks compounds the problem. It must be tested and verified across lengthy service chains and for a bewildering array of different scenarios.

A step-by-step approach, working from the inside out removes this complexity. It breaks down test programs into manageable, logical tasks that can be performed repeatedly before service launch and provides a framework that can be used to ensure quality control and comprehensive assurance once services are live.

Such an approach requires the right tools. TEMS™ Monitor Master is a complete test and monitoring solution that supports multiple interfaces and standards, as well as real and virtual VoLTE devices. It can be deployed to monitor individual nodes or end-to-end live services. Unlike passive monitoring solutions there is no installation, specialized hardware or deployment required to start measuring from day one. It can even be deployed from the cloud, enabling operators to plan and begin the programs quickly and efficiently.

In addition to powerful VoLTE testing capabilities, TEMS™ Monitor Master also caters for the test and monitoring of VoWiFi, RCS, Voice over Broadband, as well as services that blend voice and messaging capabilities, maximising ROI.

TEMS™ Monitor Master provides everything that is required to support the life cycle of VoLTE services. It can be used to test and monitor individual elements, domains and complete, end-to-end services, from a single package. It's simple to deploy, simple to use and removes the pain from IMS and VoLTE deployment and operations. Why not find out more?

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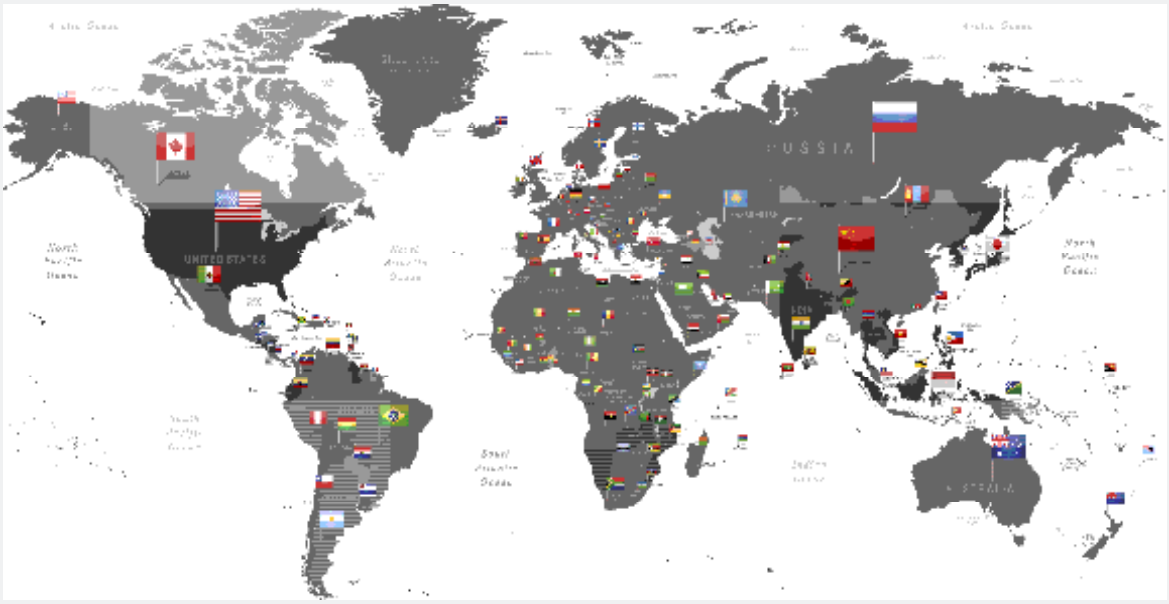

Over 650 of the World's Operators Use our Solutions

Networks are constantly changing and growing. As you strive to grow your business and satisfy your customers, Ascom Network Testing will be right there with you. Through 4G and beyond, we have the experience, the expertise, and the commitment to help you navigate through the ever-changing communications landscape.

For many people around the world, mobile voice and data communication services have become a basic necessity. To fulfill this ever-increasing need, telecommunications providers must deliver high quality services efficiently.

Ascom's Network Testing solutions are indispensable for operators if they want to maintain quality, retain subscribers, and streamline internal processes. Ascom Network Testing's solutions encompass all major telecommunications technologies from any infrastructure vendor, with a special emphasis on the latest emerging technology standards. We focus on multi-technology, multi-vendor solutions that test from the end user's perspective, so that our customers can know exactly what consumers are experiencing. This subscriber perspective is incredibly valuable for troubleshooting, optimization, and benchmarking purposes.

Comprised of industry-leading products and complementary support and services, the TEMS Portfolio is unrivaled for network troubleshooting, monitoring, and analysis.

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