ITU standardization of IMS related issues including interconnection and infrastructure ENUM

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Outline

• SIP-IMS compliance
• IMS-based VoLTE/ViLTE interconnection and test specifications
• Infrastructure ENUM
• NGN/IMS interconnection tests
• Signalling requirements for IMS-based emergency services
• Other IMS-related ITU-T activities
SIP-IMS compliance
SIP-IMS-based services

- The direct “IP-IP” interconnection of fixed network operators using the IP Multimedia Subsystem (IMS) through Inter-IMS Network to Network Interface (NNI) is a complex issue due to differences in IMS implementations.

- ITU-T SG11 jointly with ETSI TC INT developed a set of standards and related test specifications for basic call and supplementary services to provide a unified international reference for the implementation of SIP-IMS on the fixed networks. These standards may be used for the conformity assessment of SIP-IMS-based equipment on fixed networks.

ITU-T Q.3403: IP multimedia call control protocol based on the session initiation protocol and the session description protocol - Basic call: Requirements for the user side and the network side

ITU-T Q.3617-Q.3639: Service and session control protocols – supplementary services based on SIP-IMS

ITU-T Q.4000-Q.4039: Testing specifications for SIP-IMS

See SIP-IMS portal: https://www.itu.int/en/ITU-T/C-I/Pages/SIP/IMS.aspx
Requirements/test specifications for end-devices using IMS

ITU-T Q.4014.1: PSTN/ISDN terminal equipment using IP Multimedia core network subsystem; Conformance testing; Part 1: PICS

ITU-T Q.4014.2: PSTN/ISDN terminal equipment using IP multimedia core network subsystem; Conformance testing – Part 2: Test suite structure and test purposes
IMS-based VoLTE/ViLTE interconnection and relevant test specifications
Service interoperability in fixed-mobile hybrid environments is becoming a high priority to industry.

Participants identified high-quality voice telephony as a challenging but attractive opportunity for network operators.

ITU-T has been invited to facilitate the roll out of high-quality voice and video services through standards, testing and interoperability.

CTOs encouraged ITU-T to initiate studies with the goal of enabling the global interoperability of such high-quality services.
Voice and Video Services Interoperability Over Fixed-Mobile Hybrid Environments, Including IMT-Advanced (LTE)

(Geneva, 2015, web page)

Speakers: China Telecom, INTT (Tunisia), NTT, Korea Telecom, Turk Telecom, Swisscom, A1 Telekom Austria, NEC, GSMA, R&S, HEAD Acoustics, Huawei, Fraunhofer Institute

• Session 1: Domestic and international use cases of VoLTE/ViLTE services
• Session 2: Analysis of standards
• Session 3: Key issues of the implementation of VoLTE/ViLTE services
• Session 4: Wrap-up and Action Plan

The outcomes of the Workshop are listed in the summary report
Key tasks given to ITU-T SGs

**SG2 – Global ENUM:** E.164 - SIP-URI conversion

**SG3 – VoLTE, ViLTE** International roaming, tariffs and policy issues

**SG11**
- Framework of VoLTE-based networks interconnection which describes VoLTE e2e call-scenario and interconnection scenarios among VoLTE operators
- Requirements and test specifications for signaling protocols used for IMS interconnection in the NNI
- Requirements and test specifications for VoLTE terminal UNI
- Unified standard for Universal Integrated Circuit Card for VoLTE (such a SIM card)
- Requirements for International Emergency Services which is deployed on the VoLTE networks

**SG12 – G.VoLTE**

**SG13 – Y.MC-VCC** Voice and Video Call Continuity over LTE, Wi-Fi and 2G/3G

**SG16 – Audio and video codecs**

**SG17 – X.ticsc, ITU-T X.1245** – Supplement on Technical measures and mechanism on countering the spoofed call in the terminating network of VoLTE.
Resolution 93 (WTSA-16): Interconnection of 4G, IMT-2020 networks and beyond

“...

instructs the study groups

1 to identify as soon as possible future ITU-T Recommendations that need to be developed associated with the interconnection of 4G, IMT-2020 networks and beyond;

2 to cooperate, as appropriate, with interested stakeholders and alliances in order to optimize studies on this particular subject,

...

further instructs Study Group 11

to develop ITU-T Recommendations which specify the framework and signalling architectures to be used for establishing interconnection of 4G, IMT-2020 networks and beyond to achieve interoperability worldwide
Key trends

• Most of ICT operators migrate to “ALL-IP” concept where LTE plays a significant role at the access stratum providing customers the voice/video services, so called VoLTE/ViLTE

• IP Multimedia Subsystem (IMS) becomes a control platform for such services

• The implementation of E.164<-> URI resolving system is extremely important for such services

• Operators need to interconnect to each other providing VoLTE/ViLTE services within their countries and on international level, including roaming services
Key issues

• different options for signalling protocols used for Inter-IMS interconnection, which can support all existing services (basic call and supplementary services);
• different options for roaming scenarios (there are no strict requirements for operators and no default option);
• charging (e.g. roaming charges, calls using interconnection networks);
• numbering/addressing (e.g. ENUM resolution, ITU-T E.164 SIP-URI conversion);
• floating delay (problem of providing legacy services and applications, e.g. Fax/Modem over IP);
• Lawful interception
• Data retention
• Emergency services (e.g. emergency call 112)
VoLTE/ViLTE interconnection-related outcomes

The project VoLTE/ViLTE interconnection requirements and testing was a joint project between ITU-T SG11 and ETSI TC INT. Among developed standards are:

- Recommendation ITU-T Q.3640 “Framework of interconnection VoLTE/ViLTE based networks”
- Recommendation ITU-T Q.3953 “VoLTE/ViLTE interconnection testing for interworking and roaming scenarios including relevant QoS/QoE testing”
- Recommendation ITU-T Q.3940: NGN/IMS interconnection tests between network operators at the IMS 'Ic' interface and NGN NNI/SIP-I
- ETSI TS 101 585-1 IMS interconnection tests at the Ic Interface
This Recommendation identifies additional scenarios and requirements for VoLTE/ViLTE interconnection which have not been defined in existing standards and guidelines, such as:

- EPC Consideration
- EPC Configuration Requirements
- Device and U/ISIM consideration
- Multi-Mode and Multi-band Terminal
- General Requirements for VoLTE Terminal
- RAN Features
- IMS function on control plane
- IMS function on media plane
- Services Requirements
3 Types of IMS roaming architectures


**Case 1:** PCSCF is located in VPLMN
- Target IMS roaming solution, IMS is required in both VPLMN and HPLMN

**Case 2:** PCSCF is located in HPLMN, EPC local breakout (Sgi/Gi interface)
- Data local breakout, but IMS home routed, IMS is no needed in VPLMN

**Case 3:** PCSCF and P-GW/GGSN are both located in HPLMN
- Data and IMS are both home routed, IMS is no needed in VPLMN
VoLTE/ViLTE interconnection testing for interworking and roaming scenarios

This Recommendation aims to verify the various interconnections and ensure that interoperability, interworking and roaming will respect national and international requirements and service level agreements (SLAs) among operators.

<table>
<thead>
<tr>
<th>No.</th>
<th>Scenario</th>
<th>Description</th>
<th>Roaming options</th>
<th>Calling options</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Scenario 1</td>
<td>The user UE1 (a) is in the IMS network A, UE2 (a) in HPMN (a)</td>
<td></td>
<td>The test shall be performed in both directions</td>
</tr>
<tr>
<td>2</td>
<td>Scenario 1A</td>
<td>The user UE1 (a) is in the IMS network A, UE2 (a) in HPMN (a) with CSFB (circuit switched fallback)</td>
<td></td>
<td>The test shall be performed in both directions</td>
</tr>
<tr>
<td>3</td>
<td>Scenario 1B</td>
<td>The user UE1 (a) is in the IMS network A, UE2 (a) in HPMN (a) is moving from 4G to 3G coverage with SRVCC</td>
<td></td>
<td>The test shall be performed in both directions</td>
</tr>
<tr>
<td>4</td>
<td>Scenario 1C</td>
<td>The user UE1 (a) is a nomadic user in the IMS network B, UE2 (a) in HPMN (a)</td>
<td></td>
<td>The test shall be performed in both directions</td>
</tr>
<tr>
<td>5</td>
<td>Scenario 1D</td>
<td>The user UE1 (a) is a nomadic user in the IMS network B, UE2 (a) in HPMN (a) with CSFB (circuit switched fallback)</td>
<td></td>
<td>The test shall be performed in both directions</td>
</tr>
<tr>
<td>6</td>
<td>Scenario 1E</td>
<td>The user UE1 (a) is a nomadic user in the IMS network B, UE2 (a) in HPMN (a) moving from 4G to 3G coverage with SRVCC</td>
<td></td>
<td>The test shall be performed in both directions</td>
</tr>
<tr>
<td>7</td>
<td>Scenario 2</td>
<td>The user UE1 (a) is in the IMS network A, UE2 (a) roamed in VPMN (b)</td>
<td>- Local Breakout VPMN Routing architecture (LBO-VR) - LBO Home Routing architecture (LBO-HR) - SHHR VoLTE Roaming architecture</td>
<td>The test shall be performed in both directions</td>
</tr>
<tr>
<td>8</td>
<td>Scenario 2A</td>
<td>The UE1 (a) is a nomadic user in the IMS network B, UE2 (a) roamed in VPMN (b)</td>
<td>- Local Breakout VPMN Routing architecture (LBO-VR) - LBO Home Routing architecture (LBO-HR) - SHHR VoLTE Roaming architecture</td>
<td>The test shall be performed in both directions</td>
</tr>
<tr>
<td>9</td>
<td>Scenario 2B</td>
<td>The user UE1 (a) is in the IMS network A, UE2 (a) roamed in VPMN (b) with CSFB (circuit switched fallback)</td>
<td>- Local Breakout VPMN Routing architecture (LBO-VR) - LBO Home Routing architecture (LBO-HR) - SHHR VoLTE Roaming architecture</td>
<td>The test shall be performed in both directions</td>
</tr>
</tbody>
</table>
Infrastructure ENUM
The requirements of ENUM (E.164 Number Mapping) in IMS

Mapping the telephone number of the destination into an URI (Uniform Resource Identifier), which is a SIP phone number that clearly identifies the destination network.

Note: take IPX Hubbing Model as an example.
**Tier 0:** Global level, authoritative for the ENUM top level domain. Under this domain are pointers to the Tier 1 authoritative servers.

**Tier 1:** Country Code level, authoritative for ITU-T assigned E.164 country codes. Under this domain are pointers to the Tier 2 authoritative servers.

**Tier 2:** Service Provider level, authoritative for National Destination Codes and individual Subscriber Numbers.
Key issues of ENUM Hierarchical Model for IMS interconnection

- It’s difficult to estimate the processing capacity of a Tier 0&1 ENUM server which needs to be deployed by the third party.

- There is no detailed timeline for deploying Tier 0 and Tier 1 ENUM servers, as it is quite complicated to involve third parties in setting up ENUM servers to provide ENUM query services for operators.

- Security issue: Customer Data Exposure remains a real issue. Opening of ENUM Tier2 (operator level) to external queries is not available, because some IMS operators do not intend to open ENUM servers to external queries for security reasons.
Distributed ENUM Server model for IMS

- ITU-T Q.3645: Protocol at the interface between two distributed ENUM servers for IMS (09/2020)
NGN/IMS interconnection tests
This Recommendation defines the tests purposes (TPs) for next generation network (NGN) IP multimedia subsystem (IMS) interconnection tests between national and international network operators, covered by ITU International Telecommunication Regulations, at the IMS interconnection (Ic) interface and NGN network-to-network interface (NNI)/SIP-I.
Signalling requirements for IMS-based emergency services
Framework for interconnection between VoLTE-based network and other networks supporting emergency telecommunications service (ETS)

This supplement specifies the framework for interconnection between VoLTE-based network and other networks supporting emergency telecommunications service (ETS).

It also defines signalling requirements for interconnection of VoLTE-based network and other networks.
This supplement identifies and discusses signalling requirements for IP multimedia system (IMS) and GSM/UMTS network supporting multi-device emergency telecommunications service (ETS).
Signalling requirements for IP multimedia subsystem (IMS) emergency telecommunications service in support of multiple accesses

This supplement specifies the signalling requirements for Internet protocol (IP) multimedia subsystem (IMS) emergency telecommunications service in support of multiple access including fixed broadband, wireless fidelity (Wi-Fi), fourth generation (4G) and fifth generation (5G) networks.
Other IMS-related activities
This Recommendation identifies the IMS IP-Multimedia Subsystem specifications for the "ETSI Release 11" as base for the communication between IMS and NGN Network in order to support end-to-end service interoperability.

ITU-T Q.3641 (10/2018): IMS references to Release 11 for communication between IMS and NGN Networks in order to support end-to-end service interoperability

ITU-T Q.3642 (04/2019): IMS references to Release 12 for communication between IMS and NGN networks to support end-to-end service interoperability

This Recommendation lists the references to specifications defining requirements for IMS to be used for the non-roaming architecture for 3GPP access as a basis for the communication between IMS and next generation networks (NGNs), in order to support end-to-end service interoperability.
This Recommendation specifies the requirements for signalling network analyses and optimization in voice over LTE (VoLTE) in which the signalling network refers to the network entities and the signalling exchange which are related to telecommunications services. This Recommendation covers the aspects including an overview of a signalling network, requirements for signalling collecting, requirements for signalling network analyses, requirements for signalling network optimization and general security considerations in VoLTE.

Work items in progress:

Q.VoLTE-SAOFP: Framework and protocols for signalling network analyses and optimization in VoLTE
Q.IMT2020-SAOFP: Requirement, framework and protocols for signalling network analyses and optimization in IMT-2020
This Recommendation specifies the requirements and solutions for voice and video call continuity (VCC). These requirements and solutions are applied for the scenarios where the multi-connection user equipment (MUE) is attached to the network with multi-connection via long term evolution LTE, Wi-Fi and 2G/3G accesses.
This Supplement gives an overview of spoofed calls in the Internet protocol (IP) multimedia subsystem (IMS) network, analyses several aspects of existing threats and new technical difficulties, and also proposes technical measures and procedures to counter spoofed calls.

Note: it applies specifically to ITU-T X.1245: Framework for countering spam in IP-based multimedia applications.
Security framework for voice-over-long-term-evolution (VoLTE) network operation

This Recommendation analyses security threats encountered by VoLTE network and recommends countermeasures for telecommunication operators to ensure secure operation. It also provides a security reference framework for VoLTE network.

This Recommendation:

• Describes security threats to VoLTE network operation
• Provides technical and management measures for countering security threats
• Defines a security framework for VoLTE network operation
Thank you!

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