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Core Network and Interoperability Testing (INT);
VoLTE/ViLTE interoperability test description over 4G/early 5G in physical/virtual environments;
(3GPP™ Release 15);
Part 2: Test Descriptions for VoLTE/ViLTE interoperability

Reference
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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Core Network and Interoperability Testing (INT).

The present document is part 1 of a multi-part deliverable. Full details of the entire series can be found in part 1 [1].

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

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1 Scope

The present document provides the Test Descriptions (TD) for the VoLTE/ViLTE interoperability test description over 4G/early 5G in physical/virtual environments in compliance with the relevant requirements and in accordance with the Test Purposes (TPs) presented in ETSI TS 103 653-1 [1]. Emergency call and enhanced eCall are not in scope of the present document.

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at https://docbox.etsi.org/Reference/.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are necessary for the application of the present document.

[1] ETSI TS 103 653-1: "Core Network and Interoperability Testing (INT); VoLTE/ViLTE interoperability test description over 4G/early 5G in physical/virtual environments; (3GPP™ Release 15); Part 1: Test Purposes (TP) and Protocol Implementation Conformance Statement (PICS) for VoLTE/ViLTE interoperability".

[2] ETSI TS 124 229: "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; 5G; IP multimedia call control protocol based on Session Initiation Protocol (SIP) and Session Description Protocol (SDP); Stage 3 (3GPP TS 24.229 Release 15)".

[3] ETSI TS 129 165: "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; 5G; Inter-IMS Network to Network Interface (NNI) (3GPP TS 29.165 Release 15)".

[4] ETSI TS 129 228: "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; IP Multimedia (IM) Subsystem Cx and Dx Interfaces; Signalling flows and message contents (3GPP TS 29.228 Release 15)".

[5] ETSI TS 129 229: "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; Cx and Dx interfaces based on the Diameter protocol; Protocol details (3GPP TS 29.229 Release 15)".

[6] ETSI TS 129 214: "Universal Mobile Telecommunications System (UMTS); LTE; Policy and charging control over Rx reference point (3GPP TS 29.214 Release 15)".

[7] ETSI TS 129 212: "Universal Mobile Telecommunications System (UMTS); LTE; Policy and Charging Control (PCC); Reference points (3GPP TS 29.212 Release 15)".

[8] ETSI TS 129 272: "Universal Mobile Telecommunications System (UMTS); LTE; 5G; Evolved Packet System (EPS); Mobility Management Entity (MME) and Serving GPRS Support Node (SGSN) related interfaces based on Diameter protocol (3GPP TS 29.272 Release 15)".

[9] ETSI TS 129 215: "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; Policy and Charging Control (PCC) over S9 reference point; Stage 3 (3GPP TS 29.215 Release 15)".

[10] ETSI TS 129 328: "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; 5G; IP Multimedia (IM) Subsystem Sh interface; Signalling flows and message contents (3GPP TS 29.328 Release 15)".

[11] ETSI TS 129 329: "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; Sh interface based on the Diameter protocol; Protocol details (3GPP TS 29.329 Release 15)".

[12] IETF RFC 3261: "SIP: Session Initiation Protocol".

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] ETSI TS 123 008: "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; Organization of subscriber data (3GPP TS 23.008 Release 15)".

[i.2] ETSI TS 123 203: "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; Policy and charging control architecture (3GPP TS 23.203 Release 15)".

[i.3] ETSI TS 124 410: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); LTE; TISPAN; NGN Signalling Control Protocol; Communication HOLD (HOLD) PSTN/ISDN simulation services; Protocol specification (3GPP TS 24.410)".

[i.4] GSMA PRD IR.67: "DNS/ENUM Guidelines for Service Providers & GRX/IPX Providers" version 5.1.

[i.5] ETSI TR 184 008: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); Infrastructure ENUM Options for a TISPAN IPX".

[i.6] IETF RFC 3761: "The E.164 to Uniform Resource Identifiers (URI); Dynamic Delegation Discovery System (DDDS) Application (ENUM)".

[i.7] ETSI TS 103 189 (V1.2.1): "Core Network and Interoperability Testing (INT);Assessment of end-to-end Quality for VoLTE and RCS".

[i.8] ISO/IEC 9646-1: "Information technology -- Open Systems Interconnection -- Conformance testing methodology and framework -- Part 1: General concepts".

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the following terms apply:

Abstract Test Method (ATM): Refer to ISO/IEC 9646-1 [i.8].

Abstract Test Suite (ATS): Refer to ISO/IEC 9646-1 [i.8].

Implementation Under Test (IUT): Refer to ISO/IEC 9646-1 [i.8].

Test Purpose (TP): Refer to ISO/IEC 9646-1 [i.8].

3.2 Symbols

Void.

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in ETSI TS 124 229 [2], ETSI TS 129 165 [3], ETSI TS 129 228 [4], ETSI TS 129 229 [5], ETSI TS 129 214 [6], ETSI TS 129 212 [7], ETSI TS 129 272 [8], ETSI TS 129 215 [9], ETSI TS 129 328 [10], ETSI TS 129 329 [11] and the following apply:

3GPP	3rd Generation Partnership Project
ACK	SIP 'ACK' message
AGW	Access GateWay
AN-GW	Access Network Gateway
AS	(IMS) Application Server
ATS	Abstract Test Suite
CF	(Test) Configuration
DL/UL	DownLink/UpLink
ENUM	E.164 Number Mapping
EPC	Evolved Packet Core
E-UTRAN	Enhanced Universal Terrestrial Radio Access Network
GSMA	GSM Association
IOP	InterOPerability
IPX	Internet Packet eXchange
IUT	Implementation Under Test
MMI	Man-Machine Interface
MSC	Message Sequence Chart
NAPTR	Naming Authority Pointer Record
NAS	Non Access Stratum
NAT	Network Address Translation
NGN	Next Generation Network
NS	Name Server
NWK	NetWork
PDCP	Packet Data Convergence Protocol
PGW	PDN Gateway
PIXIT	Protocol Implementation eXtra Information for Testing
PHY	Physical
PMN	Public Mobile Networks
PO	Point of Observation
PO_UE	Point of Observation on UE
RAN	Radio Access Network
RCS	Rich Communication Services
REL	RELease
RRC	Radio Resource Control
SGW	Serving Gateway
SIP UA	SIP User Agent
SUT	System Under Test
TD	Test Description
TN	Telephone Number
TP	Test Purpose
TSS	Test Suite Structure
UNI	User Network Interface
UL	UpLink

4 Test Environment

4.1 Introduction

The following architectural test configurations are referenced in the VxLTE NNI interoperability TDs in the present document. They are intended to give a general rather than a specific view of the required connections between IMS and EPC network SUT(s) and associated UE(s), AS(s), and DNS(s)/ENUM(s). Other configuration variants are currently not in the scope of the present document.

NOTE: Note that in the following figures observable Diameter interfaces are indicated as a solid green line, SIP interfaces are indicated as a solid blue line and user data interfaces are indicated as a solid yellow line. Non-observable interfaces are indicated as dashed lines.

4.2 Test configurations/architecture

4.2.1 Configuration CF_VxLTE_INT

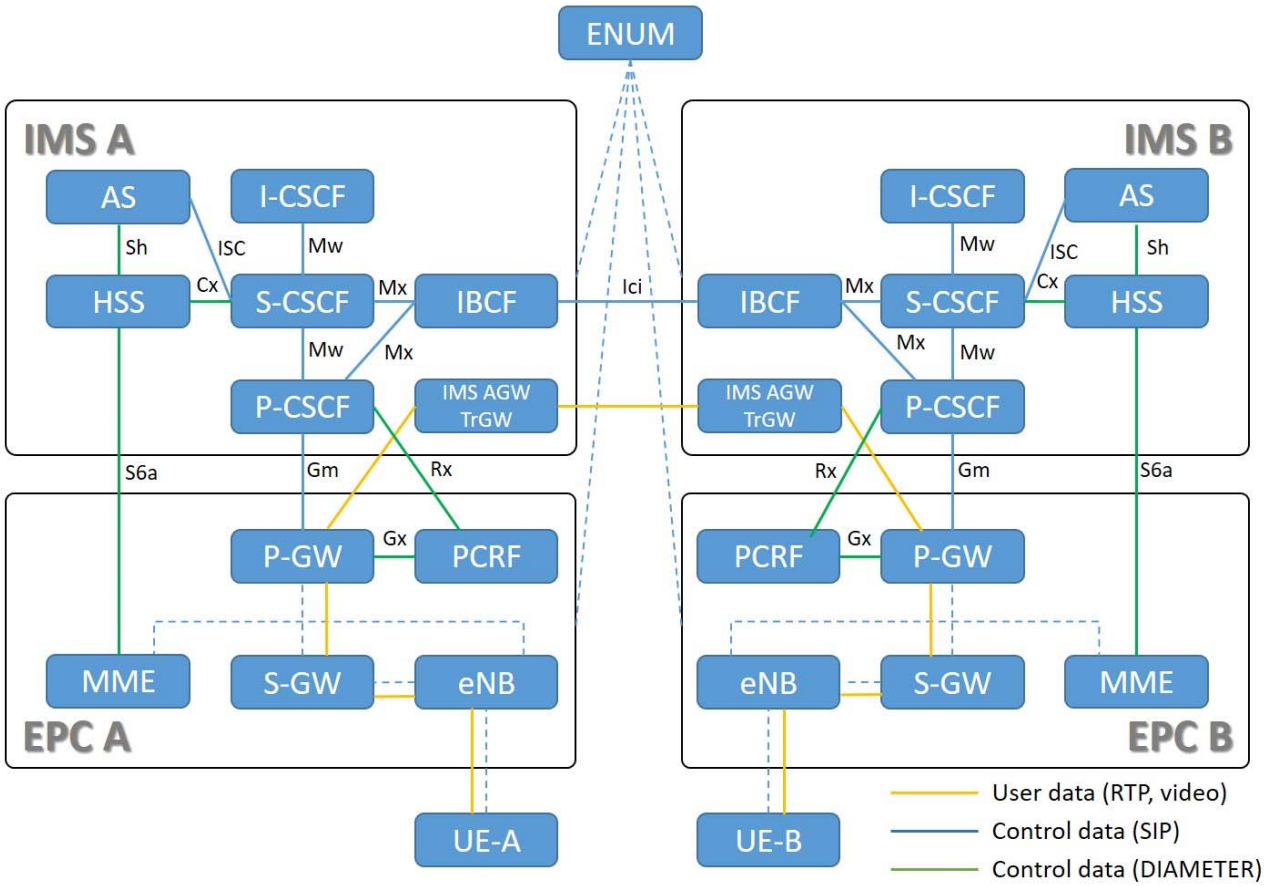


Figure 1: Configuration CF_VxLTE_INT

Configuration CF_VxLTE_INT is used for two peer networks where users are attached and registered to their home network. The suffix INT stands for home interoperability scenario. UE-A connects to home network A represented by EPC A and IMS A. UE-B connects to home network B represented by EPC B and IMS B. Attachment, Registration, Detachment and Deregistration procedures of each user are performed locally in their own home network. For Call establishment, call modification and call release procedures signalling is going between the two networks over the Ici interface and therefore all related TDs are named as home interoperability tests.

4.2.2 Configuration CF_VxLTE_RMI_A

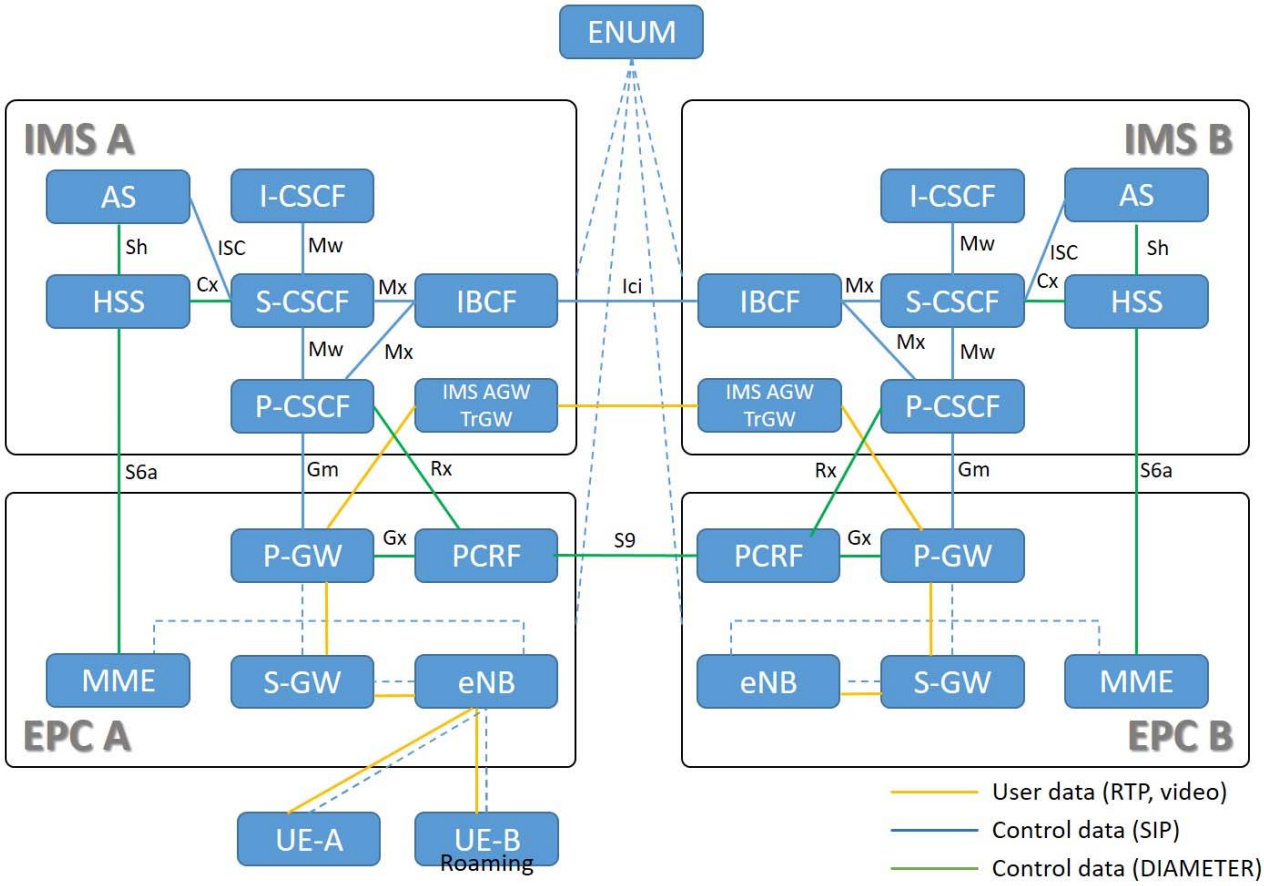


Figure 2: Configuration CF_VxLTE_RMI_A

Configuration CF_VxLTE_RMI_A describes the first roaming scenario. Within CF_VxLTE_RMI_A, UE-A connects to its home network A represented by EPC A and IMS A. UE-B connects to the visited network A attached to the EPC A. Attachment, Registration, Detachment and Deregistration procedures of user UE-A are performed in its own home network. Attachment and detachment of UE-B is performed at the visited network A and provides the ability to subsequently register the visiting user UE-B at the home network. UE_A acts as originating user and when a call is established towards user B the signalling runs from UE_A over its home network A towards the network of UE_B. Due to the previous registration of user B, network B knows that UE_B is located at network A and signalling messages are routed back to the network A and then delivered towards UE_B. The related roaming interoperability configuration is named CF_VxLTE_RMI_A; where the suffix A signifies 'visited network A'.

4.2.3 Configuration CF_VxLTE_RMI_B

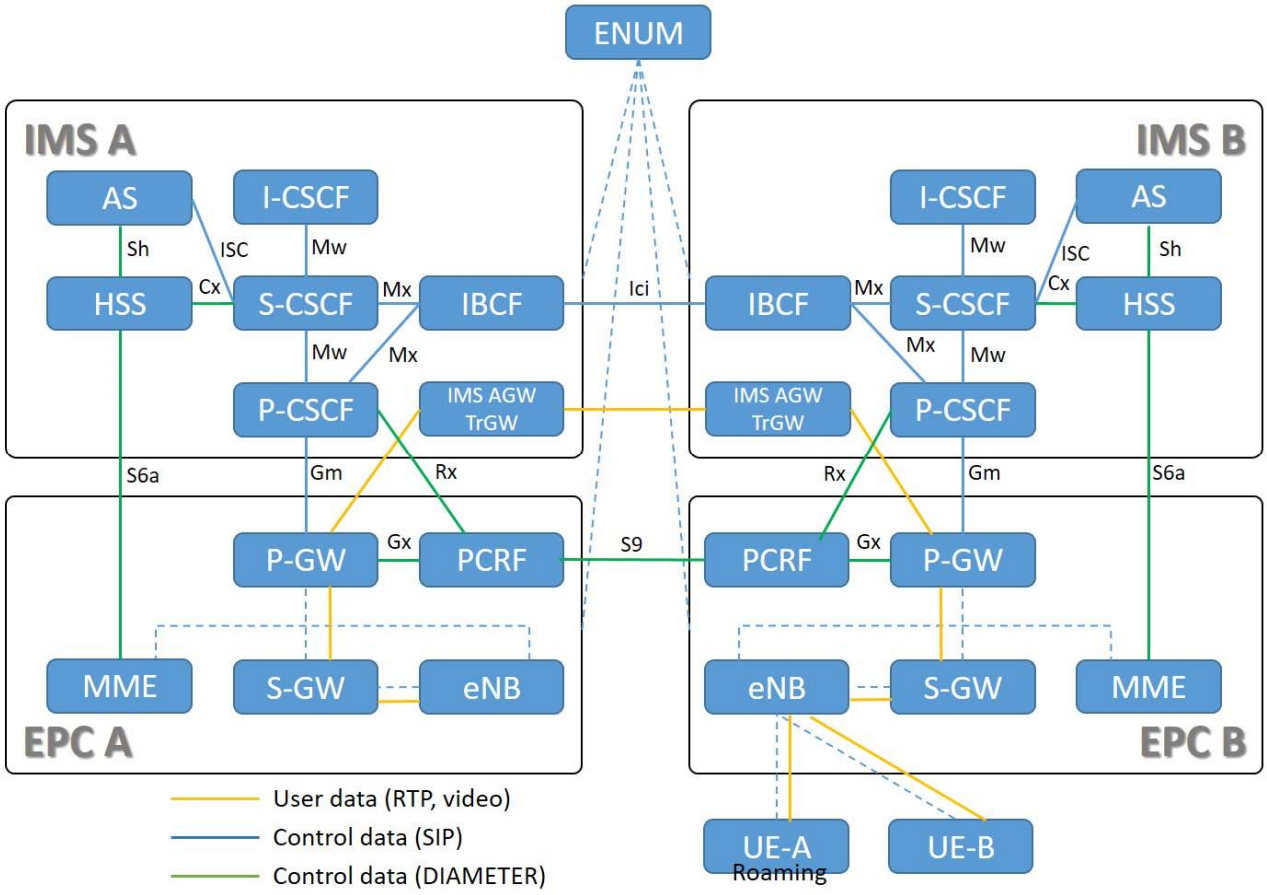


Figure 3: Configuration CF_VxLTE_RMI_B

Configuration CF_VxLTE_RMI_B describes the second roaming scenario. Within CF_VxLTE_RMI_B, UE-B connects to its home network B represented by EPC B and IMS B. UE-A connects to the visited network B attached to the EPC B. Attachment, Registration, Detachment and Deregistration procedures of user UE-B are performed in its own home network B. Attachment and detachment of UE-A is performed at the visited network B and provides the ability to subsequently register the visiting user UE-A at the home network. UE_A acts as originating user and when a call is established the signalling runs from UE_A over roaming network B towards network A. Afterwards, the call is routed back to network B towards UE_B. The related roaming interoperability configuration is named CF_VxLTE_RMI_B where the suffix B signifies 'visited network B'.

4.2.4 Configuration CF_VxLTE_RMI_S8HR

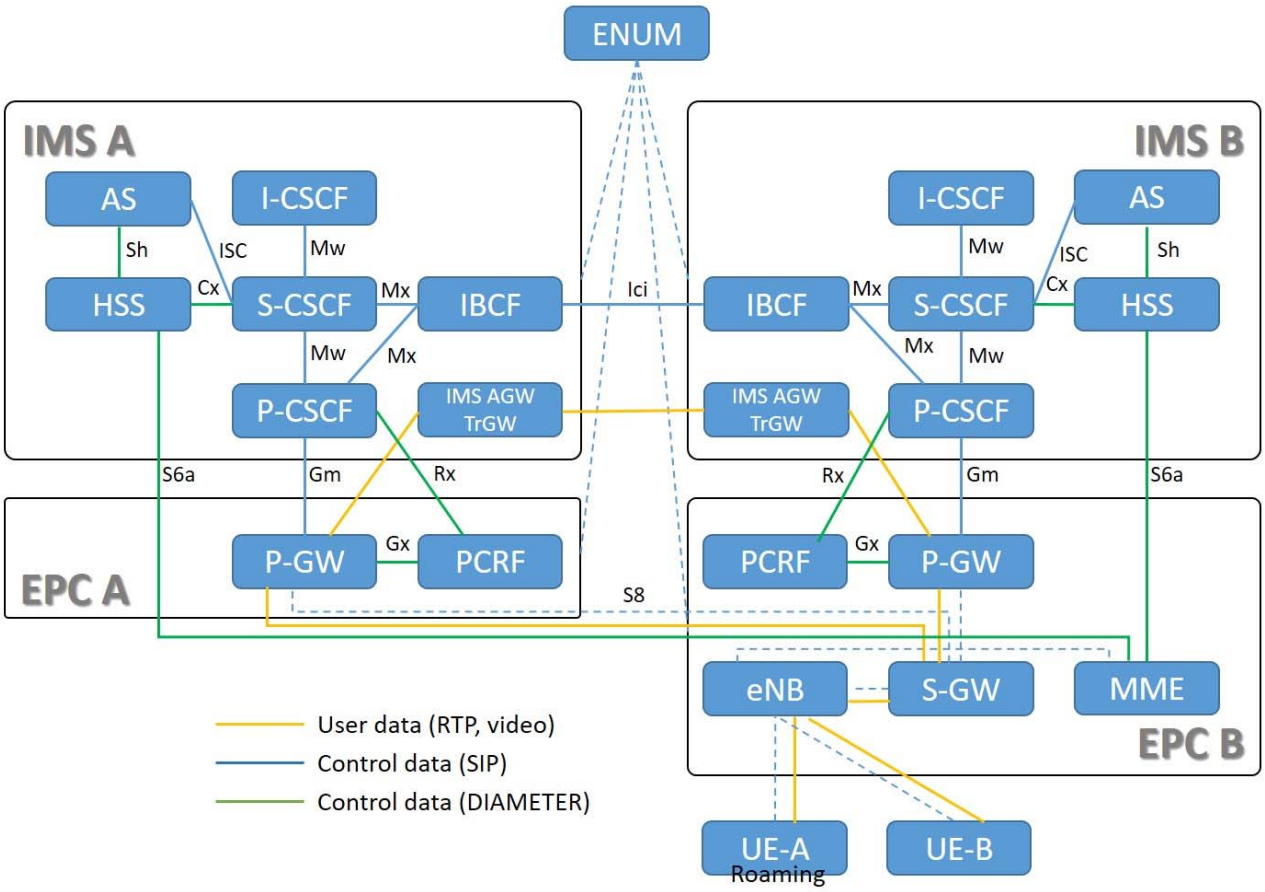


Figure 4: Configuration CF_VxLTE_RMI_S8HR

Configuration CF_VxLTE_RMI_S8HR describes an additional roaming scenario. Within CF_VxLTE_RMI_S8HR, UE-B connects to home network B represented by EPC B and IMS B. UE-A connects to visited network B attached to the EPC B. Attachment, Registration, Detachment and Deregistration procedures of user UE-B are performed in its own home network B. Attachment and detachment of UE-A is performed at the visited network A and provides the ability to subsequently register the visited user UE-A at the home network over the S8 interface. UE_A acts as originating user and when a call is established the signalling runs from UE_A over roaming/visited network B towards the network A. Afterwards, the call is routed towards UE_B. The related roaming interoperability configuration is named CF_VxLTE_RMI_S8HR where 'S8' signifies routing over interface S8.

4.3 Test infrastructure

4.3.1 Introduction

The present clause covers the list of relevant components and interfaces used for testing interoperability between EPC, PCRF and IMS. For components that are not present, standard functionality is assumed.

4.3.2 VxLTE component descriptions

4.3.2.1 User Endpoints

The test infrastructure shall contain User Endpoints (UEs). These are represented by client devices or simulators, capable of performing the EPC and IMS procedures.

The Test Descriptions are focusing only on the full message exchange details at the observation point at one client device. The peer UE in calls may be a full EPC and IMS client, or only an IMS client, or even just a stand-alone SIP UA. However, for all those UE types the main requirement remains that all IP and SIP traffic shall be observable for test validation. To highlight this requirement, the Test Descriptions always make references to the PO_SGi interface.

4.3.2.2 eNodeB/eNB (E-UTRAN)

The E-UTRAN consists of a single node, the eNodeB that interfaces with the UE. The eNodeB hosts the Physical (PHY), Medium Access Control (MAC), Radio Link Control (RLC), and Packet Data Convergence Protocol (PDCP) layers that include the functionality of user-plane header-compression and encryption. It also offers Radio Resource Control (RRC) functionality corresponding to the control plane. The E-UTRAN covers a number of functions including radio resource management, admission control, scheduling, enforcement of negotiated UL QoS, cell information broadcast, ciphering/deciphering of user and control plane data, and compression/decompression of DL/UL user plane packet headers.

4.3.2.3 MME (EPC)

The Mobility Management Entity (MME) is the key control-node for the LTE access-network. It is responsible for idle mode UE tracking and paging procedures including retransmissions. It is involved in the bearer activation/deactivation process and is also responsible for choosing the S-GW for the UE at the initial attach and at time of intra-LTE handover involving Core Network node relocation. It is responsible for authenticating the user (in conjunction with the HSS/SPR). The NAS (Non-Access Stratum) signalling terminates at the MME which is also responsible for the generation and allocation of temporary identities to the UEs. The MME validates the permission of the UE to camp on the service provider's PLMN (Public Land Mobile Network) and enforces UE roaming restrictions. The MME is the termination point in the network for ciphering/integrity protection for NAS signalling and handles security key management. Lawful interception of signalling is also a function provided by the MME. The MME provides the control plane function for mobility between LTE and 2G/3G access networks and the S6a interface with the home HSS for roaming UEs.

4.3.2.4 S-GW (EPC)

The Serving gateway (SGW) routes and forwards user data packets, while also acting as the mobility anchor for the user plane during inter-eNodeB handovers and as the anchor for mobility between LTE and other 3GPP technologies. For idle state UEs, the SGW terminates the downlink data path and triggers paging when downlink data arrives for the UE. It manages and stores UE contexts, e.g. parameters of the IP bearer service, network internal routing information. It also performs replication of the user traffic in case of lawful interception.

4.3.2.5 P-GW (EPC)

The Packet Data Network Gateway/PDN Gateway (P-GW) provides connectivity between the UE and external packet data networks. It provides the entry and exit points of traffic for the UE. A UE may have simultaneous connectivity with more than one P-GW for accessing multiple Packet Data Networks. The P-GW performs policy enforcement, packet filtering for each user, charging support, lawful interception, IP address allocation and packet screening. The P-GW also acts as the anchor for mobility between 3GPP and non-3GPP technologies such as WiMAX. The P-GW function may be co-located with the S-GW in a single network element.

4.3.2.6 PCRF (EPC)

The Policy and Charging Control (PCC) is ensured through the Policy Decision Point, namely the Policy Charging and Rules Function (PCRF) and several Policy Enforcement Points located in the EPC gateways (ETSI TS 123 203 [i.2]).

The PCRF interfaces with the AF (P-CSCF in the IMS case) over the Rx reference point. The service requests are processed through a policy engine designed to allow for operator based control of gating, QoS and charging. The decisions are also taking as input the profiles of the respective subscribers, such that the provided policies are subscriber dynamically customized.

The resulting policies are pushed to be enforced towards the P-GW in the EPC for gating and charging control over the Gx reference point. In turn, the P-GW interacts with the access specific gateway (S-GW, AN-GW, ePDG) for gating and QoS on the radio links. These interfaces are out of scope for the present document. These resulting policies, as well as feedback from the charging and RAN systems, are passed back upstream over the Gx and Rx reference points to the AF (P-CSCF component in the case of IMS) via the PCRF.

4.3.2.7 HSS/SPR (IMS)

Subscriber data (ETSI TS 123 008 [i.1]) such as profile, location and subscriptions are located for IMS in the central database Home Subscriber Server/Universal Profile Server Function (HSS/UPSF), while EPC uses as a central database the Subscription Profile Repository (SPR). The data between the HSS and SPR has to be correlated, such that service functionality and charging will happen in a unitary manner.

As stated previously, the HSS/UPSF/SPR is regarded as a common node for the present document, exposing the Cx, Sh and S6a interfaces towards different domains. The HSS/SPR is regarded as part of the IMS domain.

4.3.2.8 The P-CSCF (IMS) as the Application Function (AF) Interface to PCRF

In PCC terms, the Application Function (AF) is an abstraction of the service provider plane, which communicates with the PCRF to enable Policy and Charging Control of the application layer and IMS session level services. The AF may be a single third party service, a complex operator controlled service delivery platform or an IP Multimedia Subsystem.

When the AF in the PCC architecture is represented by IMS, the inter-working function is provided by the P-CSCF. Based on the SIP signalling and the transported SDP payloads, the P-CSCF is able to derive QoS and charging requirements for the PCRF and underlying transport system. Also, the P-CSCF will follow the status of the respectively provided communication bearers, such that it can act on events (e.g. loss of bearer, QoS changes, etc.). For all these purposes the Rx reference point is used to communicate with the PCRF element.

The P-CSCF acts also as the Session Border Controller for the SIP User-to-Network Interface, Gm. From the perspective of EPC, the SIP signalling is transparently delivered (tunnelled) between the UE and the P-CSCF. From the IMS perspective, the P-CSCF employs ciphering and integrity protection procedures, in order to further route and process the SIP signalling.

4.3.2.9 S-CSCF (IMS)

The S-CSCF is the core IMS node delivering IMS services to subscribers. The S-CSCF provides session set-up, session tear-down, session control and routing functions. It generates records for billing purposes for all sessions under its control, and invokes Application Servers based on IFCs received from the HSS. The S-CSCF acts as SIP registrar for VoLTE UEs that the HSS and I-CSCF assign to it. It queries the HSS for the applicable subscriber profiles and handles calls involving these end points once they have been registered. The Mw interfaces between I- and S-CSCFs within the same network are considered to be internal IMS interfaces. Although considered as internal and not explicitly involved in all NNI test configurations, it is recommended that these interface are exposed for troubleshooting purposes. When border control functionalities are applied, the Mw reference point between S-CSCF and IBCF within the same network domain is used as a PO for NNI interoperability checks. When applicable based on the specific configuration, the S-CSCF shall be provisioned to support required Application Servers (AS) as trusted nodes.

4.3.2.10 I-CSCF (IMS)

The I-CSCF is the contact point within an operator's network for all connections destined to a user of that network operator, or a roaming user temporarily located within that network operator's service area. On IMS registration, it interrogates the HSS to determine which suitable S-CSCF to route the request for registration. For mobile terminating calls, it interrogates the HSS to determine which S-CSCF the user is registered on. The Mw interfaces between I- and S-CSCFs within the same network are considered to be internal IMS interfaces. Although considered as internal and not explicitly involved in all NNI test configurations, it is recommended that these interface are exposed for troubleshooting purposes. When border control functionalities are applied, the Mw reference point between I-CSCF and IBCF within the same network domain is used as a PO for NNI interoperability checks.

4.3.2.11 IBCF (IMS)

The IBCF is the core IMS node providing border control functionalities such as topology hiding, transport plane control, screening of SIP signalling or application level gateway (for instance enabling communication between IPv6 and IPv4 SIP applications). However, the IBCF can act also as a pass-through entity between adjacent IMS networks. The IcI reference point between the IBCF and the IBCF of another network domain is used as a PO against which NNI interoperability tests are validated.

4.3.2.12 AS (IMS)

Interworking between external Application Servers (AS) and the IMS core is under the scope of the present document. The ISC interface between the S-CSCF and the AS is used as a Point of Observation (PO).

The test descriptions in the present document assume that an AS supports the use of the supplementary service HOLD (see ETSI TS 124 410 [i.3]).

4.3.2.13 IMS AGW (IMS)

The IMS-AGW is not a stand-alone function, but is located with the P-CSCF. The IMS-AGW is responsible for the media plane at the access point to the IMS network. It provides functions for Gate Control & Local NAT, IP realm indication and availability, Remote NAT traversal support, Traffic Policing, QoS Packet Marking, IMS Media Plane Security, etc.

4.3.2.14 TrGW (IMS)

The TrGW is responsible for the media plane at the network interconnect point to other PMNs.

4.3.2.15 DNS

The Domain Name Service (DNS) is considered as a supporting entity in this test specification. It is assumed that each IMS and EPC has its own local DNS which is connected to the common interconnect DNS. The common DNS should be configured for appropriate resource record handling as required to support proper resolution of all SIP URIs in Request URIs and Route headers.

4.3.2.16 ENUM

4.3.2.16.1 ENUM General

When testing, a combination of local and external registries can be used to simulate all functions of the Tier 0, Tier 1 and Tier 2 registries operation plus all national and international interconnect scenarios. It is assumed that each IMS and EPC core may access a local ENUM solution and an external ENUM solution with query capabilities or a combination of local and external solutions to allow retrieval of ENUM data.

4.3.2.16.2 Local ENUM Solution

Each IMS and EPC may access a local ENUM solution with query capabilities which allows retrieval of authoritative stored ENUM data (usually Tier 2 data) or authoritative cached ENUM data (any Tier).

4.3.2.16.3 Common ENUM Solution

An external ENUM registry is provided by the GSMA PRD IR.67 [i.4] to simulate a Tier 0 global root, national Tier 1 registries and off board Tier 2 registries. Depending on the scenario in simulation the registry allows to resolve a TN either directly with the SIP URI of the appropriate interconnection point or indirectly with a NS record of the destination operator. The NS record can then be used by the local ENUM solution to obtain a SIP URI.

4.3.3 VxLTE Reference Points and Protocols

4.3.3.1 The SGi reference point (IP)

4.3.3.1.1 General

The SGi reference point performs User plane generic IP interfacing, breaking out the user IP data from the EPC plane towards the Application Functions (IMS, Internet, etc.). Towards the UTRAN/E-UTRAN or non-3GPP access, this data is transported always as tunnelled and not merely routed on IP principles, such that the SGi correspondent node is provided with direct IP connectivity to the UE device. The SIP signalling as well as the IMS media are transported over this interface.

Packet data network may be an operator-external public or private packet data network or an intra-operator packet data network, e.g. for provision of IMS services. This reference point corresponds to Gi for GERAN/UTRAN accesses.

4.3.3.1.2 The Gm reference point (SIP)

The Gm interface is between the UE and the P-CSCF and enables connectivity between the UE and the IMS network for registration, authentication, encryption, and session control. The protocol used on the Gm interface is SIP/SDP and is defined within ETSI TS 124 229 [2].

The Gm reference point represents the 1st hop in SIP signalling between the UE and the IMS network represented by the P-CSCF. Its scope is to provide a secure SIP signalling channel, independent of the access network level security.

As such, with the exception of initial security negotiations, all signalling should be regarded as un-interceptable. However, for the interoperability purposes here in scope, intercepting this interface is critical for verifying the correct test scenario functionality, without requiring proprietary signalling tapping alternatives. Security measures as 3GPP-IPsec or TLS will be disabled on the Gm interface during the interoperability testing. Nevertheless, security is still to be regarded as mandatory when testing IMS UNI interoperability.

4.3.3.2 The Mw reference point between x-CSCF and x-CSCF (SIP)

The Mw interface is between an x-CSCF and another x-CSCF within the IMS core network (e.g. P-CSCF to I/S-CSCF). The protocols used on the Mw interface are SIP and SDP and are defined in ETSI TS 124 229 [2].

4.3.3.3 The Mx reference point between x-CSCF and IBCF (SIP)

The Mx interface is between an x-CSCF and an IBCF used for the interworking with another IMS network. The protocols used on the Mx interface are SIP and SDP and are defined in ETSI TS 124 229 [2].

4.3.3.4 The ISC reference point between S-CSCF and AS (SIP)

The ISC interface is between S-CSCF and Application Server and is used to interact with the MMTel supplementary services implemented on the AS. The protocol used on the ISC interface is SIP and is defined in ETSI TS 124 229 [2].

4.3.3.5 The Ici reference point between IBCF and IBCF (SIP)

Ici (or Ic) interface is between an IBCF and another IBCF belonging to a different IMS network. The protocols used on the Ici interface are SIP and SDP and are defined in ETSI TS 129 165 [3].

4.3.3.6 The Rx reference point between AF and PCRF (Diameter)

The Rx interface is between the appropriate Application Function (the P-CSCF in the case of VoLTE/ViLTE) and the PCRF allowing the Application Function to request the application of an appropriate policy for a session. The protocol used on the Rx interface is Diameter and is defined in ETSI TS 129 214 [6].

As the policy signalling interface, the Rx interface will be monitored for correct signalling as derived from the test specific SIP signalling. For the purpose of charging event notifications and bearer level event notifications, the Rx signalling will be monitored for correct activity as well as for correct actions on the involved nodes.

For practical test reasons, as with the Gm interface, security is to be disabled on this interface for the scope of interoperability monitoring. Interoperability with the security features enabled can be verified by re-executing the scenarios in scope and verifying only the end-to-end events and not the Rx interface data.

4.3.3.7 The Gx reference point between PCRF and P-GW (Diameter)

The Gx interface is between the PCRF and the PGW, allowing the PCRF direct control over the policy enforcement functions of the PGW. The protocol used on the Gx interface is Diameter and is defined in ETSI TS 129 212 [7].

As the policy signalling interface into the PCEF function, the Gx interface will be monitored for correct signalling as derived from the corresponding Rx signalling. For the purpose of charging event notifications and bearer level event notifications, the Gx signalling will be monitored for correct activity as well as for correct actions on the involved nodes.

For practical test reasons, as with the Rx interface, security is to be disabled on this interface for the scope of interoperability monitoring. Interoperability with the security features enabled can be verified by re-executing the scenarios in scope and verifying only the end-events and not the Gx interface data.

4.3.3.8 The S6a reference point between MME and HSS/SPR (Diameter)

The interface enables the transfer of subscription and authentication data for authenticating/authorizing user access. The protocol used on the S6a interface is Diameter and is defined in ETSI TS 129 272 [8].

The S6a interface will be monitored for correct signalling during network attachment/detachment to enable subscription and authentication data and location info charging event notifications transferred between the MME and HSS/SPR.

For practical test reasons, security is to be disabled on this interface for the scope of interoperability monitoring.

4.3.3.9 The S9 reference point between H-PCRF and V-PCRF (Diameter)

The S9 interface provides policy and charging rules and QoS information between the Home PMN and the Visited PMN in order to support PCC roaming related functions. The protocol used on the S9 interface is Diameter and is defined in ETSI TS 129 215 [9].

The S9 interface will be monitored for correct signalling during roaming scenarios for network attachment/detachment and IMS session establishment. It enables PCC rules to be conveyed from the H-PCRF and installed in the V-PCRF and to convey notification of events from the V-PCRF to the H-PCRF.

For practical test reasons, security is to be disabled on this interface for the scope of interoperability monitoring.

4.3.3.10 The Cx reference point between I/S CSCF and HSS (Diameter)

The Cx interface is between the I/S CSCF and HSS to enable IMS registration and passing of subscriber data to the S-CSCF. The protocol used on the Cx interface is Diameter and is defined in ETSI TS 129 228 [4] and ETSI TS 129 229 [5].

4.3.3.11 The Sh reference point between AS and HSS (Diameter)

The Sh interface is between the VoLTE Application Server and HSS to enable service and subscriber related information to be passed to the Application Server or stored in the HSS. The protocol used on the Sh interface is Diameter and is defined in ETSI TS 129 328 [10] and ETSI TS 129 329 [11].

4.3.4 Applicable 3GPP Release Number

Considering that the purposes of these tests is to prove base IOP between two different systems from potentially different vendors, the functionality has been limited to common/typical procedures, while exhaustive conformance testing is out of the scope of the present document. The present document is aimed at Release 15 but (given its scope), Release 14 implementations should still be able to perform most of the tests without major difficulties.

4.4 Test pre-requisites

4.4.1 IP Version

Whether the EPC system uses IPv4 or IPv6 to transport (i.e. tunnelling method) the User Plane data inside the EPS is irrelevant to the outcome of the tests. Options for encapsulating either IPv4 or IPv6 packets into both IPv4 and IPv6 transported tunnels exist. There are no differences in the User Plane provided services by the EPC platform relevant to the used IP transport version, such that this decision can be taken by the EPC vendors as to maximize performance and optimize their platforms.

The UE attachment to the EPS is assumed to be a dual IPv4 and IPv6. It is assumed that for the test purposes, the IMS client software will be capable of SIP signalling and media transport over both protocol version. The choice will be a configuration parameter (e.g. P-CSCF provisioned address in ISIM, DHCP or DNS). The SDP media should use the same IP version protocol as discovered for SIP signalling.

The IMS-EPC IOP Test Suite will be executed once for IMS clients using IPv4 and once for IMS clients using IPv6.

4.4.2 Number Resolution

"ENUM (IETF RFC 3761 [i.6]) is a capability that transforms E.164 numbers into domain names and then uses the DNS (Domain Name System) to discover NAPTR records that specify the services available for a specific domain name." (ETSI TR 184 008 [i.5]).

The test infrastructure focuses on the use of Infrastructure ENUM to map a telephone number into a SIP URI that may identify a specific Point of Interconnection (PoI) to that communication provider's network that may enable the originating party to establish communication with the associated terminating party either directly or through an IPX.

The Infrastructure ENUM platform has a tiered structure and provides authoritative, service specific information to the querying party. A combination of Tier 0, Tier 1 and Tier 2 registries enables global discovery of ENUM data.

When returning the SIP URI of a PoI the ENUM solution acts a hosted T2 ENUM registry for the number range holder. When returning a NS record the ENUM solution acts as either a Tier 0 or Tier 1 registry.

4.4.3 QoS aspects

The present document describes only the functional signalling aspects of the interworking of IMS networks. ETSI TS 103 189 [i.7] defines a set of test descriptions that allow the evaluation of the Quality of Service (QoS) that is available on a connection established via the NNI interface between two UEs following the use cases and test descriptions described in the present document. Wherever QoS testing can be applied a link is given to the relevant clause of ETSI TS 103 189 [i.7].

4.5 Test description overview

The test descriptions are documented in clauses 5, 6 and 7.

Clause 5 represents test descriptions in the single network (non-roaming) case and clause 6 and 7 in the roaming case respectively. For each clause, the test descriptions are presented in the following groupings:

- N/W Attachment and IMS Registration;
- SIP Session/Dedicated Bearer Operations:
  - SIP Session Establishment;
  - SIP Session Modification;
  - SIP Session Release;
  - SIP Session Abort/Reject;
- IMS De-registration (with/without SIP sessions);
- N/W Detachment (with/without SIP sessions, with/without IMS registration).

The Test Descriptions present a definitive signalling and procedural flow through the test's execution. As a very high number of test variations may be generated, here only the most common scenarios are approached.

Each Test Description can be reconfigured to test various aspects (e.g. IPv4 and IPv6 IMS registrations). Yet these reconfigurations are to be regarded only as specific to the individual test executions as they should not affect the test descriptions.

4.6 TD naming convention

TDs are numbered, starting at 01, within each group.

Table 1: TD identifier naming convention scheme

Identifier: **<TD>_<type>_<network>_<scope>_<nn>**			
<td>	=	Test Description:	fixed to "TD"
<type>	=	Communication:	VxLTE
<network>	=	Network:	INT - interoperability
			RMI - roaming
<scope>	=	group	ATT - attachment
			REG - registration
			INI - session establishment and modification
			REL - session release
			ABT - session abort
			REJ - session rejection
			DRG - deregistration
			DTC - detachment
<nn>	=	sequential number	(01 to 99)

5 Test Descriptions (Interoperability)

5.0 General

The Interoperability Test Descriptions (TDs) defined in the following clauses are derived from the Test Purposes (TPs) specified in ETSI TS 103 653-1 [1], where each TD may realize one or more TPs.

Each TD contains three parts:

1) The TD itself in tabular format.
2) The call flow associated to the TD.
3) A textual description of the call flow.

5.1 Network Attachment

5.1.1 UE Initial Network Attachment and Establishment of the Default Bearer

Interoperability Test Description		
Identifier:	TD_VxLTE_INT_ATT_01	
Objective:	To perform UE initial attachment to the network and establish a default bearer.	
Summary:	On successful initial network attachment, the UE should discover the P-CSCF IP address. The EPC will create the Default Bearers which will allow communication only between the UE and the P-CSCF.	
Configuration:	CF_VxLTE_INT	
SUT:	IMS A and EPC A	
Interfaces:	Gx, S6a	
References:		ETSI TS 124 229 [2], clauses 9.2.1 and L.2.2.1
	Gx	ETSI TS 129 212 [7], clauses 4.5.1 (item 1) and 4a.5.1 (item 1)
	S6a	ETSI TS 129 272 [8], clause 5.2.1.1
Pre-test conditions:	• Network attachment credential provisioned in UE A, HSS/SPR and PCRF. • HSS/SPR and UE A provisioned with selectable APN configurations for IPv4, IPv6 or IPv4&IPv6 PDN types. • P-CSCF address provisioned in the PCRF for the purpose of delivery to UE on attachment. • Default Bearer PCRF policies set to allow UE A - P-CSCF communication. • Default EPC Gating Policy set to "Deny". • UE A not attached to network and EPC.	
Test Sequence:	**Step**	
	1	UE A starts initial network attachment to EPC
	2	Verify that the message sequence is correct
	3	Verify that EPC establishes Default Bearer for allowing UE A - P-CSCF communication, by starting at UE A an IMS registration
	4	Verify that UE A attached successfully and received the following information: • suitable IPv4 and/or IPv6 address(es) • DNS configuration information P-CSCF IP address or FQDN
	5	Verify that arbitrary IP packets from UE A to arbitrary node, other than the P-CSCF, are filtered-out by EPC and not visible on PO_SGi
	6	Verify that arbitrary IP packets from another node (e.g. UE B sent over PO_SGi) to UE A, are filtered-out by EPC and not visible on PO_UE A
Conformance criteria of test sequence step:	2	S6a TP_S6A_MME_ULR_01 (ULR - Event 2) S6a TP_S6A_HSS_ULA_01 (ULA - Event 3) Gx TP_GX_PCRF_CCA_01 (CCR, CCA - Events 4, 5)

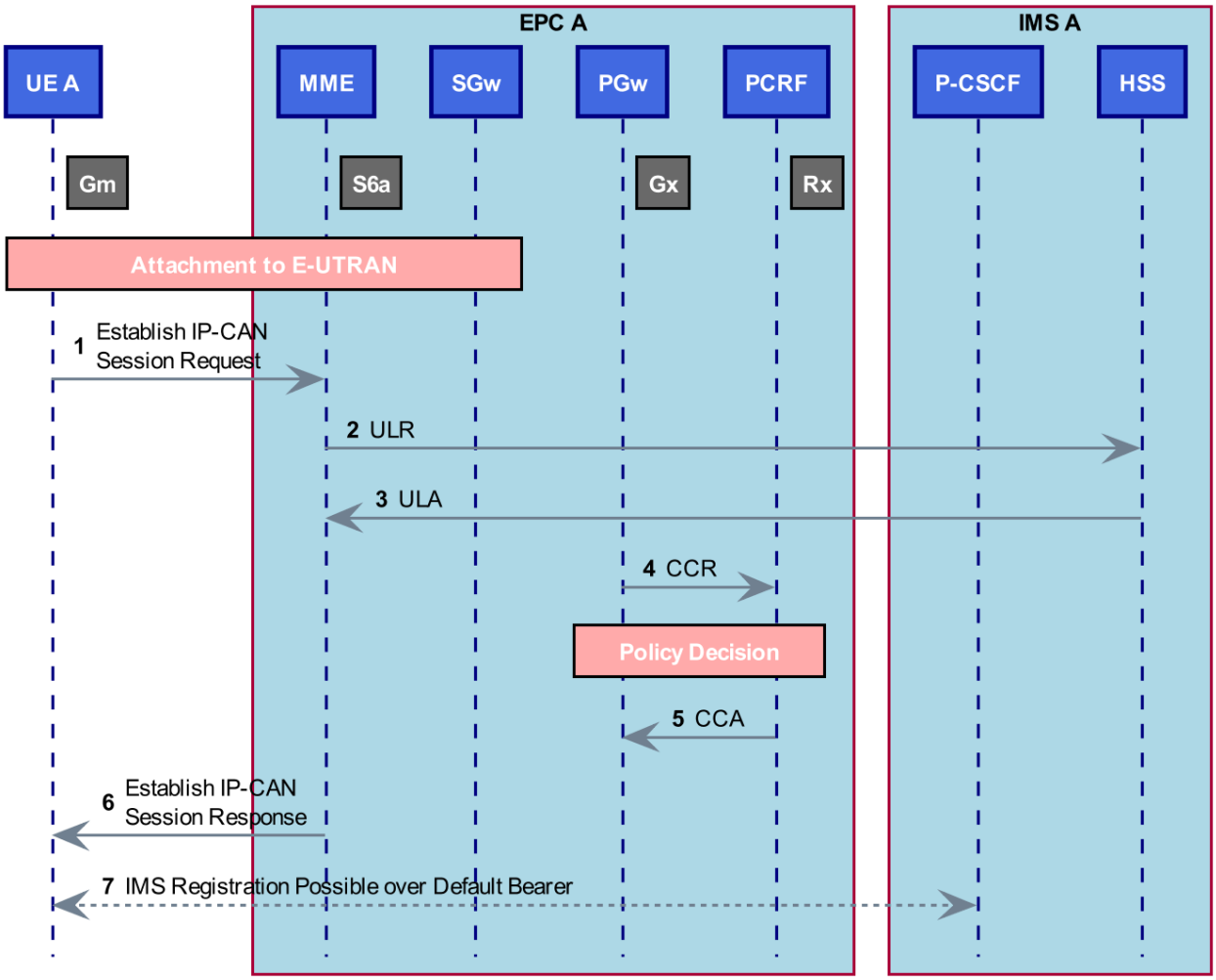


Figure 5: Initial network attachment

1) The UE-A requests IP-CAN session establishment to the EPC (MME).
2) The MME sends a ULR message to the HSS/SPR.
3) The HSS responds with ULA.
4) The P-GW sends a CCR message to the PCRF to request the default bearer. The PCRF checks if the user is entitled to set up the requested bearer.
5) The PCRF responds with a CCA.
6) The MME responds to the UE A, confirming that the IP-CAN has been successfully set up.
7) User is informed that the default bearer has been successfully set up.

5.2 IMS Registration

5.2.1 User via EPC - IMS Initial Registration - Successful

Interoperability Test Description		
Identifier:	TD_VxLTE_INT_REG_01	
Objective:	To perform initial IMS registration via the established default bearer. Note that some UEs perform IMS registration automatically on attachment - in which case this test becomes merged with the previous one.	
Summary:	On successful initial registration, the P-CSCF shall request the PCRF to perform session binding onto the underlying default bearer for the IMS application. The PCRF should act on the request and modify the bearer. Subsequent signalling should make use of the respective bearer's QoS and priority characteristics.	
Configuration:	CF_VxLTE_INT	
SUT:	IMS A and EPC A	
Interfaces:	Gm, Mw, Cx, Rx, Gx	
References:	Gm, Mw	ETSI TS 124 229 [2], clause 5.1.1.1 and clause 5.2.2.1 and clause 5.2.3B and clause 5.3.1.1 and clause 5.4.1.2 and clauses 6.2 and 6.3
	Rx	ETSI TS 129 214 [6], clauses 4.4.5a, A.8 and annex B
	Gx	ETSI TS 129 212 [7], clauses 4.5.2 and 4.5.3
	Cx	ETSI TS 129 228 [4], clauses 6.1.1, 6.1.2 and 6.3 ETSI TS 129 229 [5], clauses 6.1.1, 6.1.2, 6.1.3, 6.1.4, 6.1.7 and 6.1.8
Pre-test conditions:	• UE A previously attached to EPC, but not registered to IMS, and a default bearer has been established a Default Bearer allowing UE A - P-CSCF IP communication. • HSS provisioned with UE A' subscription. • UE A discovered the P-CSCF address.	
Test Sequence:	**Step**	
	1	UE A triggers IMS registration.
	2	Verify that the message sequence is correct.
	3	Verify that, in Diameter AA-Request/Answer, IMS included a Media Description for signalling according to UE A.IP_Address, UE A.SIP_Port, PCSCF.IP_Address, PCSCF.SIP_Port.
	4	Verify that the PCRF successfully provisioned QOS rules to the EPC on the default bearer.
	5	Verify that UE A can exchange subsequent signalling with IMS.
	6	Verify that UE A subsequent signalling is transported with appropriate PCC characteristics.
Conformance criteria of test sequence step:	2	Gm TP_GM_PCSCF_REGISTER_01 (Events 1, 10) Gm TP_GM_PCSCF_REGISTER_02 (Events 11, 20) Gm TP_GM_PCSCF_SUBSCRIBE_01 (Events 21, 24) MwPS TP_MW_PCSCF_REGISTER_01 (Events 2, 9) MwPS TP_MW_PCSCF_REGISTER_02 (Events 12, 19) MwPS TP_MW_PCSCF_SUBSCRIBE_01 (Events 22, 23) MwIS TP_MW_ICSCF_REGISTER_01 (Events 5, 8) MwIS TP_MW_ICSCF_REGISTER_02 (Events 15, 18) Cx TP_CX_HSS_UAA_01 (UAR, UAA - Events 3, 4) Cx TP_CX_HSS_MAA_01 (MAR, MAA - Events 6, 7) Cx TP_CX_HSS_UAA_02 (UAR, UAA - Events 13, 14) Cx TP_CX_HSS_SAA_01 (SAR, SAA - Events 16, 17)
	3	Rx TP_RX_PCSCF_AAR_01 (AAR - Event 25) Rx TP_RX_PCRF_AAA_01 (AAA - Event 26)
	4	Gx TP_GX_PGW_RAA_01 (RAR, RAA - Events 27, 28)

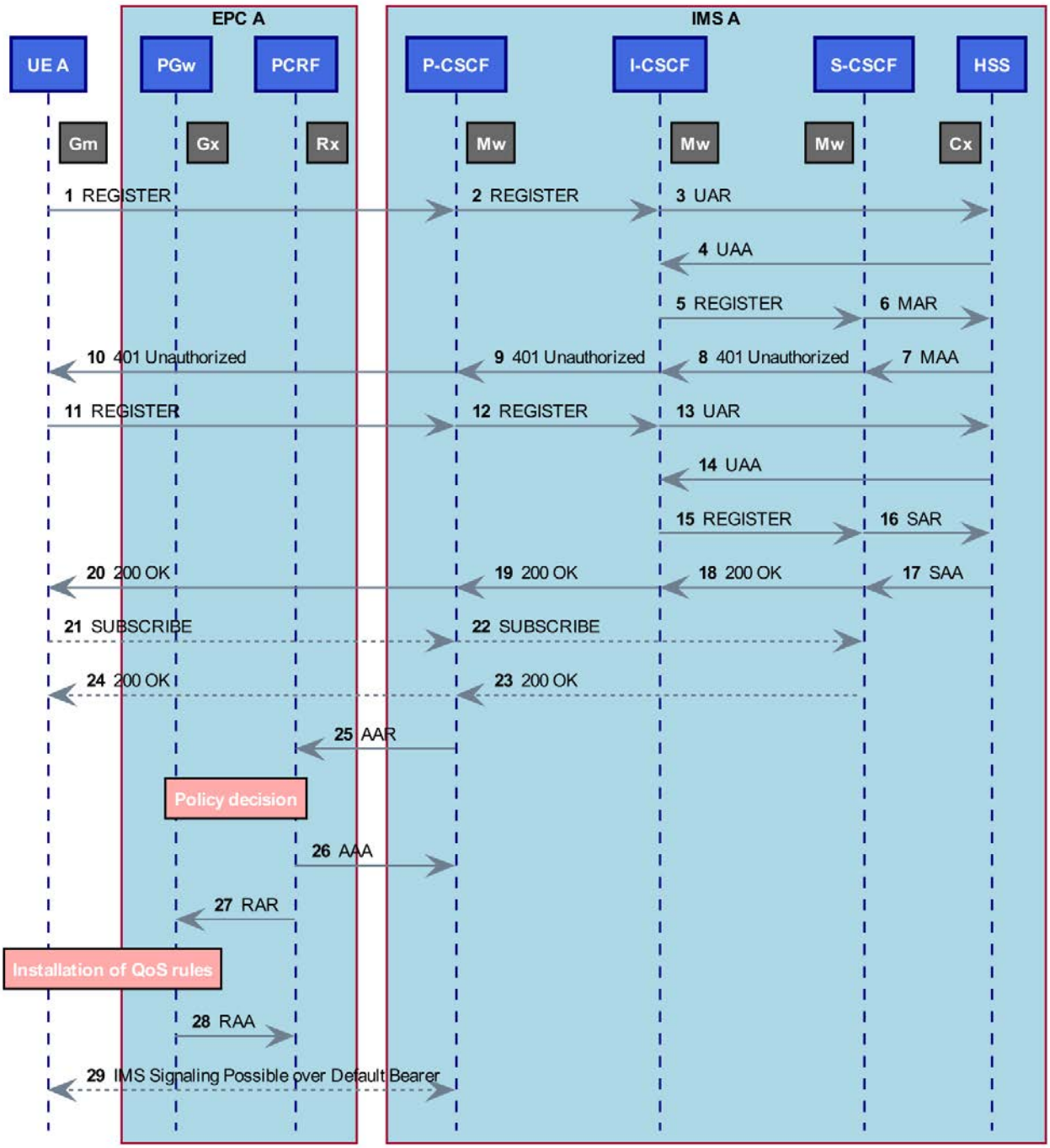


Figure 6: IMS Initial Registration (success)

1) The UE-A requests IMS A Registration.
2) P-CSCF forwards the REGISTER to I-CSCF.
3) I-CSCF sends UAR to HSS.
4) HSS responds with UAA.
5) I-CSCF forwards the REGISTER to S-CSCF.
6) S-CSCF sends MAR to HSS.
7) HSS responds with MAA.
8) IMS A rejects the REGISTER and issues a challenge.

9) I-CSCF forwards 401 response to P-CSCF.

10) P-CSCF forwards 401 response to UE-A.

11) The REGISTER is re-sent with an Authorization header.

12) P-CSCF forwards the REGISTER to I-CSCF.

13) I-CSCF sends UAR to HSS.

14) HSS responds with UAA.

15) I-CSCF forwards the REGISTER to S-CSCF.

16) S-CSCF sends SAR to HSS.

17) HSS responds with SAA.

18) The IMS S registration is successful.

19) I-CSCF forwards 200 response to P-CSCF.

20) P-CSCF forwards 200 response to UE-A.

21) The P-CSCF subscribes to the registration event package to be notified of a de-registration.

22) P-CSCF forwards the SUBSCRIBE to S-CSCF.

23) S-CSCF responds with 200 OK to P-CSCF.

24) P-CSCF forwards the 200 OK to UE-A.

25) The P-CSCF initiates session binding to the default bearer with AAR.

26) The PCRF responds with AAA to the P-CSCF.

27) The PCRF pushes a flow description with RAR to the P-GW to modify the default bearer.

28) The P-GW in the EPC responds with RAA to the PCRF.

29) The default bearer has been successfully modified and bi-directional IMS signalling is possible.

5.2.2 User via EPC - IMS Initial Registration - Unsuccessful

Interoperability Test Description		
Identifier:	TD_VxLTE_INT_REG_02	
Objective:	To attempt initial IMS registration via the established default bearer. In this case, the IMS registration is not successful and IMS will not invoke the PCRF to perform session binding to the underlying bearer.	
Summary:	On failed UE Registration to IMS, IMS will not trigger the creation of a bearer for the transport of the subsequent SIP signalling.	
Configuration:	CF_VxLTE_INT	
SUT:	IMS A and EPC A	
Interfaces:	Gm, Mw, Cx, Rx	
References:	Gm, Mw	ETSI TS 124 229 [2], clause 5.1.1.1 and clause 5.2.2.1 and clause 5.3.1.1 and clause 5.4.1.2 and clauses 6.2 and 6.3
	Rx	ETSI TS 129 214 [6], clause 4.4.5a
	Cx	ETSI TS 129 228 [4], clause 6.1.1.1
Pre-test conditions:	• UE A previously attached to EPC, but not registered to IMS. • EPC established a Default Bearer allowing UE A - P-CSCF IP communication. • HSS of IMS not provisioned with UE A's subscription. • UE A discovered the P-CSCF address.	

Interoperability Test Description			
Test Sequence:	**Step**		
	1	UE A triggers IMS registration with invalid identity.	
	2	Verify that the IMS registration has been rejected.	
	3	Verify that the PCRF is not invoked.	
Conformance criteria of test sequence step:	2	Gm MwPS MwIS Cx	TP_GM_PCSCF_REGISTER_03 (Events 1, 6) TP_MW_PCSCF_REGISTER_03 (Events 2, 5) TP_MW_ICSCF_REGISTER_03 (Events 2, 5) TP_CX_HSS_UAA_03 (UAR, UAA - Events 3, 4)
	3	Rx	TP_RX_PCSCF_AAR_02 (AAR - Event 7)

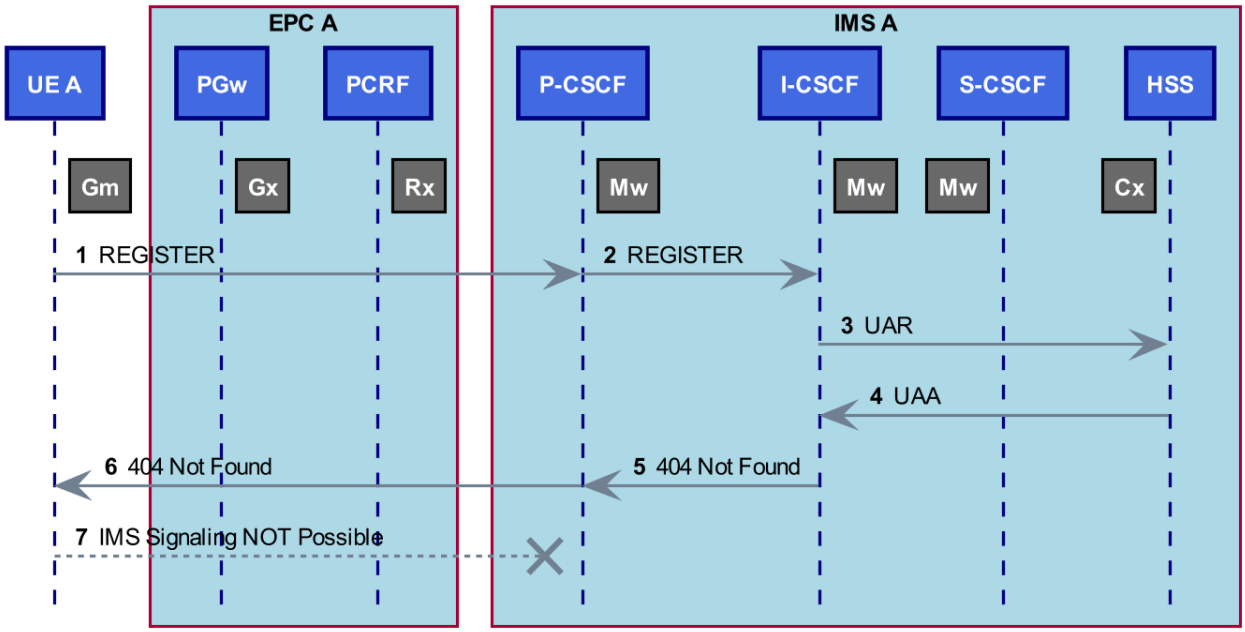


Figure 7: IMS Initial Registration (unsuccessful)

1) The UE-A request IMS A Registration.

2) P-CSCF forwards the REGISTER to I-CSCF.

3) I-CSCF sends UAR to HSS.

4) HSS responds with UAA - USER_UNKNOWN.

5) I-CSCF sends 404 response to P-CSCF.

6) P-CSCF forwards 404 response to UE-A.

7) The P-CSCF does not initiate session binding to the default bearer with AAR. The default bearer has not been established and bi-directional IMS signalling is not possible.

5.2.3 User via EPC - IMS Initial Registration - thirdparty registration to AS

Interoperability Test Description		
Identifier:	TD_VxLTE_INT_REG_03	
Objective:	To perform initial IMS registration via the established default bearer. Note that some UEs perform IMS registration automatically on attachment.	
Summary:	On successful initial registration, the P-CSCF shall request the PCRF to perform session binding onto the underlying default bearer for the IMS application. The PCRF should act on the request and modify the bearer. Subsequent signalling should make use of the respective bearer's QoS and priority characteristics.	
Configuration:	CF_VxLTE_INT	
SUT:	IMS A and EPC A	
Interfaces:	Gm, Mw, Isc, Cx, Rx, Gx, Sh	
References:	Gm, Mw	ETSI TS 124 229 [2], clause 5.1.1.1 and clause 5.2.2.1 and clause 5.2.3B and clause 5.3.1.1 and clause 5.4.1.2 and clause 5.4.2 and clause 6.2 and 6.3
	Isc	ETSI TS 124 229 [2], clause 5.4.1.7
	Rx	ETSI TS 129 214 [6], clauses 4.4.5a, A.8 and annex B
	Gx	ETSI TS 129 212 [7], clauses 4.5.2 and 4.5.3
	Cx	ETSI TS 129 228 [4], clauses 6.1.1, 6.1.2 and 6.3 ETSI TS 129 229 [5], clauses 6.1.1, 6.1.2, 6.1.3, 6.1.4, 6.1.7 and 6.1.8
	Sh	ETSI TS 129 328 [10], clause 6.1.1.1
Pre-test conditions:	• UE A previously attached to EPC, but not registered to IMS, and a default bearer has been established a Default Bearer allowing UE A - P-CSCF IP communication. • HSS provisioned with UE A' subscription. • UE A discovered the P-CSCF address.	
Test Sequence:	**Step**	
	1	UE A triggers IMS registration.
	2	Verify that the message sequence is correct.
	3	Verify that, in Diameter AA-Request/Answer, IMS included a Media Description for signalling according to UE A.IP_Address, UE A.SIP_Port, PCSCF.IP_Address, PCSCF.SIP_Port.
	4	Verify that the PCRF successfully provisioned QOS rules to the EPC on the default bearer.
	5	Verify that UE A can exchange subsequent signalling with IMS.
	6	Verify that UE A subsequent signalling is transported with appropriate PCC characteristics.
Conformance criteria of test sequence step:	2, 5	Gm TP_GM_PCSCF_REGISTER_01 (Events 1, 10) Gm TP_GM_PCSCF_REGISTER_02 (Events 11, 24) Gm TP_GM_PCSCF_SUBSCRIBE_01 (Events 25, 28) MwPS TP_MW_PCSCF_REGISTER_01 (Events 2, 9) MwPS TP_MW_PCSCF_REGISTER_02 (Events 12, 23) MwIS TP_MW_ICSCF_REGISTER_01 (Events 5, 8) MwIS TP_MW_ICSCF_REGISTER_02 (Events 15, 22) MwPS TP_MW_PCSCF_SUBSCRIBE_01 (Events 26, 27) Cx TP_CX_HSS_UAA_01 (UAR, UAA - Events 3, 4) Cx TP_CX_HSS_MAA_01 (MAR, MAA - Events 6, 7) Cx TP_CX_HSS_UAA_02 (UAR, UAA - Events 13, 14) Cx TP_CX_HSS_SAA_01 (SAR, SAA - Events 16, 17) Isc TP_ISC_SCSCF_REG_01 (Events 18, 21) Sh TP_SH_HSS_UDA_01 (UDR, UDA - Events 19, 20)
	3	Rx TP_RX_PCSCF_AAR_01 (AAR - Event 29) Rx TP_RX_PCRF_AAA_01 (AAA - Event 30)
	4	Gx TP_GX_PGW_RAA_01 (RAR, RAA - Events 31, 32)

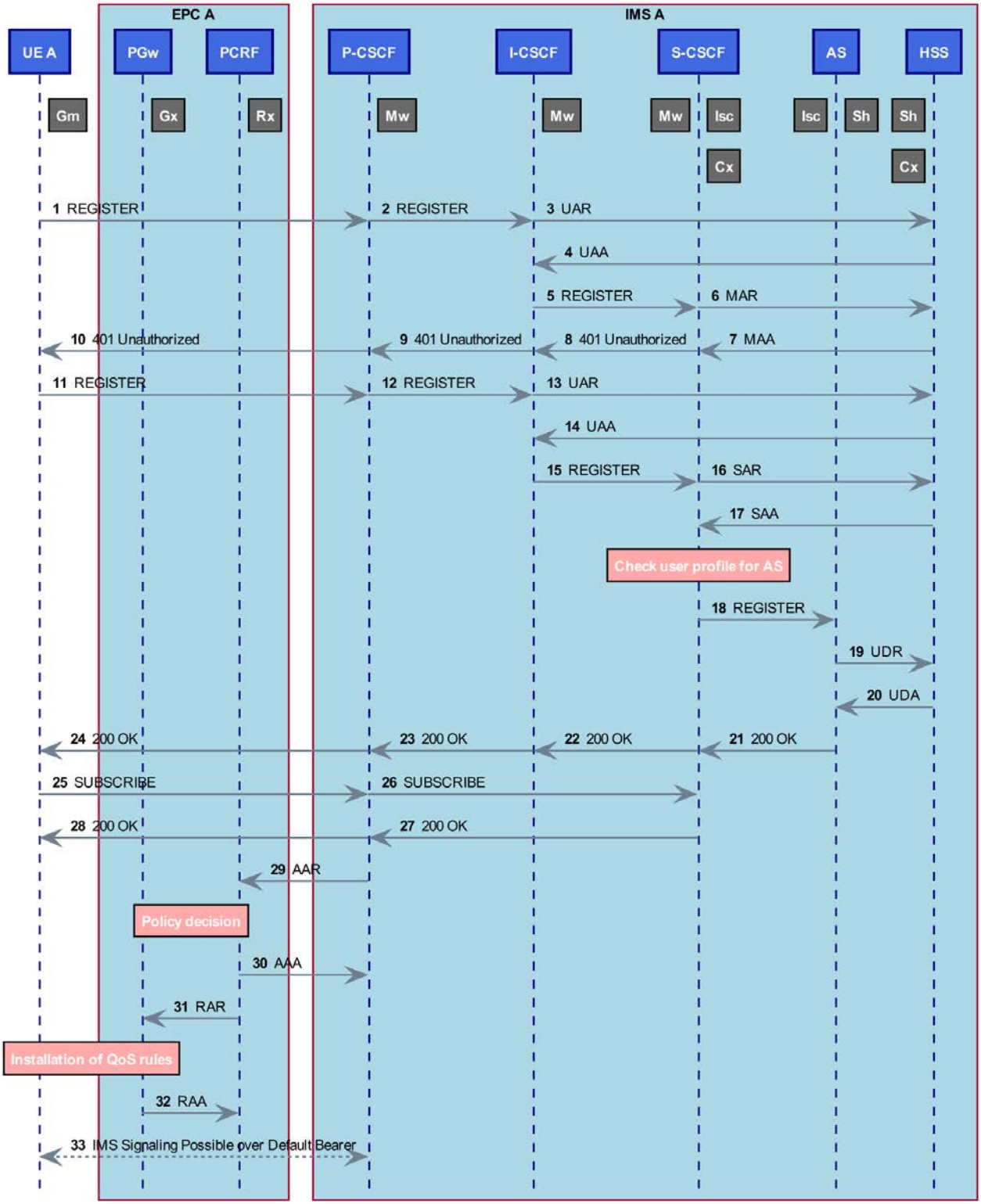


Figure 8: IMS Initial Registration (success)

1) The UE-A requests IMS A Registration.
2) P-CSCF forwards the REGISTER to I-CSCF.
3) I-CSCF sends UAR to HSS.
4) HSS responds with UAA.
5) I-CSCF forwards the REGISTER to S-CSCF.

6) S-CSCF sends MAR to HSS.

7) HSS responds with MAA.

8) IMS A rejects the REGISTER and issues a challenge.

9) I-CSCF forwards 401 response to P-CSCF.

10) P-CSCF forwards 401 response to UE-A.

11) The REGISTER is re-sent with an Authorization header.

12) P-CSCF forwards the REGISTER to I-CSCF.

13) I-CSCF sends UAR to HSS.

14) HSS responds with UAA.

15) I-CSCF forwards the REGISTER to S-CSCF.

16) S-CSCF sends SAR to HSS.

17) HSS responds with SAA.

18) S-CSCF sends REGISTER to AS.

19) AS via Sh sends UDR to the HSS.

20) HSS answers with UDA.

21) AS confirms REGISTER with 200 OK.

22) The IMS S registration is successful.

23) I-CSCF forwards 200 response to P-CSCF.

24) P-CSCF forwards 200 response to UE-A.

25) The P-CSCF subscribes to the registration event package to be notified of a de-registration.

26) P-CSCF forwards the SUBSCRIBE to S-CSCF.

27) S-CSCF responds with 200 OK to P-CSCF.

28) P-CSCF forwards the 200 OK to UE-A.

29) The P-CSCF initiates session binding to the default bearer with AAR.

30) The PCRF responds with AAA to the P-CSCF.

31) The PCRF pushes a flow description with RAR to the P-GW to modify the default bearer.

32) The P-GW in the EPC responds with RAA to the PCRF.

33) The default bearer has been successfully modified and bi-directional IMS signalling is possible.

5.3 SIP Session and Dedicated Bearer Operations (Interoperability)

5.3.0 Introduction

This clause builds on the previous attachment and IMS registration flows and considers SIP session establishment and cleardown for VoLTE/ViLTE and the resulting interactions between the UE, EPC, PCRF and IMS. In particular, the SIP sessions will trigger the creation/deletion of dedicated bearers to support the requested media flows (e.g. voice) in the SIP signalling.

The SIP Session and Session Bearer Operations cover the allocation, modification and deletion of EPC bearers for the media data between two UEs. As long as the bearers are present, media can be transported in both directions. The respective bearers will have QoS and charging characteristics according to the EPC's operator profiles and preferences. For verifying the different characteristics, both audio and video media can be exchanged, each with different bearer policies. As the bearers are modified or deleted, media traffic will be filtered-out by EPC. To achieve this effect, the same default EPC gateway policy set to "Deny" will be employed, as in the previous test cases.

It is noted that bearer information is exchanged via SDP negotiation during the SIP session establishment via the Offer/Answer mechanism and that this can happen in various ways:

- INVITE with SDP offer and 200 OK with SDP answer;
- INVITE with SDP offer and 183 Progress with SDP answer;
- INVITE with SDP offer and 180 Ringing with SDP answer;
- 200 OK with SDP offer and ACK with SDP answer;
- no SDP negotiation in the initial transaction.

However, the present document is interested in the interaction between IMS, PCRF and EPC and notes that these interactions are generic - albeit influenced by the point at which SDP is exchanged at the SIP session signalling. Therefore, the test descriptions in this clause cover only the case of the third bullet above (i.e. Offer in INVITE and answer in 180 (Ringing)). However, all of the above scenarios are valid but the P-CSCF invokes the PCRF/EPC in each case at the point at which an SDP offer and answer is received.

Each Test Description is split into separate originating and terminating situations to document the interactions between IMS, PCRF and EPC. A complete session may be derived by combining a pair of such Test Descriptions.

5.3.1 SIP Session Establishment

5.3.1.1 General

The test assumes that the UE A for originating cases and UE B for terminating cases have been previously attached to EPC and registered to IMS.

The test will verify that:

1) The P-CSCF will act on successful call establishment and trigger creation of dedicated bearers.

2) Media is only transported after the call setup is successfully completed (tests will start media before call setup and verify that the default EPC gating policy of "Deny" will initially stop the media).

3) The EPC will create new dedicated bearers for transporting the session's media.

4) The media bearer is used to transport the media between the UEs with the following parameters (see ETSI TS 123 203 [i.2]) for voice and video telephony calls respectively.

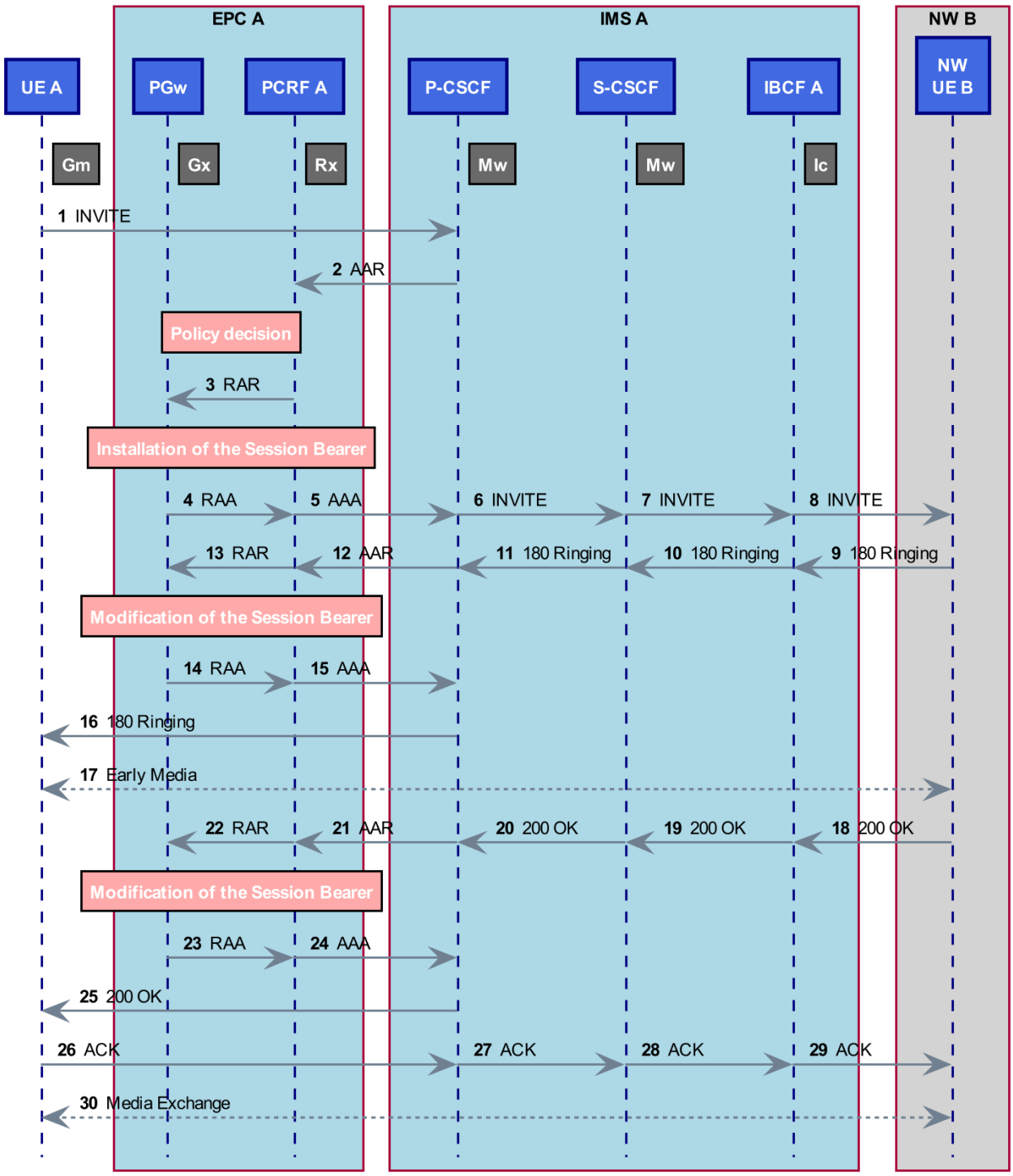
QoS Class Identifier	Resource-Type	Priority	Packet Delay Budget	Packet Error Loss Rate	Example Services
1	GBR	2	100 ms	10^{-2}	Conversational Voice
2	GBR	4	150 ms	10^{-3}	Conversational Video (Live Streaming)

Note that mapping between SDP in SIP session signalling and corresponding DIAMETER messages to PCRF and EPC is described in ETSI TS 129 215 [9].

5.3.1.2 Originating Leg

Interoperability Test Description		
Identifier:	TD_VxLTE_INT_INI_01	
Objective:	To demonstrate the establishment of dedicated bearers at the originating EPC due to SIP session establishment.	
Summary:	On successful call setup, the P-CSCF should derive from the SDP offer and answer, descriptions of the Service Data Flow. These are pushed towards PCRF and EPC as request for creation of adequate bearers. EPC creates based on the EPC's operator policies the bearers for media. When transporting media, the EPC will employ the respective bearer's characteristics. Media transport is possible only after the successful establishment of the session. Media negotiation happens during INVITE/200 OK (UE A sends SDP-offer, UE B responds with SDP-answer).	
Configuration:	CF_VxLTE_INT	
SUT:	IMS A and EPC A	
Interfaces:	Gm, Mw, Rx, Gx, Ic	
References:	Ic	ETSI TS 124 229 [2], clause 5.4.3.2 ¶11 (1st numbered list) and clause 5.4.3.2 ¶9 (item 9 1st numbered list) and clause 5.4.3.2 (item 10 1st numbered list) and clause 5.4.3.3 (item 2 in 3rd numbered list) and clause 5.4.3.3 (item 3 in 3rd numbered list) and clause 5.3.2.1 (paragraph after note 10) and clause 5.4.3.2 (item 1 in 7th numbered list) and clause 5.4.3.2 (item 10 in 1st numbered list) and clause 5.10.3.2
	Gm, Mw	ETSI TS 124 229 [2], clause 5.2.7.2 and clause 5.3.2.1 and clause 5.3.2.1A and clause 5.4.4.1 and clause 5.4.4.2
	Rx	ETSI TS 129 214 [6], clauses 4.4.1, A.1, A.2 and annex B
	Gx	ETSI TS 129 212 [7], clause 4.5.2
Pre-test conditions:	• UE A previously attached to EPC A. • EPC established a Default Bearer allowing UE A - P-CSCF IP communication. • UE A previously registered to IMS A. • EPC established an IMS signalling bearer. • UE B is registered in IMS B and ready to accept the session establishment.	
Test Sequence:	**Step**	
	1	Verify that media between UE A and UE B is not delivered in any direction before call establishment.
	2	UE A calls UE B and establishes a communication session.
	3	Verify that, in Diameter AA-Request/Answer, the IMS produced a Media Description for the session according to SDP-offer in SIP INVITE Request and SDP-answer in SIP 180 to the PCRF.
	4	Verify that the PCRF invokes the EPC P-GW with a DAMETER RA-Request to create a new bearer for the requested media.
	5	Verify that PCRF requested media description was found acceptable by EPC and dedicated bearers are established and that a RA-Answer is sent to the PCRF.
	6	Verify that media between UE A and UE B is successfully routed over the dedicated bearer.

Interoperability Test Description			
	7	Verify that media between UE A and UE B is transported with appropriate PCC characteristics.	
Conformance criteria of test sequence step:	2	Gm	TP_GM_PCSCF_INVITE_01 (Event 1)
		Gm	TP_GM_PCSCF_180RINGING_01 (Event 6)
		Gm	TP_GM_PCSCF_200OK_01 (Event 25)
		Gm	TP_GM_PCSCF_ACK_01 (Event 26)
		MwPS	TP_MW_PCSCF_INVITE_01 (Events 6, 11, 20, 27)
		MwPS	TP_MW_PCSCF_180RINGING_01 (Event 11)
		MwPS	TP_MW_PCSCF_200OK_01 (Event 20)
		MwPS	TP_MW_PCSCF_ACK_01 (Event 27)
		Ic	TP_IC_IBCF_INVITE_01 (INVITE - Event 8)
		Ic	TP_IC_IBCF_INVITE_02 (INVITE - Event 8)
		Ic	TP_IC_IBCF_INVITE_03 (INVITE, ENUM - Event 8)
		Ic	TP_IC_IBCF_ACK_01 (ACK - Event 29)
		Ic	TP_IC_IBCF_180RESP_01 (180 Ringing - Event 9)
		Ic	TP_IC_IBCF_180RESP_02 (180 Ringing - Event 9)
		Ic	TP_IC_IBCF_1XXRESP_01 (180 Ringing - Event 9)
		Ic	TP_IC_IBCF_2XXRESP_01 (200 OK - Event 18)
		Ic	TP_IC_IBCF_2XXRESP_02 (200 OK - Event 18)
		Ic	TP_IC_IBCF_2XXRESP_03 (200 OK - Event 18)
	3	Rx	TP_RX_PCSCF_AAR_03 (AAR - Event 2)
		Rx	TP_RX_PCSCF_AAR_04 (AAR - Event 12)
		Rx	TP_RX_PCSCF_AAR_05 (AAR - Event 21)
		Rx	TP_RX_PCRF_AAA_02 (AAA - Events 5, 15, 24)
	4	Gx	TP_GX_PCRF_RAR_01 (RAR - Events 3, 13, 22)
	5	Gx	TP_GX_PGW_RAA_02 (RAA - Events 4, 14, 23)
	6	Rtp	TP_RTP_03 (Event 30)



NOTE 1: In the above figure, the Gx interaction may take place after completion of the Rx interaction.
NOTE 2: For brevity, 100rel is not used in the above figure. However, 100rel is valid and may be used. If 100rel is not used, then the SDP answer in the 200 OK (INVITE) shall be identical to that in the 180 (Ringing) provisional response.

Figure 9: SIP Session Establishment - Originating Leg

1) UE A initiates the SIP session with an INVITE containing the SDP offer.

2) The IMS A P-CSCF invokes the PCRF.

3) PCRF sends RAR to EPC A P-GW.

4) EPC A P-GW responds with RAA.

5) PCRF responds to IMS A P-CSCF with AAA.

6) P-CSCF forwards the INVITE to S-CSCF.

7) S-CSCF forwards the INVITE to IBCF.

8) IBCF forwards the INVITE towards UE B.

9) The UE B responds with the 180 with SDP answer.

10) IBCF forwards the 180 to S-CSCF.

11) S-CSCF forwards the 180 to P-CSCF.

12) The IMS A P-CSCF invokes the PCRF to modify the bearer with AAR.

13) PCRF sends RAR to EPC A P-GW.

14) EPC A P-GW responds with RAA.

15) PCRF responds to IMS A P-CSCF with AAA.

16) P-CSCF forwards the SIP 180 (SDP) to UE A.

17) Early media may flow between the UEs.

18) The UE B responds with the SIP 200 OK (SDP).

19) IBCF forwards the SIP 200 OK (SDP) to S-CSCF.

20) S-CSCF forwards the SIP 200 OK (SDP) to P-CSCF.

21) The IMS A P-CSCF invokes the PCRF to complete the bearer set up with AAR.

22) PCRF sends RAR to EPC A P-GW.

23) EPC A P-GW responds with RAA.

24) PCRF responds to IMS A P-CSCF with AAA.

25) P-CSCF forwards the SIP 200 OK (SDP) to UE A.

26) The UE A sends ACK to 200 OK (INVITE).

27) P-CSCF forwards the ACK to S-CSCF.

28) S-CSCF forwards the ACK to IBCF.

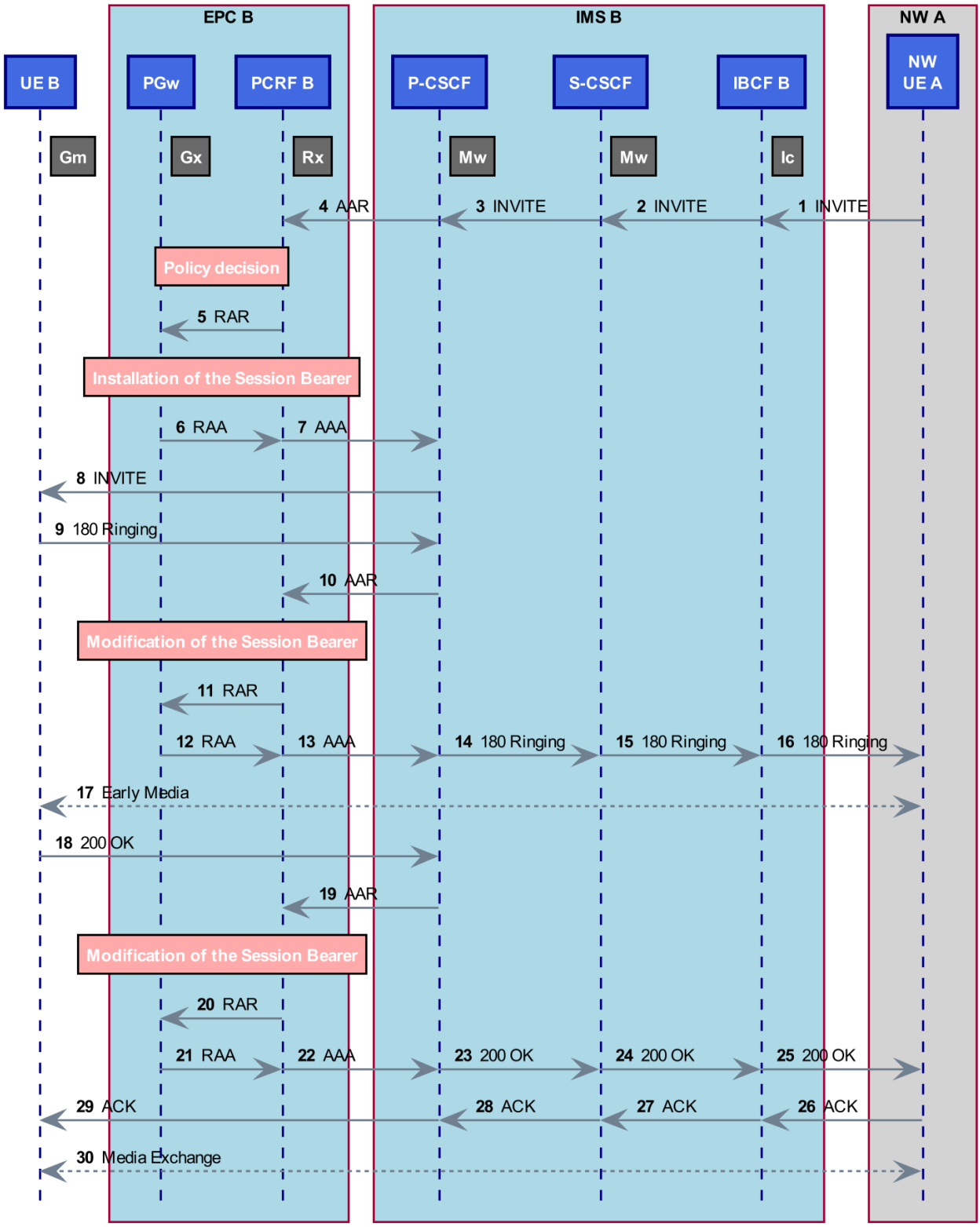
29) IBCF forwards the ACK towards UE B.

30) The dedicated bearer(s) is/are set up. Media can flow between the UEs.

5.3.1.3 Terminating Leg

Interoperability Test Description	
Identifier:	TD_VxLTE_INT_INI_02
Objective:	To demonstrate the establishment of dedicated bearers at the terminating EPC B due to SIP session establishment.
Summary:	On successful call setup, the P-CSCF should derive from the SDP offer and answer, descriptions of the Service Data Flow. These are pushed towards EPC as request for creation of adequate bearers. EPC B creates based on the EPC's operator policies the bearers for media. When transporting media, the EPC B will employ the respective bearer's characteristics. Media transport is possible only after the successful establishment of the session. Media negotiation happens during INVITE/180 (UE A sends SDP-offer, UE B responds with SDP-answer).
Configuration:	CF_VxLTE_INT
SUT:	IMS A and EPC A

Interoperability Test Description		
Interfaces:	Gm, Mw, Rx, Gx, Ic	
References:	Ic	ETSI TS 124 229 [2], clause 5.4.3.2 ¶11 (1st numbered list) and clause 5.4.3.2 ¶9 (item 9 1st numbered list) and clause 5.4.3.2 (item 10 1st numbered list) and clause 5.4.3.3 (item 2 in 3rd numbered list) and clause 5.4.3.3 (item 3 in 3rd numbered list) and clause 5.3.2.1 (paragraph after note 10) and clause 5.4.3.2 (item 1 in 7th numbered list) and clause 5.4.3.2 (item 10 in 1st numbered list) and clause 5.10.3.2
	Gm, Mw	ETSI TS 124 229 [2], clause 5.2.7.3 and clause 5.3.2.1 and clause 5.3.2.1A and clause 5.4.4.1 and clause 5.4.4.2
	Rx	ETSI TS 129 214 [6], clauses 4.4.1, A.1, A.2 and annex B
	Gx	ETSI TS 129 212 [7], clause 4.5.2
Pre-test conditions:	• UE B previously attached to EPC B. • EPC B established a Default Bearer allowing UE B - P-CSCF IP communication. • UE B previously registered to IMS B. • EPC B established an IMS B signalling bearer. • UE A ready to initiate the session establishment.	
Test Sequence:	**Step**	
	1	Verify that media between UE A and UE B is not delivered in any direction before call establishment.
	2	UE B receives a call request and establishes a communication session.
	3	Verify that, in Diameter AA-Request/Answer, the IMS B produced a Media Description for the session according to SDP-offer in SIP INVITE Request and SDP-answer in 180 (Ringing) response.
	4	Verify that IMS B requested media description was found acceptable by EPC B.
	5	Verify that media between UE A and UE B is successfully routed.
	6	Verify that media between UE A and UE B is transported with appropriate PCC characteristics.
Conformance criteria of test sequence step:	2	Gm TP_GM_PCSCF_INVITE_02 (Event 8) Gm TP_GM_PCSCF_180RINGING_02 (Event 9) Gm TP_GM_PCSCF_ACK_02 (Event 29) MwPS TP_MW_PCSCF_INVITE_02 (Event 3) MwPS TP_MW_PCSCF_180RINGING_02 (Event 14) MwPS TP_MW_PCSCF_ACK_02 (Event 28) Ic TP_IC_IBCF_INVITE_01 (INVITE - Event 1) Ic TP_IC_IBCF_INVITE_02 (INVITE - Event 1) Ic TP_IC_IBCF_INVITE_03 (INVITE, ENUM - Event 1) Ic TP_IC_IBCF_ACK_01 (ACK - Event 26) Ic TP_IC_IBCF_180RESP_01 (180 Ringing - Event 16) Ic TP_IC_IBCF_180RESP_02 (180 Ringing - Event 16) Ic TP_IC_IBCF_1XXRESP_01 (180 Ringing - Event 16) Ic TP_IC_IBCF_2XXRESP_01 (200 OK - Event 25) Ic TP_IC_IBCF_2XXRESP_02 (200 OK - Event 25) Ic TP_IC_IBCF_2XXRESP_03 (200 OK - Event 25)
	3	Rx TP_RX_PCSCF_AAR_06 (AAR - Events 4) Rx TP_RX_PCSCF_AAR_07 (AAR - Events 10) Rx TP_RX_PCSCF_AAR_08 (AAR - Events 19) Rx TP_RX_PCRF_AAA_02 (AAA - Events 7, 13, 22)
	4	Gx TP_GX_PCRF_RAR_01 (RAR - Events 5, 11, 20)
	5	Gx TP_GX_PGW_RAA_02 (RAA - Events 6, 12, 21)
	6	Rtp TP_RTP_ 03 (Event 30)



NOTE 1: In the above figure, the Gx interaction may take place after completion of the Rx interaction.
NOTE 2: For brevity, 100rel is not used in the above figure. However, 100rel is valid and may be used. If 100rel is not used, then the SDP answer in the 200 OK (INVITE) shall be identical to that in the 180 (Ringing) provisional response.

Figure 10: SIP Session Establishment - Terminating Leg

1) UE A initiates the SIP session with an INVITE containing the SDP offer.

2) IBCF forwards the INVITE to S-CSCF.

3) S-CSCF forwards the INVITE to P-CSCF.
4) The IMS B P-CSCF invokes the PCRF.
5) PCRF sends RAR to EPC B P-GW.
6) EPC B P-GW responds with RAA.
7) PCRF responds to IMS B P-CSCF with AAA.
8) P-CSCF forwards the INVITE to UE B.
9) The UE B responds with the 180 (Ringing) with SDP answer.
10) The IMS B P-CSCF invokes the PCRF to modify the bearer.
11) PCRF sends RAR to EPC B P-GW.
12) EPC B P-GW responds with RAA.
13) PCRF responds to IMS B P-CSCF with AAA.
14) P-CSCF forwards the SIP 180 (SDP) to S-CSCF.
15) S-CSCF forwards the SIP 180 (SDP) to IBCF.
16) IBCF forwards the SIP 180 (SDP) towards UE A.
17) Early media may flow between the UEs.
18) The UE B responds with the 200 OK.
19) The IMS B P-CSCF invokes the PCRF to modify the bearer.
20) PCRF sends RAR to EPC B P-GW.
21) EPC B P-GW responds with RAA.
22) PCRF responds to IMS B P-CSCF with AAA.
23) P-CSCF forwards the SIP 200 OK to S-CSCF.
24) S-CSCF forwards the SIP 200 OK to IBCF.
25) IBCF forwards the SIP 200 OK towards UE A.
26) The UE A sends ACK to 200 OK (INVITE).
27) IBCF forwards the ACK to S-CSCF.
28) S-CSCF forwards the ACK to P-CSCF.
29) P-CSCF forwards the ACK to UE B.
30) The dedicated bearer(s) is/are set up. Media can flow between the UEs.

5.3.2 SIP Session Modification

5.3.2.0 General

There are multiple reasons for session modifications, like for example placing an active call on hold or adding/removing video to/from an audio call.

These tests build on previous ones and assume that the UE A/B have been previously attached to EPC, registered to IMS with a session successfully established, and media is flowing.

These tests will verify that:

1) The P-CSCF will act on successful call session modification as signalled in SIP signalling and trigger modification of call bearer via the PCRF and EPC.

2) The EPC will modify the call's media bearers accordingly.

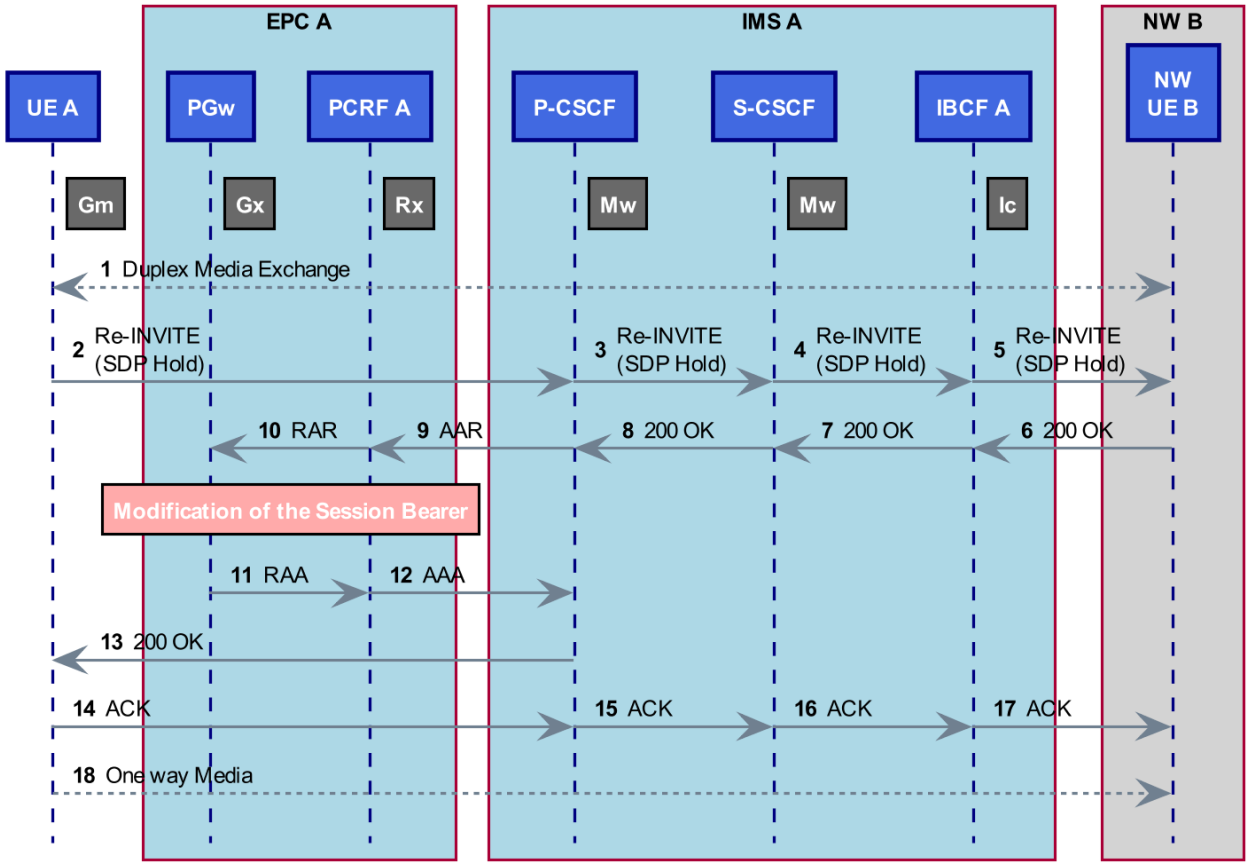
3) Media flows are impacted accordingly (e.g. new flow added, existing flow stopped, etc.).

5.3.2.1 Originating Leg

The test descriptions included here use the MMTEL Call-Hold/Call Resume features to illustrate the modification of a media flow(s) in an existing active session.

Interoperability Test Description		
Identifier:	TD_VxLTE_INT_INI_03	
Objective:	To demonstrate the modification of an existing media flow mid-session.	
Summary:	On successful call hold, the P-CSCF should derive from the SDP offer and answer, updates for the Service Data Flows. These are pushed towards PCRF/EPC as request for modification of the previously created bearers. EPC modifies, based on the EPC's operator policies, the bearers for media. When transporting media, the EPC will employ the respective bearer's characteristics. Media transport is possible, after the successful modification of the session, modified according to the new offer/answer exchange.	
Configuration:	CF_VxLTE_INT	
SUT:	IMS A and EPC A	
Interfaces:	Gm, Mw, Rx, Gx, Ic	
References:	Ic	ETSI TS 124 229 [2], clause 5.4.3.2 (6th numbered list) and clause 5.4.3.3 (9th numbered list)
	Gm, Mw	ETSI TS 124 229 [2], clause 5.1.4A and clause 5.2.7.2 and clause 5.7.1.24 and clause 6.1.4.2 and clause 6.1.4.3
	Rx	ETSI TS 129 214 [6], clauses 4.4.2, A.1, A.2 and annex B
	Gx	ETSI TS 129 212 [7], clause 4.5.2
Pre-test conditions:	• UE A and UE B previously attached to EPC A. • EPC A established a Default Bearer allowing UE A to P-CSCF IP communication and UE-B to P-CSCF communication. • UE A and UE B previously registered to IMS. • UE A previously established a call with UE B, encompassing either audio only or both audio and video media.	
Test Sequence:	**Step**	
	1	Verify that media between UE A and UE B is delivered in both directions and for audio or audio/video after call establishment.
	2	UE A initiates Call-Hold operation for all media types and removes audio or audio/video media from the communication session.
	3	Verify that, in Diameter AA-Request generated by IMS P-CSCF contains a Media Description for session modification according to the new SDP-offer in SIP INVITE Request and resultant SDP-answer in SIP 200 INVITE response.
	4	Verify that IMS requested media description update was found acceptable by EPC.
	5	Verify that one way media between UE A and UE B is still successfully exchanged.
	6	Verify that media between UE B and UE A can no longer be exchanged and is filtered out by EPC.

Interoperability Test Description			
Conformance criteria of test sequence step:	1	Rtp	TP_RTP_03 (Event 1)
	2	Gm	TP_GM_PCSCF_RE_INVITE_01 (Event 2)
		MwPS	TP_MW_PCSCF_RE_INVITE_01 (Event 3)
		MwSI	TP_MW_SCSCF_RE_INVITE_01 (Event 4)
		MwPS	TP_MW_PCSCF_200OK_02 (Event 8)
		MwPS	TP_MW_PCSCF_ACK_02 (Event 15)
		Ic	TP_IC_IBCF_REINVITE_01 (INVITE - Event 5)
		Ic	TP_IC_IBCF_2XXRESP_04 (200 OK - Event 6)
	3	Rx	TP_RX_PCSCF_AAR_09 (AAR - Event 9)
		Rx	TP_RX_PCRF_AAA_02 (AAA - Event 12)
	4	Gx	TP_GX_PCRF_RAR_01 (RAR - Event 10)
	5	Gx	TP_GX_PGW_RAA_02 (RAA - Event 11)
	6	Rtp	TP_RTP_02 (Event 18)



NOTE 1: A SIP UPDATE message may also be used instead of re-INVITE to initiate a new offer/answer exchange.
NOTE 2: The Rx exchange need not wait for the Gx exchange to complete.

Figure 11: SIP Session Modification - Originating Leg

1) Media exchange between UE A and UE B.

2) UE A initiates the SIP session with a Re-INVITE containing the new SDP offer. In this case, the SDP will differ in a media attribute line(s) set to "sendonly" indicating the existing media stream(s) are being placed on hold.

3) P-CSCF forwards the Re-INVITE to S-CSCF.

4) S-CSCF forwards the Re-INVITE to IBCF.

5) IBCF forwards the Re-INVITE towards UE B.

6) The UE B responds with the SIP 200 OK (SDP).

7) IBCF forwards the SIP 200 OK (SDP) to S-CSCF.

8) S-CSCF forwards the SIP 200 OK (SDP) to P-CSCF.

9) The IMS A P-CSCF invokes the PCRF to complete the bearer set up with AAR.

10) PCRF sends RAR to EPC A P-GW.

11) EPC A P-GW responds with RAA.

12) PCRF responds to IMS A P-CSCF with AAA.

13) P-CSCF forwards the SIP 200 OK (SDP) to UE A.

14) The UE A sends ACK to 200 OK (Re-INVITE).

15) P-CSCF forwards the ACK to S-CSCF.

16) S-CSCF forwards the ACK to IBCF.

17) IBCF forwards the ACK towards UE B.

18) The dedicated bearer(s) is/are modified Media can flow only one way from UE-A to UE-B.

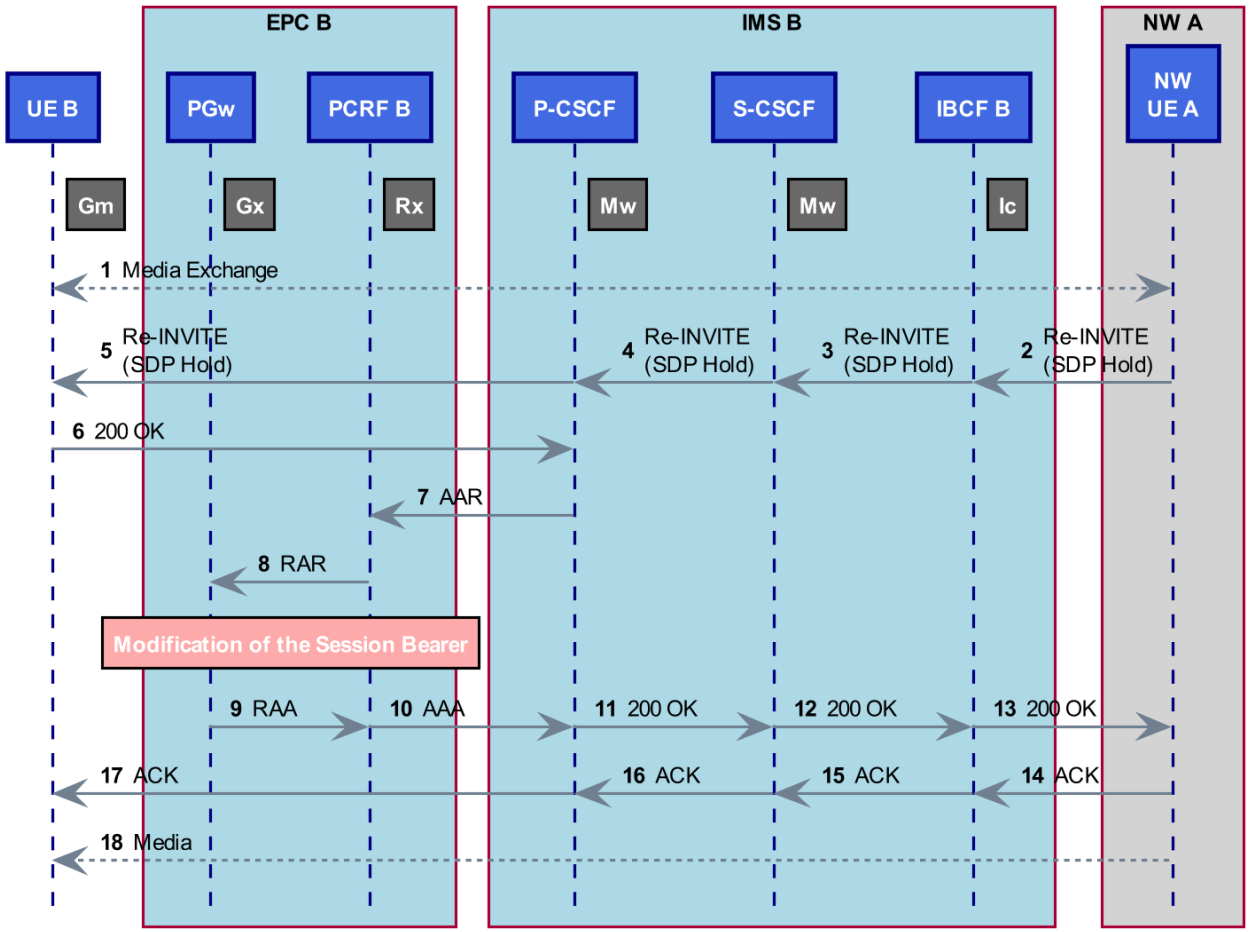
Note that a subsequent Call Resume has an identical message flow (with the SDP media attribute being set to "sendrecv") and the resulting Flow-Status AVP being set to ENABLED (2) to return to a duplex media connection.

5.3.2.2 Terminating Leg

The test descriptions included here use the MMTEL Call-Hold/Call Resume features to illustrate the modification of a media flow(s) in an existing active session.

Interoperability Test Description		
Identifier:	TD_VxLTE_INT_INI_04	
Objective:	To demonstrate the modification of an existing media flow mid-session.	
Summary:	On successful call hold, the P-CSCF should derive from the SDP offer and answer, updates for the Service Data Flows. These are pushed towards PCFRF/EPC as request for modification of the previously created bearer(s). EPC modifies, based on the EPC's operator policies, the bearers for media. When transporting media, the EPC will employ the respective bearer's characteristics. Media transport is possible, after the successful modification of the session, modified according to the new offer/answer exchange.	
Configuration:	CF_VxLTE_INT	
SUT:	IMS A and EPC A	
Interfaces:	Gm, Mw, Rx, Gx, Ic	
References:	Ic	ETSI TS 124 229 [2], clause 5.4.3.2 (6th numbered list) clause 5.4.3.3 (9th numbered list)
	Gm, Mw	ETSI TS 124 229 [2], clause 5.1.4A and clause 5.2.7.2 and clause 5.7.1.24 and clause 6.1.4.2 and clause 6.1.4.3
	Rx	ETSI TS 129 214 [6], clauses 4.4.2, A.1, A.2 and annex B
	Gx	ETSI TS 129 212 [7], clause 4.5.2
Pre-test conditions:	• UE B previously attached to EPC B. • EPC provisioned a Default Bearer allowing UE B - P-CSCF IP communication. • UE B previously registered to IMS. • EPC provisioned an IMS signalling bearer. • UE A or another endpoint ready to accept the session establishment. • UE B previously established a call with UE A, encompassing both audio and video media.	

Interoperability Test Description			
Test Sequence:	**Step**		
	1	Verify that media between UE A and UE B is delivered in both directions and for both media stream types after call establishment.	
	2	UE A initiates a Call-Hold operation and removes audio media from the communication session.	
	3	Verify that, in Diameter AA-Request generated by IMS P-CSCF contains a Media Description for session modification according to the new SDP-offer in SIP INVITE Request and resultant SDP-answer in SIP 200 INVITE response.	
	4	Verify that IMS requested media description update was found acceptable by EPC.	
	5	Verify that one way media between UE A and UE B is still successfully exchanged.	
	6	Verify that media between UE B and UE A can no longer be exchanged and is filtered out by EPC.	
Conformance criteria of test sequence step:	1	Rtp	TP_RTP_03 (Event 1)
	2	Gm	TP_GM_PCSCF_RE_INVITE_02 (Event 3)
		MwPS	TP_MW_PCSCF_RE_INVITE_02 (Event 4)
		MwSI	TP_MW_SCSCF_RE_INVITE_03 (Event 5)
		Ic	TP_IC_IBCF_REINVITE_01 (INVITE - Event 2)
		Ic	TP_IC_IBCF_2XXRESP_04 (200 OK - Event 13)
	3	Rx	TP_RX_PCSCF_AAR_10 (AAR - Event 7)
		Rx	TP_RX_PCRF_AAA_02 (AAA - Event 10)
	4	Gx	TP_GX_PCRF_RAR_01 (RAR - Event 8)
	5	Gx	TP_GX_PGW_RAA_02 (RAA - Event 9)
	6	Rtp	TP_RTP_02 (Event 18)



NOTE 1: A SIP UPDATE message may also be used instead of Re-INVITE to initiate a new offer/answer exchange.
NOTE 2: The Rx exchange need not wait for the Gx exchange to complete.

Figure 12: SIP Session Modification - Terminating Leg

1) Media exchange between UE A and UE B.

2) UE A initiates the SIP session with a Re-I NVITE containing the new SDP offer. In this case, the SDP will differ in a media attribute line(s) set to "sendonly" indicating the existing media stream(s) are being placed on hold.

3) IBCF forwards the Re-INVITE to S-CSCF.

4) S-CSCF forwards the Re-INVITE to P-CSCF.

5) P-CSCF forwards the Re-INVITE to UE B.

6) The UE B responds with the 200 OK.

7) The IMS B P-CSCF invokes the PCRF to modify the bearer.

8) PCRF sends RAR to EPC B P-GW.

9) EPC B P-GW responds with RAA.

10) PCRF responds to IMS B P-CSCF with AAA.

11) P-CSCF forwards the SIP 200 OK to S-CSCF.

12) S-CSCF forwards the SIP 200 OK to IBCF.

13) IBCF forwards the SIP 200 OK towards UE A.

14) The UE A sends ACK to 200 OK (Re-INVITE).

15) IBCF forwards the ACK to S-CSCF.

16) S-CSCF forwards the ACK to P-CSCF.

17) P-CSCF forwards the ACK to UE B.

18) The dedicated bearer(s) is/are modified Media can flow only one way from UE-A to UE-B.

Note that a subsequent Call Resume has an identical message flow (with the SDP media attribute being set to "sendrecv") and the resulting Flow-Status AVP being set to ENABLED (2) to return to a duplex media connection.

5.3.3 SIP Session Release

5.3.3.0 General

These tests show the removal of the session bearers during the normal release procedures of an already established session.

The test assumes that the UE A/B has been previously attached to EPC and registered to IMS. A call is assumed to have been successfully established.

The test procedure will follow the Call Release procedures, terminating any bearers that have been previously created as part of the call.

These tests will verify that:

1) The P-CSCF will act on call release and trigger release of call bearers.

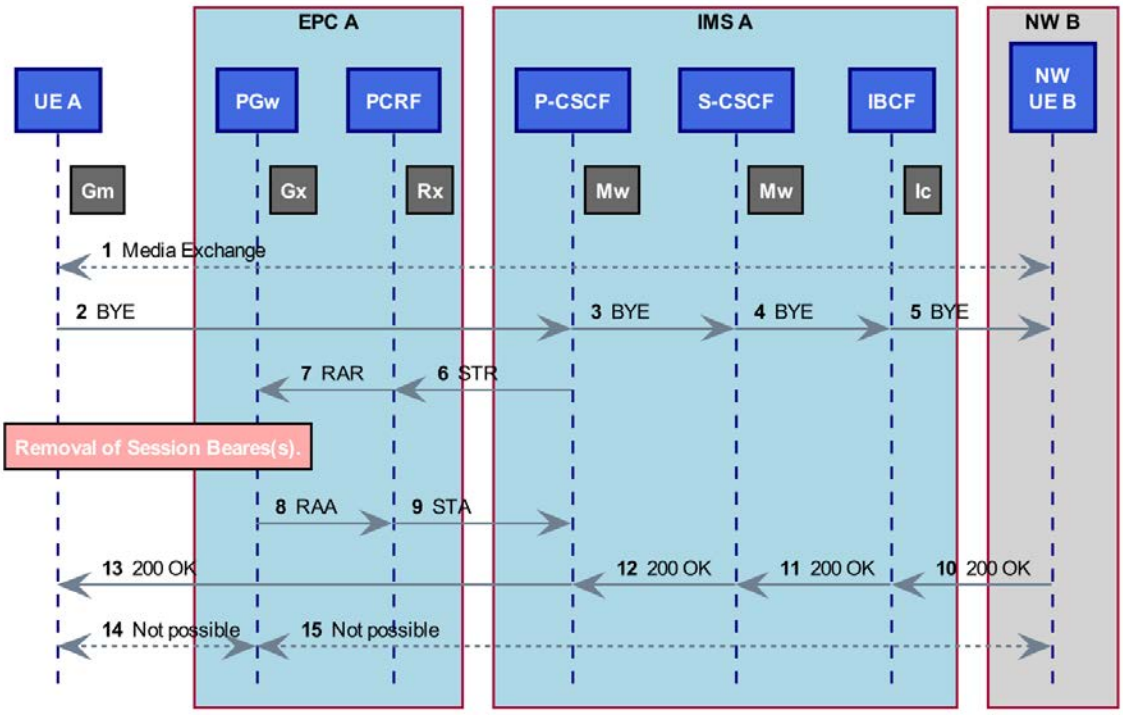
2) The PCRF/EPC will remove the call's media bearers accordingly.

3) Media will not be transported after the session termination. Tests will continue transmitting media after the session release and verify that the default EPC gating policy of "Deny" will stop all media.

5.3.3.1 Originating UE Initiated Session Release

Interoperability Test Description		
Identifier:	TD_VxLTE_INT_REL_01	
Objective:	To perform originating UE session release and the tear down of related dedicated bearers.	
Summary:	On call release, the P-CSCF A should trigger the removal of all relevant previously created bearers. EPC A removes the bearers for media. Media transport is no longer possible, after the session release.	
Configuration:	CF_VxLTE_INT	
SUT:	IMS A and EPC A	
Interfaces:	Gm, Mw, Gx, Rx, Ic	
References:	Gm, Mw	ETSI TS 124 229 [2], clause 5.1.5 (1st paragraph) and clause 5.2.8.2 clause 5.4.5.2 clause 6.2 clause 6.3
	Ic	ETSI TS 124 229 [2], clause 5.4.3.2 (item 1 in 7th numbered list)
	Gx	ETSI TS 129 212 [7], clause 4.5.2
	Rx	ETSI TS 129 214 [6], clause 4.4.4

Interoperability Test Description			
Pre-test conditions:	• UE A and UE B previously attached to EPC A. • EPC A established a Default Bearer allowing UE A to P-CSCF IP communication and UE B to P-CSCF IP communication. • UE A & UE B previously registered to IMS and IMS signalling bearers provisioned. • UE A previously established a call with UE B.		
Test Sequence:	**Step**		
	1	Verify that media between UE A and UE B is delivered in both directions and for all negotiated media stream types after the call establishment.	
	2	UE A initiates a Call-Release operation, ending the session.	
	3	Verify that P-CSCF terminates the Rx session, triggering removal of all session related bearers.	
	4	Verify that EPC A removes all session related bearers.	
	5	Verify that media between UE A and UE B can no longer be exchanged and is filtered out by EPC A.	
Conformance criteria of test sequence step:	1	Rtp	TP_RTP_03 (Event 1)
	2	Gm MwPS Ic	TP_GM_PCSCF_BYE_01 (Event 2) TP_MW_PCSCF_BYE_01 (Event 3) TP_IC_IBCF_BYE_01 (Event 5)
	3	Gm MwPS Rx Gx	TP_GM_PCSCF_200OK_BYE_01 (Event 13) TP_MW_PCSCF_200OK_BYE_01 (Event 12) TP_RX_PCSCF_STR_01 (STR - Event 6) TP_GX_PCRF_RAR_02 (RAR - Event 7)
	4	Gx Rx	TP_GX_PGW_RAA_03 (RAA - Event 8) TP_RX_PCRF_STA_01 (STA - Event 9)
	5	Rtp	TP_RTP_01 (Events 14, 15)



NOTE: In the above figure, the Gx interaction may take place after completion of the Rx interaction.

Figure 13: SIP Session Tear-down - Originating UE Initiated Session Release

1) UE A established a call with UE B.

2) UE A initiates the SIP session release with a BYE.

3) P-CSCF forwards the BYE to S-CSCF.

4) S-CSCF forwards the BYE to IBCF.

5) IBCF forwards the BYE towards UE B.

6) P-CSCF sends a ST-Request to the PCRF (Session-Termination request).

7) PCRF sends a RA-Request to the PGw (Re-Auth request).

8) P-GW responds P-CSCF.

9) PCRF responds to P-CSCF.

10) UE B sends 200 OK (BYE) towards IBCF.

11) IBCF forwards the 200 OK (BYE) to S-CSCF.

12) S-CSCF forwards the 200 OK (BYE) to P-CSCF.

13) P-CSCF forwards the 200 OK (BYE) towards UE A.

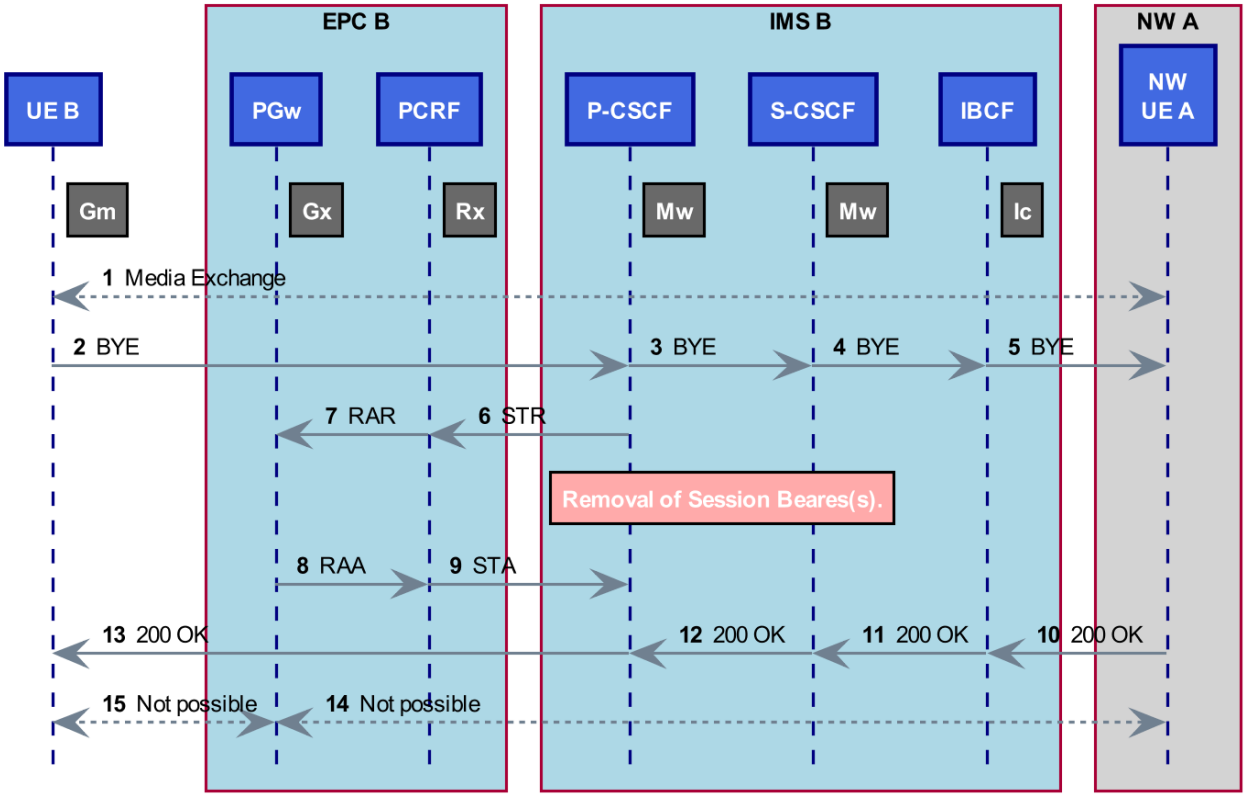
14) The dedicated bearer(s) is/are down.

15) No media can flow between the UEs.

5.3.3.2 Terminating UE Initiated Session Release

Interoperability Test Description		
Identifier:	TD_VxLTE_INT_REL_02	
Objective:	To perform terminating UE session release and the tear down of related dedicated bearers.	
Summary:	On call release, the P-CSCF B should trigger the removal of all relevant previously created bearers. EPC B removes the bearers for media. Media transport is no longer possible, after the session release.	
Configuration:	CF_VxLTE_INT	
SUT:	IMS B and EPC B	
Interfaces:	Gm, Mw, Gx, Rx, Ic	
References:	Gm, Mw	ETSI TS 124 229 [2], clause 5.1.5 (1st paragraph) and clause 5.2.8.2 clause 5.4.5.2 clause 6.2 clause 6.3
	Ic	ETSI TS 124 229 [2], clause 5.4.3.2 (item 1 in 7th numbered list)
	Gx	ETSI TS 129 212 [7], clause 4.5.2
	Rx	ETSI TS 129 214 [6], clause 4.4.4
Pre-test conditions:	• UE A and UE B previously attached to EPC B. • EPC B established a Default Bearer allowing UE A to P-CSCF B IP communication and UE B to P-CSCF B IP communication. • UE A & UE B previously registered to IMS and IMS signalling bearers provisioned. • UE A previously established a call with UE B.	
Test Sequence:	**Step**	
	1	Verify that media between UE A and UE B is delivered in both directions and for negotiated media stream types after call establishment.
	2	UE B initiates a Call-Release (BYE) operation to UE A, ending the session.
	3	Verify that P-CSCF terminates the Rx session, triggering the removal of all session related bearers.
	4	Verify that EPC B removes all session related bearers.
	5	Verify that media between UE A and UE B can no longer be exchanged and is filtered out by EPC B.

Interoperability Test Description			
Conformance criteria of test sequence step:	1	Rtp	TP_RTP_03 (Event 1)
	2	Gm MwPS Ic	TP_GM_PCSCF_BYE_02 (Event 2) TP_MW_PCSCF_BYE_02 (Event 3) TP_IC_IBCF_BYE_01 (BYE - Event 5)
	3	Gm MwPS Rx Gx	TP_GM_PCSCF_200OK_BYE_02 (Event 13) TP_MW_PCSCF_200OK_BYE_02 (Event 12) TP_RX_PCSCF_STR_01 (STR - Event 6) TP_GX_PCRF_RAR_02 (RAR - Event 7)
	4	Gx Rx	TP_GX_PGW_RAA_03 (RAA - Event 8) TP_RX_PCRF_STA_01 (STA - Event 9)
	5	Rtp	TP_RTP_01 (Events 14, 15)



NOTE: The Rx exchange need not wait for the Gx exchange to complete.

Figure 14: SIP Session Tear-down - Terminating UE Initiated Session Release

1) UE B established a call with UE A.
2) UE B initiates the SIP session release with a BYE.
3) P-CSCF forwards the BYE to S-CSCF
4) S-CSCF forwards the BYE to IBCF.
5) IBCF forwards the BYE towards UE A.
6) P-CSCF sends a ST-Request to the PCRF (Session-Termination request).
7) PCRF sends a RA-Request to the PGw (Re-Auth request).
8) P-GW responds with RAA.
9) PCRF responds to P-CSCF with STA.

10) UE A sends 200 OK (BYE).

11) IBCF forwards 200 OK (BYE) to S-CSCF.

12) S-CSCF forwards 200 OK (BYE) to P-CSCF.

13) P-CSCF forwards 200 OK (BYE) towards UE B.

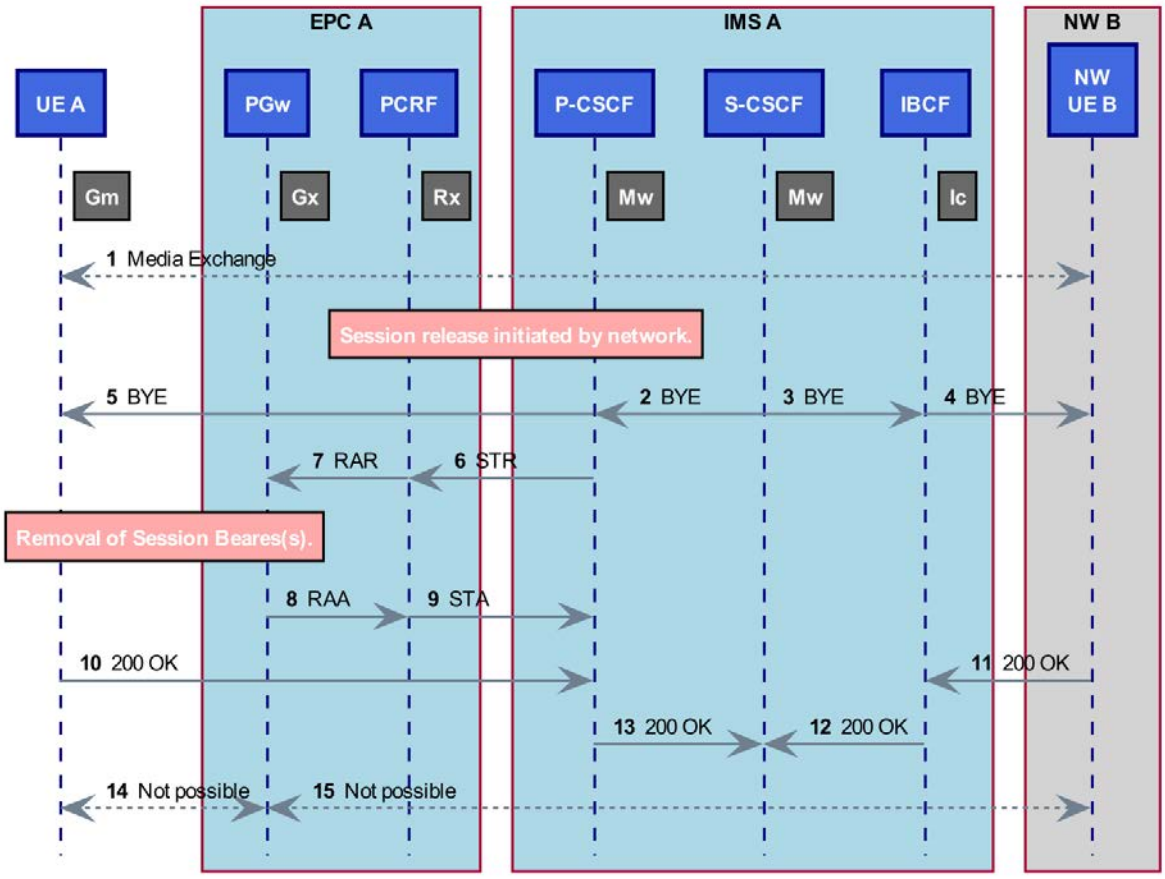
14) The dedicated bearer(s) is/are down.

15) No media can flow between the UEs.

5.3.3.3 Originating Network Initiated Session Release

Interoperability Test Description		
Identifier:	TD_VxLTE_INT_REL_03	
Objective:	To perform network session release and the tear down of related dedicated bearers.	
Summary:	The S-CSCF A should trigger the Call-Release operation and remove all relevant previously created bearers. EPC A removes the bearers for media. Media transport is no longer possible, after the session release.	
Configuration:	CF_VxLTE_INT	
SUT:	IMS A and EPC A	
Interfaces:	Gm, Mw, Gx, Rx, Ic	
References:	Gm, Mw	ETSI TS 124 229 [2], clause 5.1.5 (1st paragraph) and clause 5.2.8.1.2 clause 5.4.5.2 clause 6.2 clause 6.3
	Ic	ETSI TS 124 229 [2], clause 5.4.3.2 (item 1 in 7th numbered list)
	Gx	ETSI TS 129 212 [7], clause 4.5.2
	Rx	ETSI TS 129 214 [6], clause 4.4.4
Pre-test conditions:	• UE A and UE B previously attached to EPC A. • EPC A established a Default Bearer allowing UE A to P-CSCF IP communication and UE B to P-CSCF IP communication. • UE A & UE B previously registered to IMS and IMS signalling bearers provisioned. UE A registered only for limited time. • UE A previously established a call with UE B.	
Test Sequence:	**Step**	
	1	Verify that media between UE A and UE B is delivered in both directions and for all negotiated media stream types after the call establishment.
	2	IMS A initiates a Call-Release operation, ending the session due to registration expiration.
	3	Verify that P-CSCF terminates the Rx session, triggering removal of all session related bearers.
	4	Verify that EPC A removes all session related bearers.
	5	Verify that media between UE A and UE B can no longer be exchanged and is filtered out by EPC A.
Conformance criteria of test sequence step:	1	Rtp TP_RTP_03 (Event 1)
	2	MwPS TP_MW_PCSCF_BYE_03 (Event 2) MwSI TP_MW_SCSCF_BYE_03 (Event 3) MwIS TP_MW_SCSCF_BYE_01 (Event 3)
	3	Gm TP_GM_PCSCF_BYE_03 (Event 5) Gm TP_GM_PCSCF_200OK_BYE_03 (Event 10) MwPS TP_MW_PCSCF_200OK_BYE_03 (Event 13) MwSI TP_MW_SCSCF_200OK_BYE_01 (Event 13) Ic TP_IC_IBCF_BYE_01 (BYE - Event 4) Rx TP_RX_PCSCF_STR_01 (STR - Event 6) Gx TP_GX_PCRF_RAR_02 (RAR - Event 7)
	4	Gx TP_GX_PGW_RAA_03 (RAA - Event 8) Rx TP_RX_PCRF_STA_01 (STA - Event 9)

Interoperability Test Description		
	5	Rtp TP_RTP_01 (Events 14, 15)



NOTE: In the above figure, the Gx interaction may take place after completion of the Rx interaction.

Figure 15: SIP Session Tear-down - Originating Network Initiated Session Release

1) UE A established a call with UE B.
2) IMS A initiates the SIP session release with a BYE to UE A.
3) IMS A initiates the SIP session release with a BYE to UE B.
4) IBCF forwards the BYE to UE B.
5) P-CSCF forwards the BYE to UE A.
6) P-CSCF sends a ST-Request to the PCRF (Session-Termination request).
7) PCRF sends a RA-Request to the PGw (Re-Auth request).
8) P-GW responds P-CSCF.
9) PCRF responds to P-CSCF.
10) UE A sends 200 OK (BYE).
11) UE B sends 200 OK (BYE).
12) IBCF forwards the 200 OK (BYE) to S-CSCF.
13) P-CSCF forwards the 200 OK (BYE) to S-CSCF.
14) The dedicated bearer(s) is/are down.

15) No media can flow between the UEs.

5.3.4 SIP Session Abort/Reject

5.3.4.0 General

These test cases cover unsuccessful session setup. Either the call is aborted in the originating side or rejected in the terminating side.

The test assumes that the UE A/B has been previously attached to EPC and registered to IMS.

For session abort, it is assumed that a call is established to the ringing phase prior to the originating UE initiating session release. Early media is possible in the backward direction prior to session abort.

For session reject, the INVITE is delivered to the terminating UE but is rejected (e.g. busy).

In both cases, dedicated media bearers are established prior to being torn down after session abort/reject.

5.3.4.1 SIP Session Abort - Originating Leg

Interoperability Test Description		
Identifier:	TD_VxLTE_INT_ABT_01	
Objective:	To perform SIP session abort (originating side) and the related interactions with PCRF A and EPC A.	
Summary:	On session abort, the P-CSCF A should trigger the removal of all relevant previously created early media bearers. EPC A removes the bearers for early media. Media transport is no longer possible, after the session abort.	
Configuration:	CF_VxLTE_INT	
SUT:	IMS A and EPC A	
Interfaces:	Gm, Mw, Gx, Rx, Ic	
References:	Gm, Mw	ETSI TS 124 229 [2], clause 5.1.5 (2nd paragraph) and clause 5.1.3 and clause 6.2 and clause 5.2.8.1.1 and clause 9.2
	Ic	ETSI TS 124 229 [2], clause 5.4.3.2 (item 10 1st numbered list) and clause 5.4.3.2 ¶11 (1st numbered list) and clause 5.10.3.2 and clause 5.4.3.2 ¶9 (item 9 1st numbered list) and clause 5.4.3.3 (item 2 in 3rd numbered list) and clause 5.4.3.3 (item 3 in 3rd numbered list) and clause 5.4.3.2 and clause 5.2.8.1.1 and clause 5.3.2.2 IETF RFC 3261 [12], clause 9.2
	Gx	ETSI TS 129 212 [7], clause 4.5.2
	Rx	ETSI TS 129 214 [6], clause 4.4.4
Pre-test conditions:	• UE A and UE B previously attached to EPC A. • EPC A established a Default Bearer allowing UE A to P-CSCF IP communication and UE B to P-CSCF IP communication. • UE A & UE B previously registered to IMS and IMS signalling bearers provisioned.	

Interoperability Test Description			
Test Sequence:	**Step**		
	1	Verify that media between UE A and UE B is not delivered in any direction.	
	2	UE A initiates a session establishment operation.	
	3	UE B answers with SIP 180 Ringing INVITE Response and starts sending early media	
	4	Verify that early media is delivered from UE B to UE A.	
	5	UE A cancels the session establishment.	
	6	Verify that P-CSCF A terminates the Rx session, triggering removal of all early media related bearers.	
	7	Verify that EPC A removes all early media related bearers.	
	8	Verify that media between UE A and UE B can no longer be exchanged and is filtered out by EPC A.	
Conformance criteria of test sequence step:	1	Rtp	TP_RTP_01 (Event 1)
	2	Gm	TP_GM_PCSCF_INVITE_01 (Event 3)
		MwPS	TP_MW_PCSCF_INVITE_01 (Event 8)
		MwSI	TP_MW_SCSCF_INVITE_01 (Event 9
		Ic	TP_IC_IBCF_INVITE_03 (INVITE, ENUM - Event 8)
		Ic	TP_IC_IBCF_INVITE_01 (INVITE - Event 10)
		Ic	TP_IC_IBCF_INVITE_02 (INVITE - Event 10)
		Rx	TP_RX_PCSCF_AAR_03 (AAR - Event 4)
		Rx	TP_RX_PCRF_AAA_02 (AAA - Event 7)
		Gx	TP_GX_PCRF_RAR_01 (RAR - Event 5)
		Gx	TP_GX_PGW_RAA_02 (RAA - Event 6)
	3	Ic	TP_IC_IBCF_180RESP_01 (180 Ringing - Event 11)
		Ic	TP_IC_IBCF_1XXRESP_01 (180 Ringing - Event 11)
		Rx	TP_RX_PCSCF_AAR_04 (AAR - Event 14)
		Rx	TP_RX_PCRF_AAA_02 (AAA - Event 17)
		Gx	TP_GX_PCRF_RAR_01 (RAR - Event 15)
		Gx	TP_GX_PGW_RAA_02 (RAA - Event 16)
	4	Rtp	TP_RTP_02 (Event 19)
	5	Gm	TP_GM_PCSCF_CANCEL_01 (Event 20)
		MwPS	TP_MW_PCSCF_CANCEL_01 (Event 23)
		MwSI	TP_MW_SCSCF_CANCEL_01 (Event 24)
		Ic	TP_IC_IBCF_CANCEL_01 (CANCEL - Event 25)
	6	Rx	TP_RX_PCSCF_STR_03 (STR - Event 21)
		Gx	TP_GX_PCRF_RAR_02 (RAR - Event 22)
	7	Gx	TP_GX_PGW_RAA_03 (RAA - Event 26)
		Rx	TP_RX_PCRF_STA_01 (STA - Event 27)
		Ic	TP_IC_IBCF_CANCEL_OK_01 (OK - Event 28)
		Ic	TP_IC_IBCF_487INVITE_01 (487 INVITE - Event 32)
		Ic	TP_IC_IBCF_487INVITE_ACK_01 (ACK - Event 37)
		Gm	TP_GM_PCSCF_200OK_CANCEL_01 (Event 31)
		MwPS	TP_MW_PCSCF_200OK_CANCEL_01 (Event 30)
		Gm	TP_GM_PCSCF_487INVITE_01 (Event 35)
		MwPS	TP_MW_PCSCF_487INVITE_01 (Event 34)
	8	Rtp	TP_RTP_01 (Events 41,42)

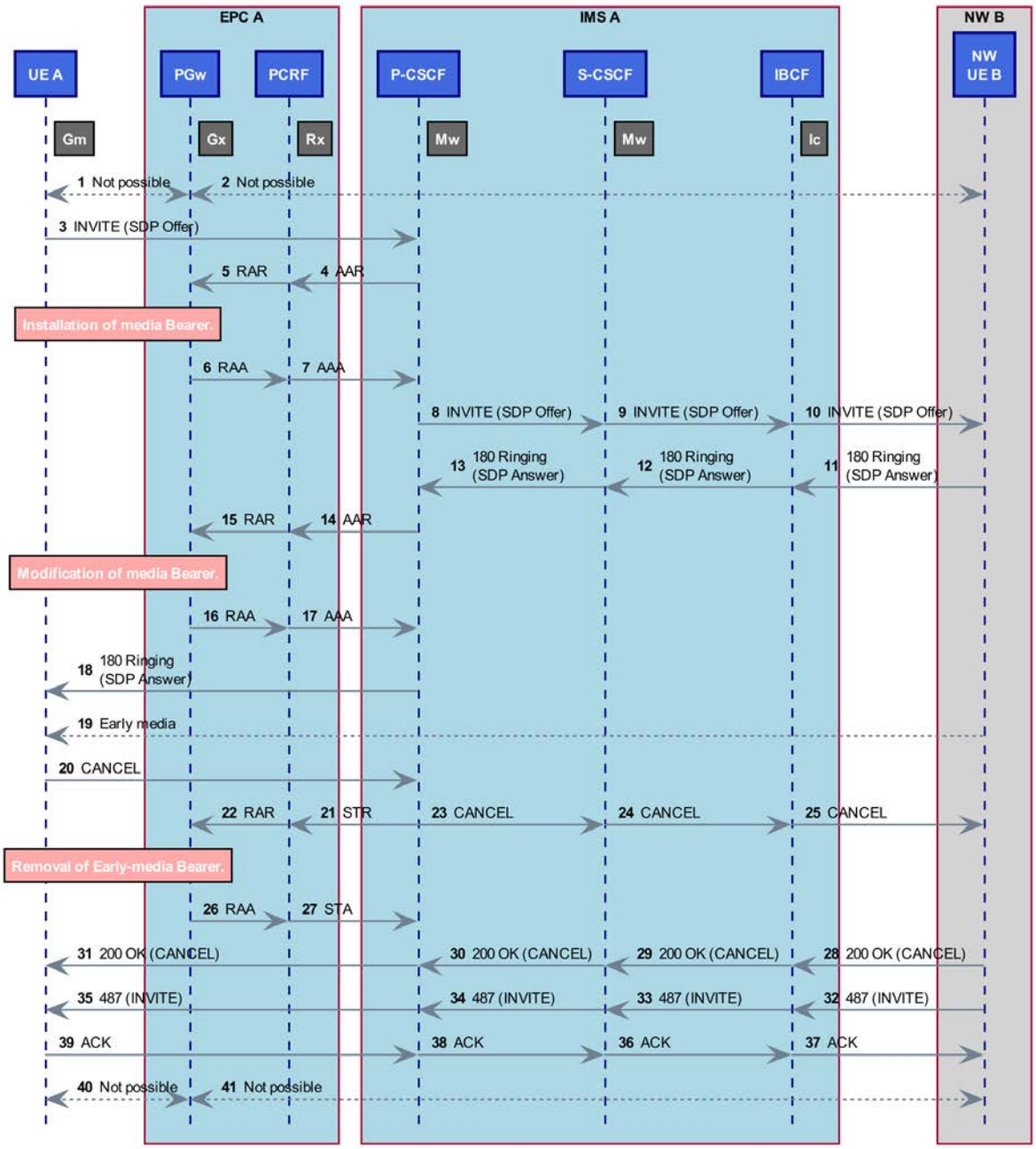


Figure 16: SIP Session Abort - Originating Leg

1) The dedicated bearer(s) is/are down.
2) No media can flow between the UEs.
3) UE A initiates the SIP session with an INVITE containing the SDP offer.
4) The IMS A P-CSCF invokes the PCRF.
5) PCRF sends RAR to EPC A P-GW.
6) EPC A P-GW responds with RAA.
7) PCRF responds to IMS A P-CSCF with AAA.
8) P-CSCF sends the INVITE to S-CSCF.
9) S-CSCF sends the INVITE to IBCF.

10) IBCF forwards the INVITE to UE B
11) UE B responds with the 180 (Ringing) with SDP answer.
12) IBCF sends the 180 (Ringing) to S-CSCF.
13) S-CSCF sends the 180 (Ringing) to P-CSCF.
14) The IMS A P-CSCF invokes the PCRF to modify the bearer.
15) PCRF sends RAR to EPC A P-GW.
16) EPC A P-GW responds with RAA.
17) PCRF responds to IMS A P-CSCF with AAA.
18) P-CSCF forwards the SIP 180 (SDP) to S-CSCF.
19) Early media may flow between the UEs.
20) The UE A responds with the CANCEL.
21) P-CSCF sends a ST-Request to the PCRF (Session-Termination request).
22) PCRF sends a RA-Request to the PGw (Re-Auth request).
23) P-GW responds. P-CSCF.
24) PCRF responds to P-CSCF.
25) P-CSCF sends CANCEL to S-CSCF.
26) S-CSCF sends CANCEL to IBCF.
27) IBCF forwards the CANCEL to UE B.
28) UE B responds with 200 OK (CANCEL).
29) IBCF sends 200 OK (CANCEL) to S-CSCF.
30) S-CSCF sends 200 OK (CANCEL) to P-CSCF.
31) P-CSCF forwards 200 OK (CANCEL) to UE A.
32) UE B initiates request termination.
33) IBCF sends 487 (INVITE) to S-CSCF.
34) S-CSCF sends 487 (INVITE) to P-CSCF.
35) P-CSCF forwards 487 (INVITE) to UE A.
36) S-CSCF initiates ACK to IBCF.
37) IBCF forwards ACK to UE B.
38) P-CSCF sends ACK to S-CSCF.
39) UE A sends ACK to IMS A P-CSCF.
40) The dedicated bearer(s) is/are down.
41) No media can flow between the UEs.

5.3.4.2 SIP Session Abort - Terminating Leg

Interoperability Test Description		
Identifier:	TD_VxLTE_INT_ABT_02	
Objective:	To perform SIP session abort (originating side) and the related interactions with PCRF and EPC.	
Summary:	On session abort, the P-CSCF B should trigger the removal of all relevant previously created early media bearers. EPC B removes the bearers for early media. Media transport is no longer possible, after the session abort.	
Configuration:	CF_VxLTE_INT	
SUT:	IMS B and EPC B	
Interfaces:	Gm, Mw, Gx, Rx, Ic	
References:	Gm, Mw	ETSI TS 124 229 [2], clause 5.1.5 (2nd paragraph) and clause 5.1.3 and clause 6.2
	Ic	ETSI TS 124 229 [2], clause 5.4.3.2 (item 10 1st numbered list) and clause 5.4.3.2 ¶11 (1st numbered list) and clause 5.10.3.2 and clause 5.4.3.2 ¶9 (item 9 1st numbered list) and clause 5.4.3.3 (item 2 in 3rd numbered list) and clause 5.4.3.3 (item 3 in 3rd numbered list) and clause 5.3.2.1 (paragraph after note 10) and clause 5.4.3.2 and clause 5.2.8.1.1 and clause 5.3.2.2 IETF RFC 3261 [12], clause 9.2
	Gx	ETSI TS 129 212 [7], clause 4.5.2
	Rx	ETSI TS 129 214 [6], clause 4.4.4
Pre-test conditions:	• UE A and UE B previously attached to EPC B. • EPC B established a Default Bearer allowing UE A to P-CSCF B & UE B to P-CSCF B • UE A & UE B previously registered to IMS. • UE A & UE B previously registered to IMS and IMS signalling bearers provisioned.	
Test Sequence:	**Step**	
	1	Verify that media between UE A and UE B is not delivered in any direction.
	2	UE A initiates a session establishment operation.
	3	UE B answers with SIP 180 Ringing INVITE Response and starts sending early media
	4	Verify that early media is delivered from UE B to UE A.
	5	UE A cancels the session establishment.
	6	Verify that P-CSCF terminates the Rx session, triggering removal of all early media related bearers.
	7	Verify that EPC A removes all early media related bearers.
	8	Verify that media between UE A and UE B can no longer be exchanged and is filtered out by EPC.

Interoperability Test Description			
Conformance criteria of test sequence step:	1	Rtp	TP_RTP_01 (Events 1, 2)
	2	Gm	TP_GM_PCSCF_INVITE_02 (Event 10)
		MwPS	TP_MW_PCSCF_INVITE_02 (Event 5)
		MwSI	TP_MW_SCSCF_INVITE_02 (Event 4)
		Ic	TP_IC_IBCF_INVITE_03 (INVITE, ENUM - Event 3)
		Ic	TP_IC_IBCF_INVITE_01 (INVITE - Event 3)
		Ic	TP_IC_IBCF_INVITE_02 (INVITE - Event 3)
		Rx	TP_RX_PCSCF_AAR_06 (AAR - Event 6)
		Rx	TP_RX_PCRF_AAA_02 (AAA - Event 9)
		Gx	TP_GX_PCRF_RAR_01 (RAR - Event 7)
		Gx	TP_GX_PGW_RAA_02 (RAA - Event 8)
	3	Gm	TP_GM_PCSCF_180RINGING_02 (Event 11)
		MwPS	TP_MW_PCSCF_180RINGING_02 (Event 16)
		MwSI	TP_MW_SCSCF_180RINGING_02 (Event 17)
		Ic	TP_IC_IBCF_180RESP_01 (180 Ringing - Event 18)
		Ic	TP_IC_IBCF_180RESP_02 (180 Ringing - Event 18)
		Ic	TP_IC_IBCF_1XXRESP_01 (180 Ringing - Event 18)
		Rx	TP_RX_PCSCF_AAR_07 (AAR - Event 12)
		Rx	TP_RX_PCRF_AAA_02 (AAA - Event 15)
		Gx	TP_GX_PCRF_RAR_01 (RAR - Event 13)
		Gx	TP_GX_PGW_RAA_02 (RAA - Event 14)
	4	Rtp	TP_RTP_02 (Event 19)
	5	Gm	TP_GM_PCSCF_CANCEL_02 (Event 23)
		MwPS	TP_MW_PCSCF_CANCEL_02 (Event 22)
		MwSI	TP_MW_SCSCF_CANCEL_02 (Event 21)
		Ic	TP_IC_IBCF_CANCEL_02 (CANCEL - Event 20)
	6	Rx	TP_RX_PCSCF_STR_04 (STR - Event 24)
		Gx	TP_GX_PCRF_RAR_02 (RAR - Event 25)
	7	Gm	TP_GM_PCSCF_200OK_CANCEL_01 (Event 28)
		MwPS	TP_MW_PCSCF_200OK_CANCEL_01 (Event 29)
		Gm	TP_GM_PCSCF_487INVITE_02 (Event 32)
		MwPS	TP_MW_PCSCF_487INVITE_02 (Event 33)
		Gx	TP_GX_PGW_RAA_03 (RAA - Event 26)
		Rx	TP_RX_PCRF_STA_01 (STA - Event 27)
		Ic	TP_IC_IBCF_CANCEL_OK_02 (OK - Event 31)
		Ic	TP_IC_IBCF_487INVITE_02 (487 INVITE - Event 35)
		Ic	TP_IC_IBCF_487INVITE_ACK_02 (ACK - Event 38)
	8	Rtp	TP_RTP_01 (Events 41, 42)

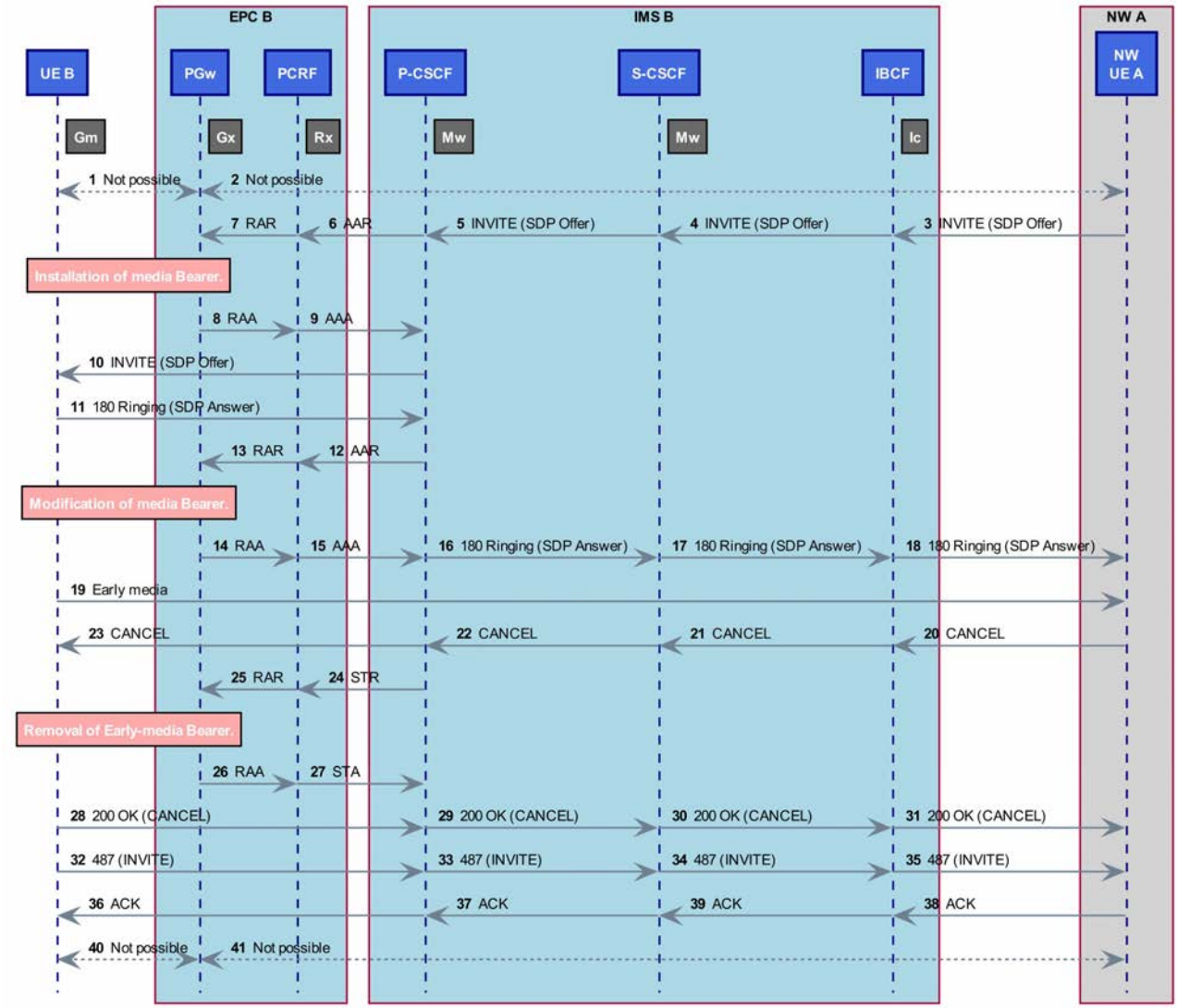


Figure 17: SIP Session Abort - Terminating Leg

1) The dedicated bearer(s) is/are down.
2) No media can flow between the UEs.
3) UE B initiates the SIP session with an INVITE containing the SDP offer.
4) The IMS B P-CSCF invokes the PCRF.
5) PCRF sends RAR to EPC B P-GW.
6) EPC A P-GW responds with RAA.
7) PCRF responds to IMS A P-CSCF with AAA.
8) P-CSCF sends the INVITE to S-CSCF.
9) S-CSCF sends the INVITE to IBCF.
10) IBCF forwards the INVITE to UE B
11) UE A responds with the 180 (Ringing) with SDP answer.
12) IBCF sends the 180 (Ringing) to S-CSCF.
13) S-CSCF sends the 180 (Ringing) to P-CSCF.

14) The IMS A P-CSCF invokes the PCRF to modify the bearer.
15) PCRF sends RAR to EPC A P-GW.
16) EPC A P-GW responds with RAA.
17) PCRF responds to IMS A P-CSCF with AAA.
18) P-CSCF forwards the SIP 180 (SDP) to S-CSCF.
19) Early media may flow between the UEs.
20) The UE A responds with the CANCEL.
21) P-CSCF sends a ST-Request to the PCRF (Session-Termination request).
22) PCRF sends a RA-Request to the PGw (Re-Auth request).
23) P-GW responds. P-CSCF.
24) PCRF responds to P-CSCF.
25) P-CSCF sends CANCEL to S-CSCF.
26) S-CSCF sends CANCEL to IBCF.
27) IBCF forwards the CANCEL to UE A.
28) UE A responds with 200 OK (CANCEL).
29) IBCF sends 200 OK (CANCEL) to S-CSCF.
30) S-CSCF sends 200 OK (CANCEL) to P-CSCF.
31) P-CSCF forwards 200 OK (CANCEL) to UE B.
32) UE B initiates request termination.
33) IBCF sends 487 (INVITE) to S-CSCF.
34) S-CSCF sends 487 (INVITE) to P-CSCF.
35) P-CSCF forwards 487 (INVITE) to UE B.
36) S-CSCF initiates ACK to IBCF.
37) IBCF forwards ACK to UE A.
38) P-CSCF sends ACK to S-CSCF.
39) UE A sends ACK to IMS B P-CSCF.
40) The dedicated bearer(s) is/are down.
41) No media can flow between the UEs.

5.3.4.3 SIP Session Reject - Originating Leg

Interoperability Test Description			
Identifier:	TD_VxLTE_INT_REJ_01		
Objective:	To demonstrate interaction between IMS and PCRF/EPC at the originating side when and IMS session is rejected.		
Summary:	On session reject, the P-CSCF should trigger the removal of all relevant previously created early media bearers. EPC removes the bearers for early media. Media transport is no longer possible, after the session reject.		
Configuration:	CF_VxLTE_INT		
SUT:	IMS A and EPC A		
Interfaces:	Gm, Mw, Gx, Rx, Ic		
References:	Gm, Mw	ETSI TS 124 229 [2], clause 5.1.5 (2nd paragraph) and clause 5.1.3 and clause 6.2	
	Ic	ETSI TS 124 229 [2], clause 5.4.3.2 ¶11 (1st numbered list) and clause 5.4.3.2 ¶9 (item 9 1st numbered list) and clause 5.4.3.2 (item 10 in 1st numbered list) and clause 5.10.3.2 and clause 5.10.3.2 and IETF RFC 3261 [12], clause 13.3.1.3	
	Gx	ETSI TS 129 212 [7], clause 4.5.2	
	Rx	ETSI TS 129 214 [6], clause 4.4.4	
Pre-test conditions:	• UE A and UE B previously attached to EPC A. • EPC A established a Default Bearer allowing UE A to P-CSCF IP communication and UE B to P-CSCF IP communication. • UE A previously registered to IMS A. • EPC A provisioned IMS A signalling bearers.		
Test Sequence:	**Step**		
	1	Verify that media between UE A and UE B is not delivered in any direction.	
	2	UE A initiates a session establishment operation.	
	3	Verify that media bearer is initiated and reflects the SDP offer.	
	4	UE B rejects session establishment.	
	5	Verify that P-CSCF A terminates the Rx session, triggering the removal of all early media related bearers.	
	6	Verify that EPC A removes all early media related bearers.	
	7	Verify that media between UE A and UE B can no longer be exchanged and is filtered out by EPC A.	
Conformance criteria of test sequence step:	1	Rtp	TP_RTP_01 (Events 1,2)
	2	Gm MwPS MwSI Ic Ic Ic Rx Rx Gx Gx	TP_GM_PCSCF_INVITE_01 (Event 3) TP_MW_PCSCF_INVITE_01 (Event 8) TP_MW_SCSCF_INVITE_01 (Event 9) TP_IC_IBCF_INVITE_03 (INVITE, ENUM - Event 10) TP_IC_IBCF_INVITE_01 (INVITE - Event 10) TP_IC_IBCF_INVITE_02 (INVITE - Event 10) TP_RX_PCSCF_AAR_03 (AAR - Event 4) TP_RX_PCRF_AAA_02 (AAA - Event 7) TP_GX_PCRF_RAR_01 (RAR - Event 5) TP_GX_PGW_RAA_02 (RAA - Event 6)
	3	Rtp	TP_RTP_02 (Event 18)
	4, 5	Gm MwPS MwSI Ic Ic	TP_GM_PCSCF_486INVITE_01 (Event 14) TP_MW_PCSCF_486INVITE_01 (Event 13) TP_MW_SCSCF_486INVITE_01 (Event 12) TP_IC_IBCF_486INVITE_01 (Event 11) TP_IC_IBCF_486INVITE_ACK_01 (Event 22)
	6, 7	Rx Gx Gx Rx Rtp	TP_RX_PCSCF_STR_05 (STR - Event 15) TP_GX_PCRF_RAR_02 (RAR - Event 16) TP_GX_PGW_RAA_03 (RAA - Event 17) TP_RX_PCRF_STA_01 (STA - Event 18) TP_RTP_01 (Events 23,24)

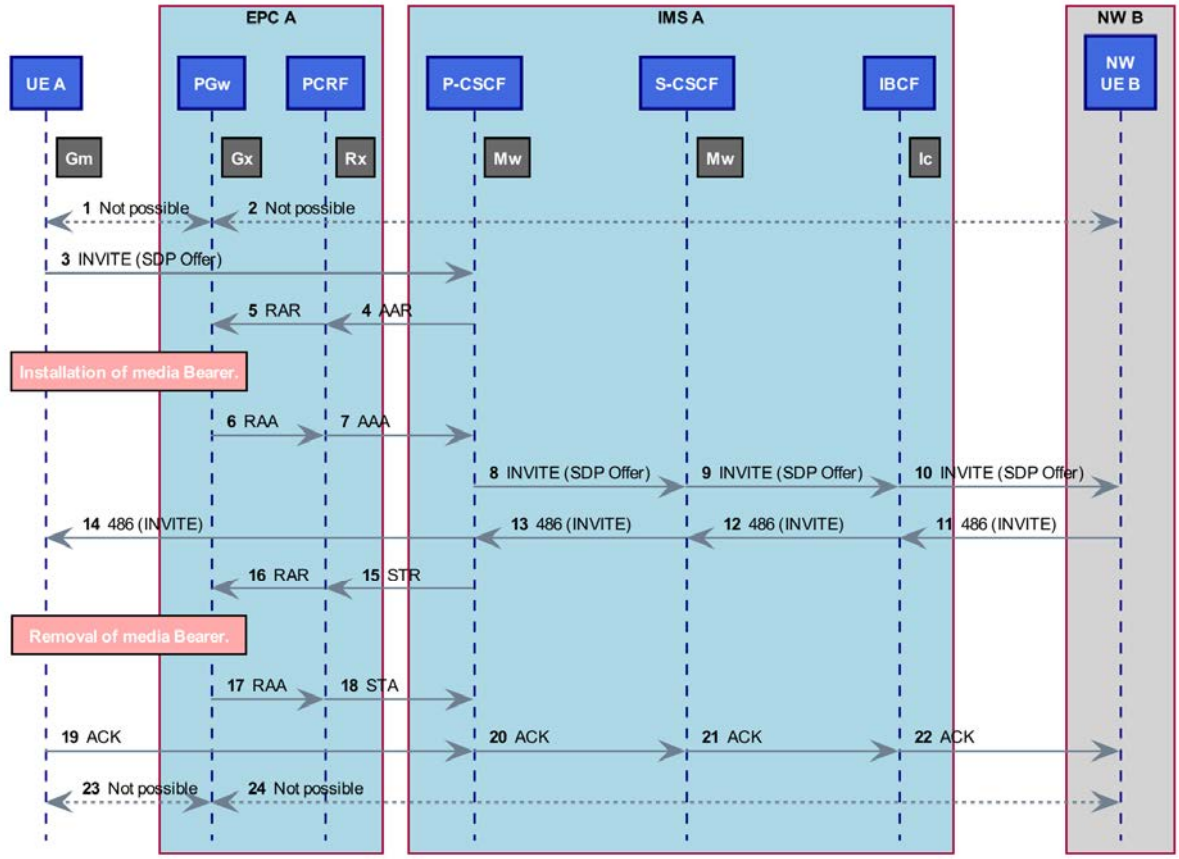


Figure 18: SIP Session Reject - Originating Leg

1) The dedicated bearer(s) is/are down.
2) No media can flow between the UEs.
3) UE A initiates the SIP session with an INVITE containing the SDP offer.
4) The IMS A P-CSCF invokes the PCRF.
5) PCRF sends RAR to EPC A P-GW.
6) EPC A P-GW responds with RAA.
7) PCRF responds to IMS A P-CSCF with AAA.
8) P-CSCF sends the INVITE to S-CSCF.
9) S-CSCF sends the INVITE to IBCF.
10) IBCF forwards the INVITE to UE B.
11) UE B rejects the incoming call.
12) IBCF sends the 486 (INVITE) to S-CSCF.
13) S-CSCF sends the 486 (INVITE) to P-CSCF.
14) P-CSCF forwards the 486 (INVITE) to UE A.
15) The IMS A P-CSCF invokes the PCRF to remove the bearer.
16) PCRF sends RAR to EPC A P-GW.
17) EPC A P-GW responds with RAA.

18) PCRF responds to IMS A P-CSCF with STA.

19) UE A sends ACK to IMS A P-CSCF.

20) P-CSCF sends ACK to S-CSCF.

21) S-CSCF forwards ACK to IBCF.

22) IBCF sends ACK to UE B.

23) The dedicated bearer(s) is/are down.

24) No media can flow between the UEs.

5.3.4.4 SIP Session Reject - Terminating Leg

Interoperability Test Description		
Identifier:	TD_VxLTE_INT_REJ_02	
Objective:	To demonstrate interaction between IMS and PCRF/EPC at the originating side when an IMS session is rejected.	
Summary:	On session reject, the P-CSCF should trigger the removal of all relevant previously created early media bearers. EPC removes the bearers for early media. Media transport is no longer possible, after the session reject.	
Configuration:	CF_VxLTE_INT	
SUT:	IMS B and EPC B	
Interfaces:	Gm, Mw, Gx, Rx, Ic	
References:	Gm, Mw	ETSI TS 124 229 [2], clause 5.1.5 (2nd paragraph) and clause 5.1.3 and clause 6.2
	Ic	ETSI TS 124 229 [2], clause 5.4.3.2 ¶11 (1st numbered list) and clause 5.10.3.2 and clause 5.4.3.2 ¶9 (item 9 1st numbered list) and clause 5.4.3.2 (item 10 in 1st numbered list) and clause 5.10.3.2 and clause 5.3.2.2 IETF RFC 3261 [12], clause 9.2 and clause 13.3.1.3
	Gx	ETSI TS 129 212 [7], clause 4.5.2
	Rx	ETSI TS 129 214 [6], clause 4.4.4
Pre-test conditions:	• UE B previously attached to EPC B. • EPC B established a Default Bearer allowing UE B to P-CSCF B IP communication. • UE B previously registered to IMS B. • EPC B provisioned IMS B signalling bearers.	
Test Sequence:	**Step**	
	1	Verify that media between UE A and UE B is not delivered in any direction.
	2	UE A initiates a session establishment operation.
	3	UE B answers with SIP 486 (busy) Response and rejects session establishment.
	4	Verify that P-CSCF terminates the Rx session, triggering removal of all early media related bearers.
	5	Verify that EPC B removes all early media related bearers.
	6	Verify that media between UE A and UE B can no longer be exchanged and is filtered out by EPC B.

Interoperability Test Description			
Conformance criteria of test sequence step:	1	Rtp	TP_RTP_01 (Events 1,2)
	2	Gm	TP_GM_PCSCF_INVITE_02 (Event 10)
		MwSP	TP_MW_PCSCF_INVITE_02 (Event 4)
		MwSI	TP_MW_SCSCF_INVITE_02 (Event 4)
		Ic	TP_IC_IBCF_INVITE_03 (INVITE, ENUM - Event 3)
		Ic	TP_IC_IBCF_INVITE_01 (INVITE - Event 3)
		Ic	TP_IC_IBCF_INVITE_02 (INVITE - Event 3)
		Rx	TP_RX_PCSCF_AAR_06 (AAR - Event 6)
		Rx	TP_RX_PCRF_AAA_02 (AAA - Event 9)
		Gx	TP_GX_PCRF_RAR_01 (RAR - Event 7)
		Gx	TP_GX_PGW_RAA_02 (RAA - Event 8)
	3	Gm	TP_GM_PCSCF_486INVITE_02 (Event 11)
		MwPS	TP_MW_PCSCF_486INVITE_02 (Event 12)
		MwSI	TP_MW_SCSCF_486INVITE_02 (Event 13)
		Ic	TP_IC_IBCF_486INVITE_02 (486 Busy - Event 14)
	4	Rx	TP_RX_PCSCF_STR_06 (STR - Event 15)
		Gx	TP_GX_PCRF_RAR_02 (RAR - Event 16)
		Gx	TP_GX_PGW_RAA_03 (RAA - Event 17)
		Rx	TP_RX_PCRF_STA_01 (STA - Event 18)
	5	Ic	TP_IC_IBCF_486INVITE_ACK_02 (ACK - Event 19)
	6	Rtp	TP_RTP_01 (Events 23, 24)

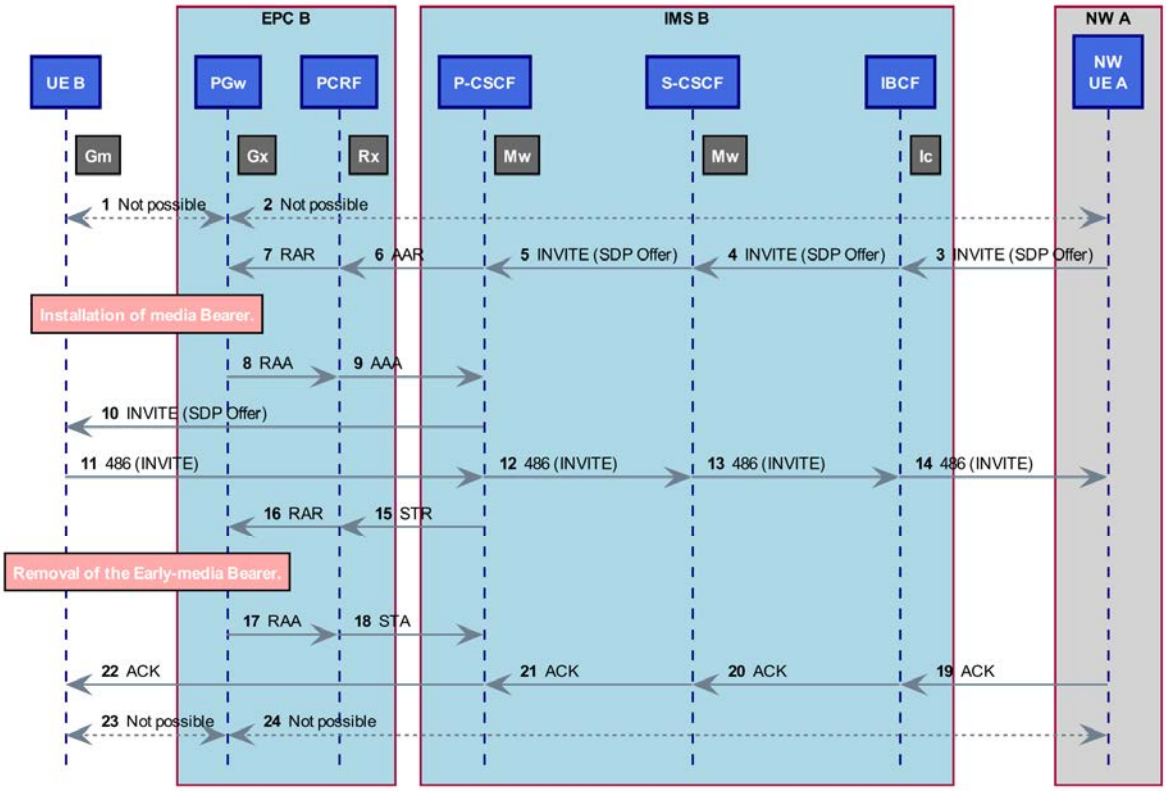


Figure 19: SIP Session Abort - Terminating Leg

1) The dedicated bearer(s) is/are down.

2) No media can flow between the UEs.

3) UE A initiates the SIP session with an INVITE containing the SDP offer.

4) IMS B IBCF forwards the INVITE to IMS B S-CSCF.

5) S-CSCF forwards the INVITE to P-CSCF.

6) The IMS B P-CSCF invokes the PCRF.

7) PCRF sends RAR to EPC B P-GW.

8) EPC B P-GW responds with RAA.

9) PCRF responds to IMS B P-CSCF with AAA.

10) IMS B P-CSCF forwards the INVITE to UE B.

11) UE B rejects the incoming call.

12) P-CSCF forwards 486 (INVITE) to S-CSCF.

13) S-CSCF forwards 486 (INVITE) to IBCF.

14) IBCF forwards 486 (INVITE) to UE A.

15) The IMS B P-CSCF invokes the PCRF to remove the Early-media bearer.

16) PCRF sends RAR to EPC B P-GW.

17) EPC B P-GW responds with RAA.

18) PCRF responds to IMS B P-CSCF with STA.

19) UE A sends ACK to IMS B IBCF.

20) IBCF forwards the ACK to S-CSCF.

21) S-CSCF forwards the ACK to P-CSCF.

22) P-CSCF forwards the ACK to Ue B.

23) The dedicated bearer(s) is/are down.

24) No media can flow between the UEs.

5.4 IMS Deregistration

5.4.0 General

These tests cover interaction between the EPC, PCRF and IMS when IMS de-registration takes place.

These tests assume that an UE has been previously attached to EPC and performed an IMS registration. There may or may not be active SIP sessions at the point of de-registration.

The test procedure will trigger an UE-initiated de-registration. On this event the S-CSCF will perform a S-CSCF initiated call release. On receiving the call release, the P-CSCF will act and trigger the termination of the SIP session bearers in the EPC. As a result, SIP session media will be filtered and should no longer pass the EPC, in either direction.

The tests will verify the following outcomes:

1) Any active SIP sessions and their associated bearers are removed.

2) Session's media will be filtered-out by EPC, as the session bearers have been removed and the Default Bearer has a default policy of "deny".

The IMS signalling bearer is removed.

5.4.1 User via EPC - IMS De-registration (no SIP session active)

Interoperability Test Description		
Identifier:	TD_VxLTE_INT_DRG_01	
Objective:	To perform initial IMS de-registration and remove the session binding from the underlying default bearer.	
Summary:	On UE A de-registration, P-CSCF signals to PCRF the termination of the IMS signalling session. EPC removes the QOS rules of the IMS signalling bearer. Initial registrations are still possible, but traffic will be categorized in the Default Bearer.	
Configuration:	CF_VxLTE_INT	
SUT:	IMS A and EPC A	
Interfaces:	Gm, Mw, Cx, Rx, Gx	
References:	Gm, Mw	ETSI TS 124 229 [2], clause 5.2.5.1and clause 5.4.1.5 and clause 6.2 and 6.3
	Rx	ETSI TS 129 214 [6], clauses 4.4.4, 4.4.5a and A.8
	Gx	ETSI TS 129 212 [7], clause 4.5.2
	Cx	ETSI TS 129 228 [4], clauses 6.1.1.1, 6.1.2.1 and A.4.3 ETSI TS 129 229 [5], clauses 6.1.1, 6.1.2, 6.1.3 and 6.1.4
Pre-test conditions:	• UE A previously attached to EPC. • EPC established a Default Bearer allowing UE A - P-CSCF IP communication. • UE A previously registered to IMS. • EPC provisioned the IMS signalling bearer allowing UE A - P-CSCF IP communication with AF Signalling QoS characteristics.	
Test Sequence:	**Step**	
	1	UE A triggers IMS de-registration, removing all registered contacts at respective P-CSCF.
	2	Verify that P-CSCF invokes the PCRF to remove the session binding established at IMS registration.
	3	Verify that signalling between UE A and P-CSCF is still possible, by using a registration status pull (no contacts in SIP REGISTER request). Verify that this signalling is transported in the still active Default Bearer.
Conformance criteria of test sequence step:	1	Gm TP_GM_PCSCF_REGISTER_07 (Event 1) Gm TP_GM_PCSCF_200OK_01 (Event 10) MwPS TP_MW_PCSCF_REGISTER_07 (Event 2) MwIS TP_MW_ICSCF_REGISTER_07 (Event 5) MwIS TP_MW_SCSCF_REGISTER_07 (Event 8) Cx TP_CX_HSS_UAA_04 (UAR,UAA - Events 3,4) Cx TP_CX_HSS_SAA_02 (SAR,SAA - Events 6, 7)
	2	Rx TP_RX_PCSCF_STR_07 (STR - Event 11) Rx TP_RX_PCRF_STA_02 (STA - Event 12) Gx TP_GX_PGW_RAA_04 (RAR, RAA - Events 13, 14)

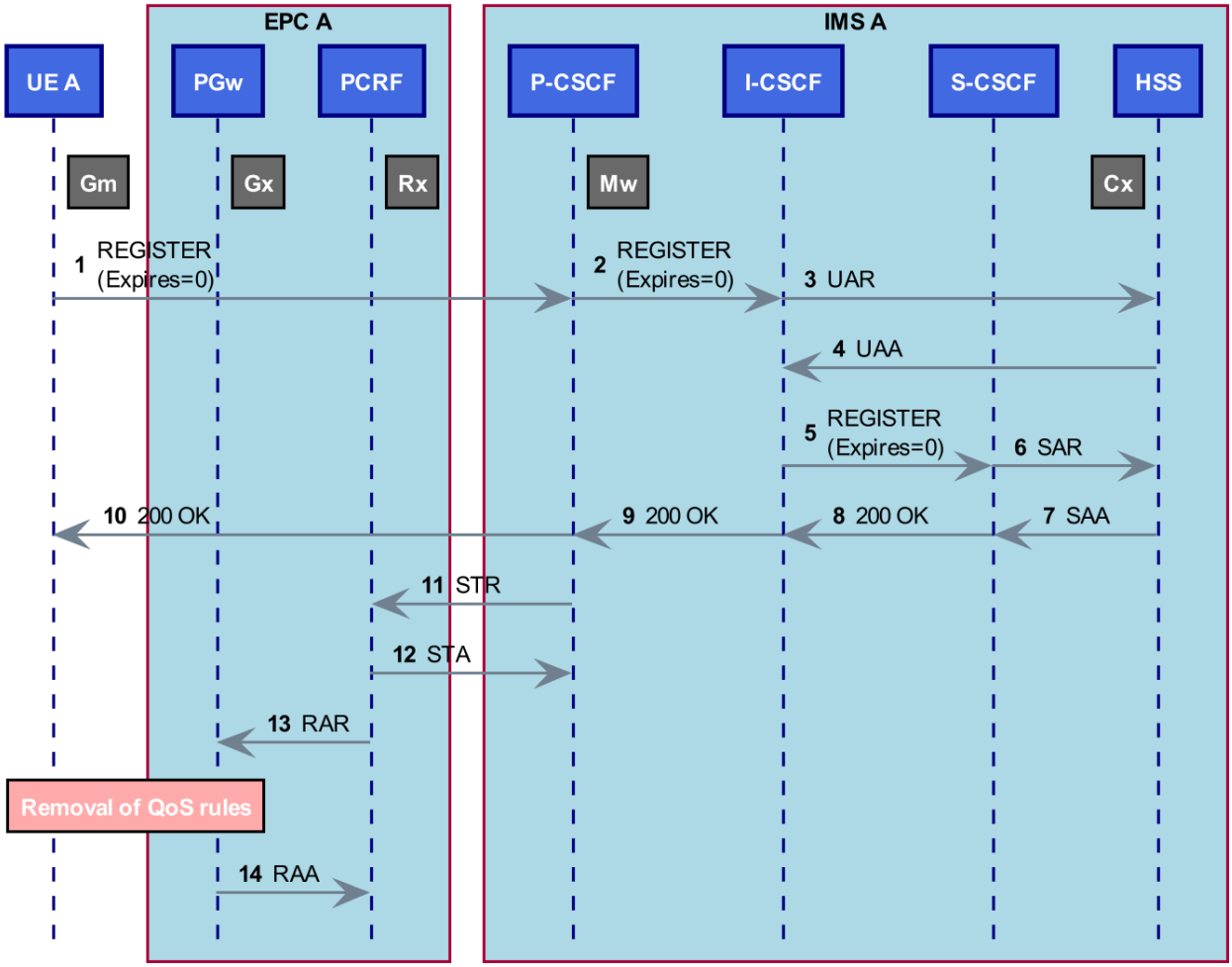


Figure 20: IMS De-registration

1) The UE-A requests IMS A De-Registration.
2) P-CSCF forwards the REGISTER(Expires=0) to I-CSCF.
3) I-CSCF sends UAR to HSS.
4) HSS responds with UAA.
5) I-CSCF forwards the REGISTER to S-CSCF.
6) S-CSCF sends SAR to HSS.
7) HSS responds with SAA.
8) The IMS de-registration is successful.
9) I-CSCF forwards 200 response to P-CSCF.
10) P-CSCF forwards 200 response to UE-A.
11) The P-CSCF initiates session termination with STR.
12) The PCRF responds with STA to the P-CSCF.
13) The PCRF removes the QOS rules at the P-GW to modify the default bearer.
14) The P-GW in the EPC responds with RAA to the PCRF.
15) The default bearer has been successfully modified.

5.4.2 User via EPC - IMS Administrative De-registration (no SIP session active)

Interoperability Test Description		
Identifier:	TD_VxLTE_INT_DRG_02	
Objective:	To perform IMS admin initiated de-registration and remove the session binding from the underlying default bearer.	
Summary:	On administrative de-registration, S-CSCF notifies the UE A and P-CSCF about the event. P-CSCF signals to PCRF the termination of the session binding to the default bearer and the EPC removes the previously provisioned QOS rules. Initial registration are still possible, but traffic will be categorized in the Default Bearer.	
Configuration:	CF_VxLTE_INT	
SUT:	IMS A and EPC A	
Interfaces:	Gm, Mw, Cx, Rx, Gx	
References:	Gm, Mw	ETSI TS 124 229 [2], clause 5.2.5.1 and clause 5.4.1.5 and clauses 6.2 and 6.3
	Rx	ETSI TS 129 214 [6], clauses 4.4.4, 4.4.5a, A.8
	Gx	ETSI TS 129 212 [7], clause 4.5.2
	Cx	ETSI TS 129 228 [4], clause 6.1.3 ETSI TS 129 229 [5], clauses 6.1.9, 6.1.10
Pre-test conditions:	• UE A previously attached to EPC. • EPC established a Default Bearer allowing UE A - P-CSCF IP communication. • UE A previously registered to IMS. • EPC provisioned the IMS signalling bearer allowing UE A - P-CSCF IP communication with AF Signalling QoS characteristics.	
Test Sequence:	**Step**	
	1	S-CSCF/HSS triggers administrative de-registration, removing all registered contacts of UE A
	2	Verify that S-CSCF signals de-registration to the P-CSCF.
	3	Verify that P-CSCF invokes the PCRF to remove the session binding to the default bearer.
	4	Verify that signalling between UE A and P-CSCF is still possible, by using a registration status pull (no contacts in SIP REGISTER request). Verify that this signalling is transported in the still active Default Bearer.
Conformance criteria of test sequence step:	1	Cx TP_CX_HSS_RTA_01 (RTR, RTA - Events 1, 8)
	2	GM TP_MW_PCSCF_NOTIFY_01 (Event 3) GM TP_MW_PCSCF_200OK_01 (Event 4) MwPS TP_MW_PCSCF_NOTIFY_01 (Event 2) MwPS TP_MW_PCSCF_200OK_01 (Event 5) MwPS TP_MW_PCSCF_NOTIFY_02 (Events 6, 7) MwIS TP_MW_SCSCF_NOTIFY_01 (Events 2, 6)
	3	Rx TP_RX_PCSCF_STR_08 (STR - Event 9) Rx TP_RX_PCRF_STA_02 (STA - Event 10) Gx TP_GX_PGW_RAA_04 (RAR, RAA - Events 11, 12)

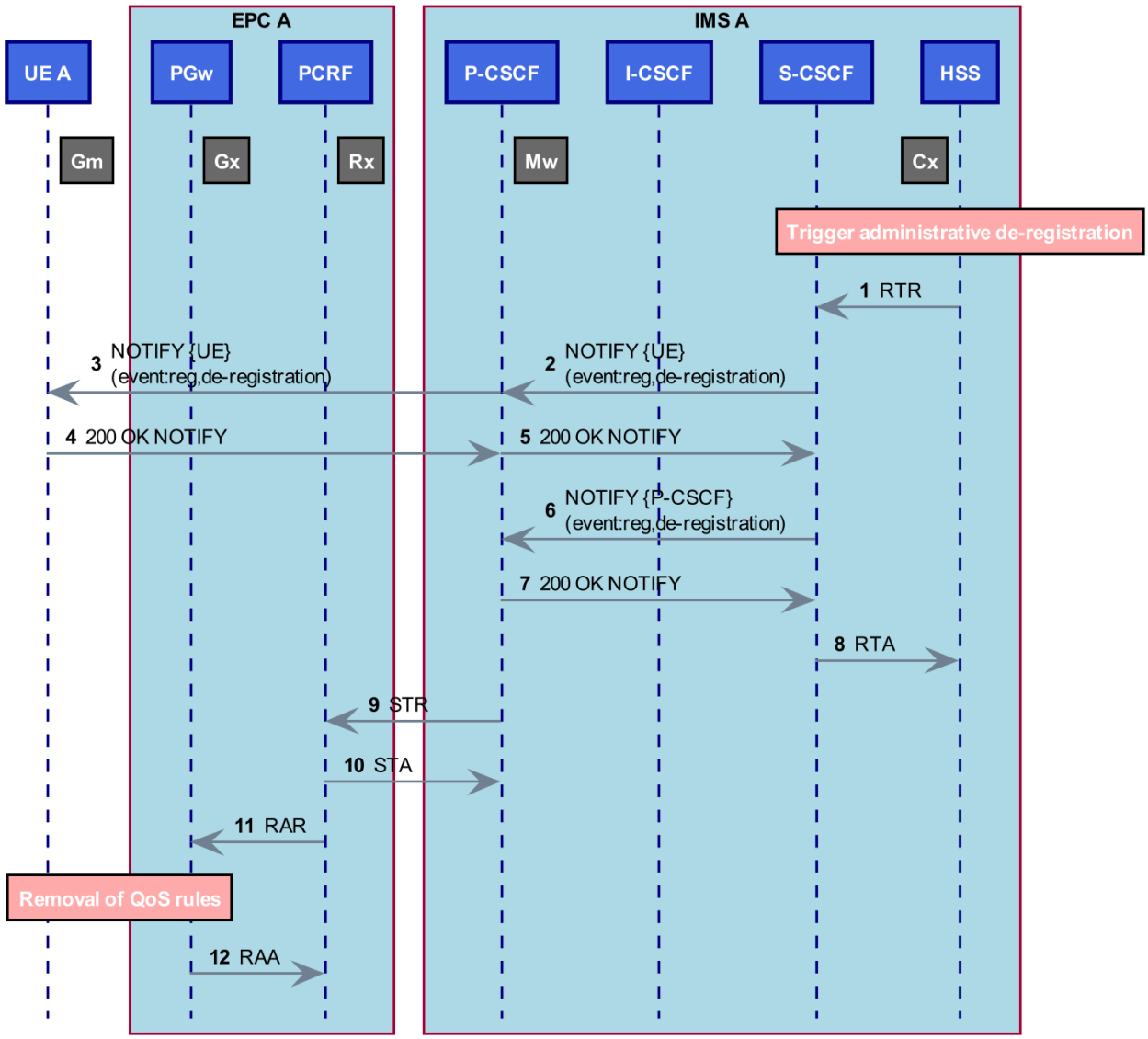


Figure 21: IMS Administrative De-Registration

1) Operator triggers administrative de-registration. HSS sends RTR to S-CSCF.
2) S-CSCF sends the NOTIFY(reg-event, UE) to P-CSCF.
3) P-CSCF forwards the NOTIFY to UE-A.
4) UE-A responds with 200 OK.
5) P-CSCF forwards 200 OK to S-CSCF.
6) S-CSCF sends the NOTIFY(reg-event, P-CSCF) to P-CSCF.
7) P-CSCF responds with 200 OK.
8) S-CSCF sends RTA to HSS.
9) The P-CSCF initiates session termination with STR.
10) The PCRF responds with STA to the P-CSCF.
11) The PCRF removes the QOS rules at the P-GW to modify the default bearer.
12) The P-GW in the EPC responds with RAA to the PCRF.

5.4.3 User via EPC - IMS Registration expiration (no SIP session active)

Interoperability Test Description		
Identifier:	TD_VxLTE_INT_DRG_03	
Objective:	To perform IMS de-registration due to expiry of the registration timer and remove the session binding from the underlying default bearer.	
Summary:	On registration expiration, P-CSCF signals to PCRF the termination of the IMS signalling session. P-CSCF signals to PCRF the termination of the session binding to the default bearer and the EPC removes the previously provisioned QOS rules. Initial registration are still possible, but traffic will be categorized in the Default Bearer.	
Configuration:	CF_VxLTE_INT	
SUT:	IMS A and EPC A	
Interfaces:	Gm, Mw, Cx, Rx, Gx	
References:	Gm, Mw	ETSI TS 124 229 [2], clause 5.2.5.1and clause 5.4.1.5 and clauses 6.2 and 6.3
	Rx	ETSI TS 129 214 [6], clause 4.4.4, 4.4.5a and A.8
	Gx	ETSI TS 129 212 [7], clause 4.5.2
	Cx	ETSI TS 129 228 [4], clauses 6.1.1.1, 6.1.2.1 and A.4.3 ETSI TS 129 229 [5], clauses 6.1.1, 6.1.2, 6.1.3 and 6.1.4
Pre-test conditions:	• UE A previously attached to EPC. • EPC established a Default Bearer allowing UE A - P-CSCF IP communication. • UE A previously registered to IMS. • EPC established session binding and provision of the IMS signalling bearer.	
Test Sequence:	**Step**	
	1	UE A registration expires at P-CSCF, for all contacts of UE A.
	2	Verify that P-CSCF signals termination of IMS signalling bearer.
	3	Verify that signalling between UE A and P-CSCF is still possible, by using a registration status pull (no contacts in REGISTER request). Verify that this signalling is transported in the still active Default Bearer.
Conformance criteria of test sequence step:	1	MwPS TP_MW_PCSCF_REGISTER_09 (Event 2) MwIS TP_MW_ICSCF_REGISTER_07 (Event 5) MwSI TP_MW_SCSCF_REGISTER_07 (Event 8) Rx TP_RX_PCRF_STA_02 (STR, STA - Events 1,14) Cx TP_CX_HSS_UAA_04 (UAR,UAA - Events 3,4) Cx TP_CX_HSS_SAA_02 (SAR,SAA - Events 6,7)
	2	MwPS TP_MW_PCSCF_NOTIFY_01 (Event 11) MwPS TP_MW_PCSCF_200OK_01 (Event 12) MwIS TP_MW_SCSCF_NOTIFY_01 (Events 10, 13)
	3	Gx TP_GX_PGW_RAA_04 (RAR, RAA - Events 15, 16)

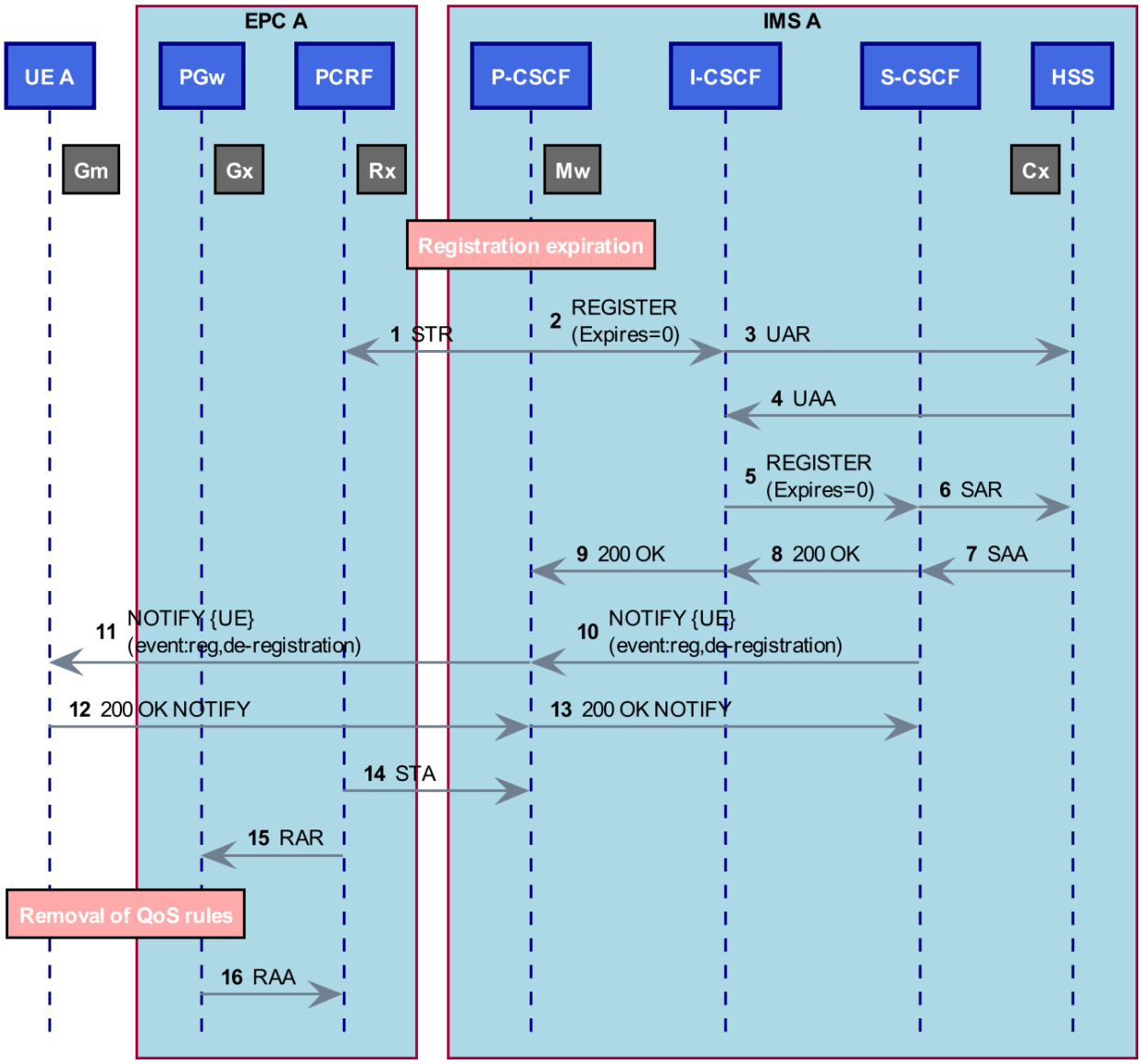


Figure 22: IMS Registration Expiration

1) Registration expires at the P-CSCF initiates session termination with STR.
2) P-CSCF sends the REGISTER(Expires=0) to I-CSCF.
3) I-CSCF sends UAR to HSS.
4) HSS responds with UAA.
5) I-CSCF forwards the REGISTER to S-CSCF.
6) S-CSCF sends SAR to HSS.
7) HSS responds with SAA.
8) S-CSCF send 200 response to I-CSCF
9) I-CSCF forwards 200 response to P-CSCF. The IMS de-registration is successful.
10) S-CSCF sends the NOTIFY(reg-event, UE) to P-CSCF.
11) P-CSCF forwards the NOTIFY to UE-A.

12) UE-A responds with 200 OK.

13) P-CSCF forwards 200 OK to S-CSCF.

14) The PCRF responds with STA to the P-CSCF.

15) The PCRF removes the QOS rules at the P-GW to modify the default bearer.

16) The P-GW in the EPC responds with RAA to the PCRF.

5.4.4 User via EPC - IMS De-registration with Active SIP Sessions

Interoperability Test Description		
Identifier:	TD_VxLTE_INT_DRG_04	
Objective:	To perform initial IMS de-registration and remove the session binding from the underlying default bearer.	
Summary:	On UE A de-registration, the S-CSCF performs S-CSCF-initiated termination of active session. P-CSCF will act on this event and signals to PCRF termination of the SIP session bearers. EPC removes the SIP Session bearer. Media cannot be exchanged on previous SIP Session bearer. The S-CSCF answers to the de-registration. The P-CSCF signals to PCRF the termination of IMS signalling session. EPC removes IMS signalling bearer.	
Configuration:	CF_VxLTE_INT	
SUT:	IMS A and EPC A	
Interfaces:	Gm, Mw, Cx, Rx, Gx	
References:	Gm, Mw	ETSI TS 124 229 [2], clause 5.2.5.1and clause 5.4.1.4.1 and clause 5.4.5.1 and clauses 6.2 and 6.3
	Rx	ETSI TS 129 214 [6], clauses 4.4.4, 4.4.5a and A.8
	Gx	ETSI TS 129 212 [7], clause 4.5.2
	Cx	ETSI TS 129 228 [4], clauses 6.1.1.1, 6.1.2.1 and A.4.3 ETSI TS 129 229 [5], clauses 6.1.1, 6.1.2, 6.1.3 and 6.1.4
Pre-test conditions:	• UE A previously attached to EPC. • EPC established a Default Bearer allowing UE A to P-CSCF and UE B to P-CSCF IP communication. • UE A & UE B previously registered to IMS. • EPC established an IMS signalling bearers. • UE A initiated/received a SIP session request such that a SIP session is active with UE B. • EPC established a SIP session bearer for media. • Default EPC gating policy set to "Deny".	
Test Sequence:	**Step**	
	1	Verify that media between UE A and UE B is successfully forwarded.
	2	UE A triggers IMS de-registration, removing all registered contacts at respective P-CSCF.
	3	Verify that S-CSCF triggers S-CSCF-initiated call release.
	4	Verify that P-CSCF signals termination of active SIP session media bearers.
	5	Verify that EPC removes SIP session media bearers and as such media packets are no longer forwarded between UE A and UE B, in either direction.
	6	Verify that P-CSCF signals termination of IMS signalling bearer.
	7	Verify that media between UE A and UE B is not delivered in any direction after termination of SIP session bearers.

Interoperability Test Description			
Conformance criteria of test sequence step:	1	Rtp	TP_RTP_03 (Event 1)
	2, 3	Gm	TP_GM_PCSCF_REGISTER_10 (Events 2, 9)
		MwPS	TP_MW_PCSCF_REGISTER_10 (Events 3, 7)
		MwSI	TP_MW_SCSCF_REGISTER_10 (Events 6, 7. 8. 18)
		Cx	TP_CX_HSS_UAA_04 (UAR,UAA - Events 4,5)
		Cx	TP_CX_HSS_SAA_02 (SAR,SAA - Events 10,11)
		Rx	TP_RX_PCSCF_STR_01 (STR - Event 12)
		Gx	TP_GX_PCRF_RAR_02 (RAR - Event 13)
		Gx	TP_GX_PGW_RAA_03 (RAA - Event 14)
		Rx	TP_RX_PCRF_STA_01 (STA - Event 15)
	6	Rx	TP_RX_PCSCF_STR_07 (STR - Event 21)
		Rx	TP_RX_PCRF_STA_01 (STA - Event 24)
		Gx	TP_GX_PGW_RAA_04 (RAR, RAA - Events 22, 23)

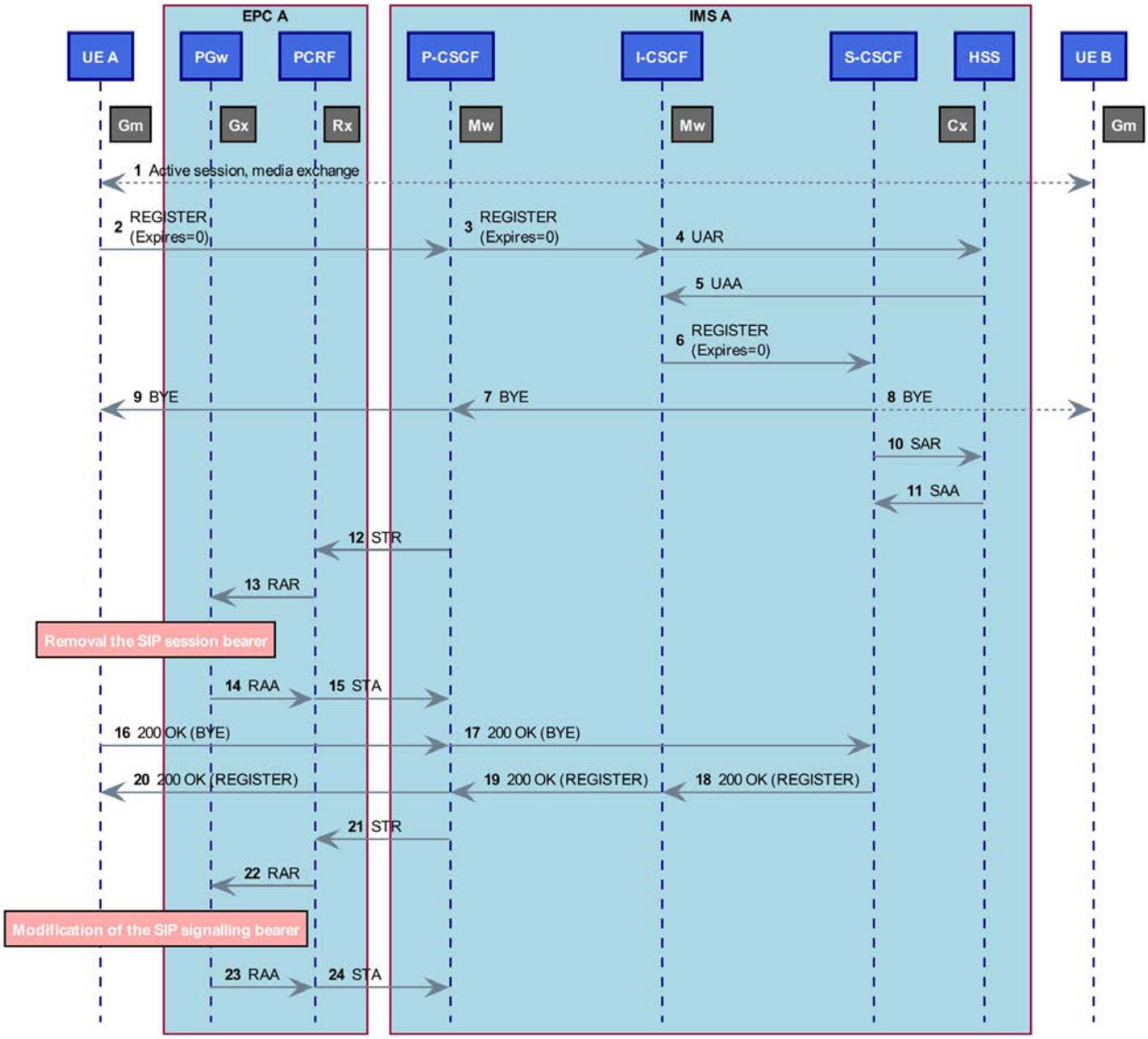


Figure 23: IMS UE De-registration with Active Session

1) UE-A, UE-B active session, media exchange.

2) The UE-A requests IMS A De-Registration.

3) P-CSCF forwards the REGISTER(Expires=0) to I-CSCF.

4) I-CSCF sends UAR to HSS.

5) HSS responds with UAA.

6) I-CSCF forwards the REGISTER to S-CSCF.

7) S-CSCF sends BYE to P-CSCF.

8) S-CSCF sends BYE for UE-B.

9) P-CSCF forwards BYE to UE-A.

10) S-CSCF sends SAR to HSS.

11) HSS responds with SAA.

12) The P-CSCF initiates session termination with STR.

13) The PCRF removes the SIP session bearer - RAR.

14) The P-GW in the EPC responds with RAA to the PCRF.

15) The PCRF responds with STA to the P-CSCF.

16) The UE-A confirms BYE with 200 response.

17) P-CSCF forwards 200 response to S-CSCF.

18) The IMS de-registration is successful. S-CSCF sends 200 response on REGISTER.

19) I-CSCF forwards 200 response to P-CSCF.

20) P-CSCF forwards 200 response to UE-A.

21) The P-CSCF initiates session termination with STR.

22) The PCRF at the P-GW modifies the SIP signalling bearer.

23) The P-GW in the EPC responds with RAA to the PCRF.

24) The PCRF responds with STA to the P-CSCF.

5.5 Network Detachment

5.5.0 General

These tests cover interaction between the EPC, PCRF and IMS when network detachment takes place. Detachment may be triggered by the UE or network.

At the point of detachment, a UE may or may not be registered to IMS and may or may not have active IMS sessions. All possibilities are covered. All affected bearers for a given established session will be removed, and administrative termination of the SIP registration/sessions will be triggered as appropriate.

5.5.1 UE Initiated Network Detachment (no IMS Registration)

Interoperability Test Description		
Identifier:	TD_VxLTE_INT_DTC_01	
Objective:	To demonstrate UE initiated network detachment (IP-CAN session termination) for a UE that has not yet registered to IMS.	
Summary:	On complete network detachment, the EPC removes all relevant bearers.	
Configuration:	CF_VxLTE_INT	
SUT:	IMS A and EPC A	
Interfaces:	Gx	
References:	Gx	ETSI TS 129 212 [7], clause 4.5.7
Pre-test conditions:	• UE A previously attached to EPC with a single attachment	

Interoperability Test Description		
Test Sequence:	**Step**	
	1	UE A starts complete network detachment, whilst not being registered at IMS.
	2	Verify that EPC removes the affected bearer.
	3	Verify that EPC P-GW informs the PCRF of the loss of the bearer.
Conformance criteria of test sequence step:	2	Gx TP_GX_PCRF_CCA_02 (CCR, CCA - Events 2, 3)

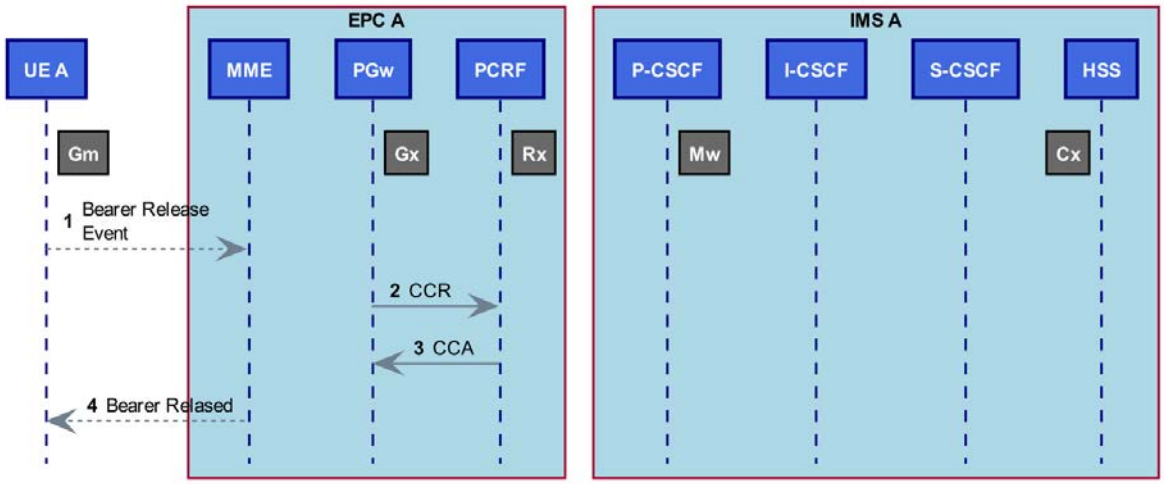


Figure 24: UE Initiated Network Detachment (not IMS Registered)

1) User initiates detachment on UE-A. The UE-A requests IP-CAN session dis-establishment to the EPC (MME).

2) The P-GW sends a CCR message to the PCRF to inform the PCRF that the default bearer is being released.

3) The PCRF responds with a CCA.

4) The MME responds to the UE, confirming that the IP-CAN has been successfully released. User is informed that the default bearer has been successfully released.

5.5.2 UE Initiated Network Detachment with Previously Established IMS Registration

Interoperability Test Description		
Identifier:	TD_VxLTE_INT_DTC_02	
Objective:	To demonstrate UE initiated network detachment (IP-CAN session termination) for a UE that has also registered to IMS.	
Summary:	On complete network detachment, without previous termination of IMS registration, the EPC informs the IMS about the event. EPC removes all relevant bearers. IMS terminates the IMS registration.	
Configuration:	CF_VxLTE_INT	
SUT:	IMS A and EPC A	
Interfaces:	Gm, Mw, Cx, Rx, Gx	
References:	Gm, Mw	ETSI TS 124 229 [2], clause 5.2.5.1 and clause 5.2.8.1.2 and clause 5.4.1.5 and clauses 6.2 and 6.3
	Rx	ETSI TS 129 214 [6], clause 4.4.6.1
	Gx	ETSI TS 129 212 [7], clause 4.5.7
	Cx	ETSI TS 129 228 [4], clauses 6.1.1.1, 6.1.2.1 and A.4.3 ETSI TS 129 229 [5], clauses 6.1.1, 6.1.2, 6.1.3 and 6.1.4

Interoperability Test Description			
Pre-test conditions:	• UE A previously attached to EPC with a single attachment. • UE A previously registered to IMS.		
Test Sequence:	**Step**		
	1	UE A starts complete network detachment, without previously triggering IMS de-registration.	
	2	Verify that EPC removes the affected bearer.	
	3	Verify that EPC P-GW informs the PCRF of the loss of the bearer.	
	4	Verify that PCRF informs IMS P-CSCF of the loss of the bearer.	
	5	Verify that IMS performs P-CSCF-initiated administrative de-registration on.	
	6	Verify that IMS P-CSCF terminates the Rx session with PCRF.	
Conformance criteria of test sequence step:	2,3	Gx	TP_GX_PCRF_CCA_02 (CCR, CCA - Events 2, 3)
	4	MwPS Rx	TP_MW_PCSCF_REGISTER_09 (Event 5) TP_RX_PCRF_ASA_01 (ASR, ASA - Events 4, 13)
	5	MwIS MwSI Cx Cx	TP_MW_ICSCF_REGISTER_07 (Event 8) TP_MW_SCSCF_REGISTER_07 (Event 8, 11) TP_CX_HSS_UAA_04 (UAR, UAA - Events 6, 7) TP_CX_HSS_SAA_02 (SAR, SAA - Events 10, 11)
	6	Rx	TP_RX_PCRF_STA_02 (STR, STA - Events 14, 15)

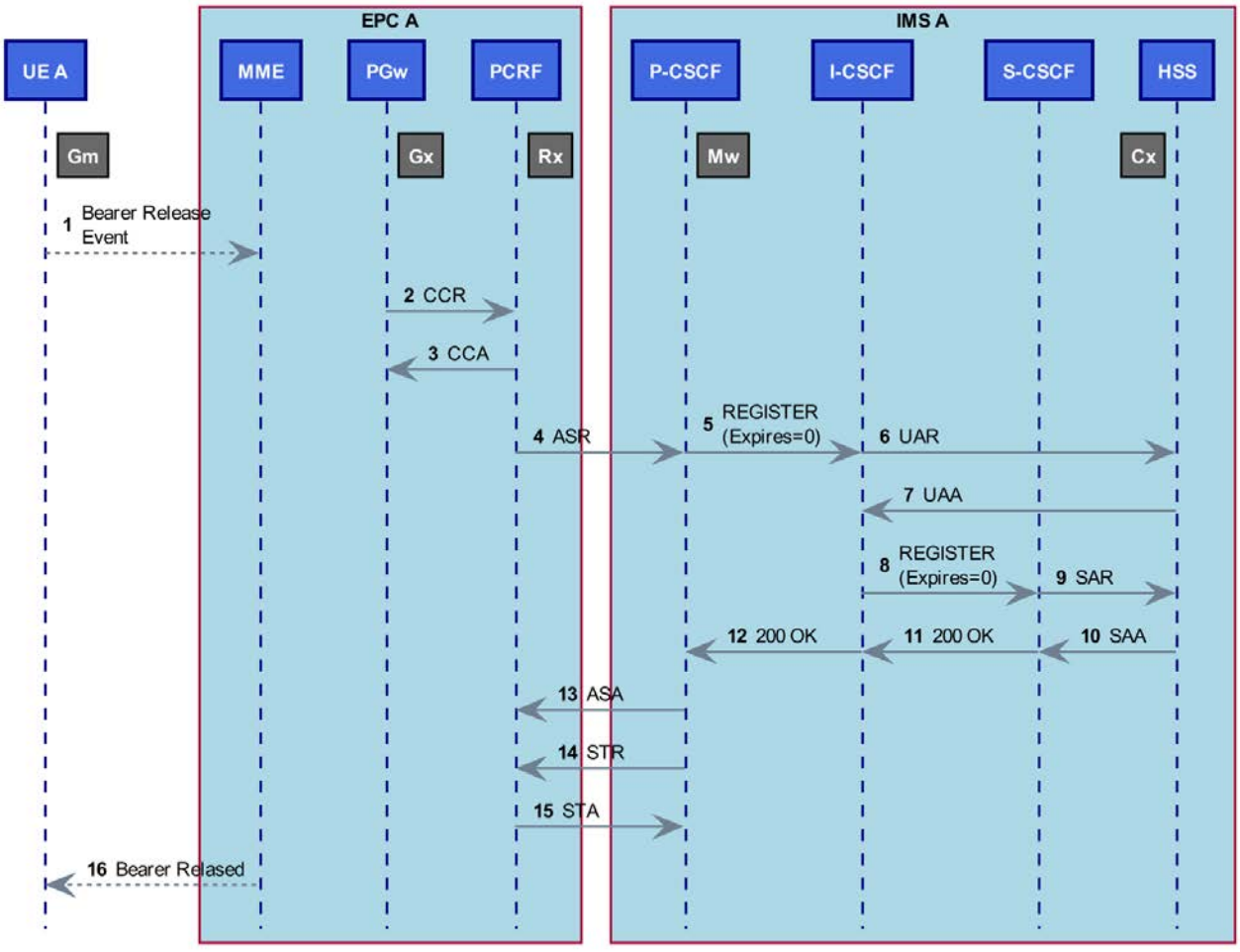


Figure 25: UE Initiated Network Detachment (IMS Registered)

1) User initiates detachment on UE-A. The UE-A requests IP-CAN session dis-establishment to the EPC (MME).

2) The P-GW sends a CCR message to the PCRF to inform the PCRF that the default bearer is being released.

3) The PCRF responds with a CCA.

4) PCRF sends ASR to IMS P-CSCF.

5) P-CSCF forwards the REGISTER(Expires=0) to I-CSCF.

6) I-CSCF sends UAR to HSS.

7) HSS responds with UAA.

8) I-CSCF forwards the REGISTER to S-CSCF.

9) S-CSCF sends SAR to HSS.

10) HSS responds with SAA.

11) The IMS de-registration is successful.

12) I-CSCF forwards 200 response to P-CSCF.

13) IMS P-CSCF responds with ASA.

14) IMS P-CSCF sends STR to abort the Rx session.

15) PCRF responds with STA.

16) The MME responds to the UE, confirming that the IP-CAN has been successfully released. User is informed that the default bearer has been successfully released.

5.5.3 UE Initiated Network Detachment with Previously Established IMS Registration & IMS Sessions

Interoperability Test Description		
Identifier:	TD_VxLTE_INT_DTC_03	
Objective:	To demonstrate UE initiated network detachment (IP-CAN session termination) for a UE that is registered to IMS and also has active IMS sessions.	
Summary:	On removal of all bearers, PCRF will notify IMS P-CSCF that Rx session should be aborted. IMS will take action and terminate all ongoing SIP sessions and the IMS registration.	
Configuration:	CF_VxLTE_INT	
SUT:	IMS A and EPC A	
Interfaces:	Gm, Mw, Cx, Rx, Gx	
References:	Gm, Mw	ETSI TS 124 229 [2], clause 5.2.5.1and clause 5.2.8.1.2 and clause 5.4.1.5 and clauses 6.2 and 6.3
	Rx	ETSI TS 129 214 [6], clause 4.4.6.1
	Gx	ETSI TS 129 212 [7], clause 4.5.7
	Cx	ETSI TS 129 228 [4], clauses 6.1.1.1, 6.1.2.1 and A.4.3 ETSI TS 129 229 [5], clauses 6.1.1, 6.1.2, 6.1.3 and 6.1.4
Pre-test conditions:	• UE A previously attached to EPC with a single attachment. • UE A previously registered to IMS. • UE A previously established SIP session with UE B.	
Test Sequence:	**Step**	
	1	UE initiates IP-CAN session termination.
	2	EPC triggers removal of all affected bearers.
	3	Verify that EPC aborts affected Rx sessions with IMS.
	4	Verify that IMS performs P-CSCF-initiated call release on affected SIP sessions and admin IMS De-registration.
	5	Verify that media is no longer exchanged after these procedures.
	6	Verify that media between UE and other endpoint can no longer be exchanged and is filtered out by EPC.

Interoperability Test Description			
Conformance criteria of test sequence step:	1	Gx	TP_GX_PCRF_CCA_02 (CCR, CCA - Events 2, 3)
	2	Rx Rx	TP_RX_PCRF_ASA_01 (ASR, ASA - Events 4, 5) TP_RX_PCRF_STA_02 (STR, STA - Events 6, 7)
	3	Rx Rx	TP_RX_PCRF_ASA_01 (ASR, ASA - Events 11, 12) TP_RX_PCRF_STA_02 (STR, STA - Events 13, 14)
	4	MwPS MwIS MwSI Cx Cx	TP_MW_PCSCF_REGISTER_11 (Events 8, 9, 15, 22) TP_MW_ICSCF_REGISTER_07 (Event 18) TP_MW_SCSCF_REGISTER_07 (Events 18, 21) TP_CX_HSS_UAA_04 (UAR,UAA - Events 16, 17) TP_CX_HSS_SAA_02 (SAR,SAA - Events 19, 20)

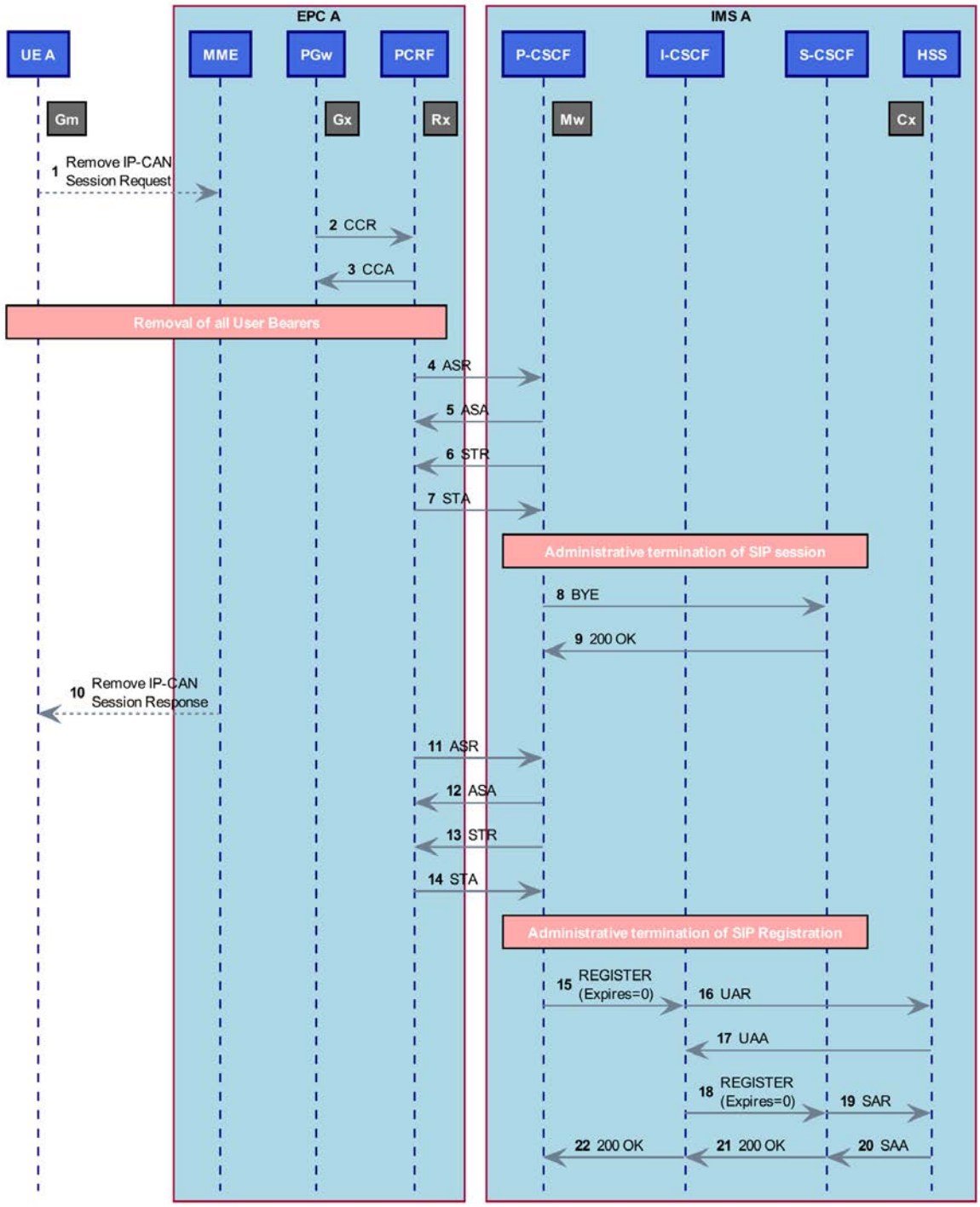


Figure 26: UE Initiated Network Detachment (IMS Registered & IMS sessions)

1) User initiates detachment on UE-A. The UE-A requests IP-CAN session dis-establishment to the EPC (MME).
2) The P-GW sends a CCR message to the PCRF to inform the PCRF that the default bearer is being released.
3) The PCRF responds with a CCA.
4) PCRF sends ASR to IMS P-CSCF (for session bearer).
5) IMS P-CSCF responds with ASA.
6) IMS P-CSCF sends STR to abort the Rx session (session bearer).
7) EPC P-GW responds with STA.
8) P-CSCF forwards the BYE to S-CSCF.
9) S-CSCF forwards 200 OK (BYE) to P-CSCF.
10) The MME responds to the UE, confirming that the IP-CAN has been successfully released.
11) PCRF sends ASR to IMS P-CSCF (for default bearer).
12) IMS P-CSCF responds with ASA.
13) IMS P-CSCF sends STR to abort the Rx session (default bearer).
14) EPC P-GW responds with STA.
15) P-CSCF forwards the REGISTER(Expires=0) to I-CSCF.
16) I-CSCF sends UAR to HSS.
17) HSS responds with UAA.
18) I-CSCF forwards the REGISTER to S-CSCF.
19) S-CSCF sends SAR to HSS.
20) HSS responds with SAA.
21) The IMS de-registration is successful.
22) I-CSCF forwards 200 response to P-CSCF.

5.5.4 HSS Initiated Network Detachment (no IMS Registration)

Interoperability Test Description		
Identifier:	TD_VxLTE_INT_DTC_04	
Objective:	To demonstrate HSS initiated network detachment (IP-CAN session termination) for a UE that has not yet registered to IMS.	
Summary:	On complete network detachment, the EPC removes all relevant bearers.	
Configuration:	CF_VxLTE_INT	
SUT:	IMS A and EPC A	
Interfaces:	Gx, S6a	
References:	Gx	ETSI TS 129 212 [7], clause 4.5.7
	S6a	ETSI TS 129 272 [8], clause 5.2.1.2
Pre-test conditions:	• UE A previously attached to EPC with a single attachment.	
Test Sequence:	**Step**	
	1	HSS triggers n/w initiated network detachment, whilst UE is not registered at IMS.
	2	Verify that EPC removes the affected bearer.
	3	Verify that EPC P-GW informs the PCRF of the loss of the bearer.
	4	Verify that EPC MME informs the UE of the detachment.

Interoperability Test Description		
Conformance criteria of test sequence step:	1	S6a TP_S6A_HSS_CLR_01 (CLR - Event 1)
	2	Gx TP_GX_PCRF_CCA_03 (CCR, CCA - Events 3, 5)
	3	S6a TP_S6A_HSS_CLA_01 (CLR - Event 6)

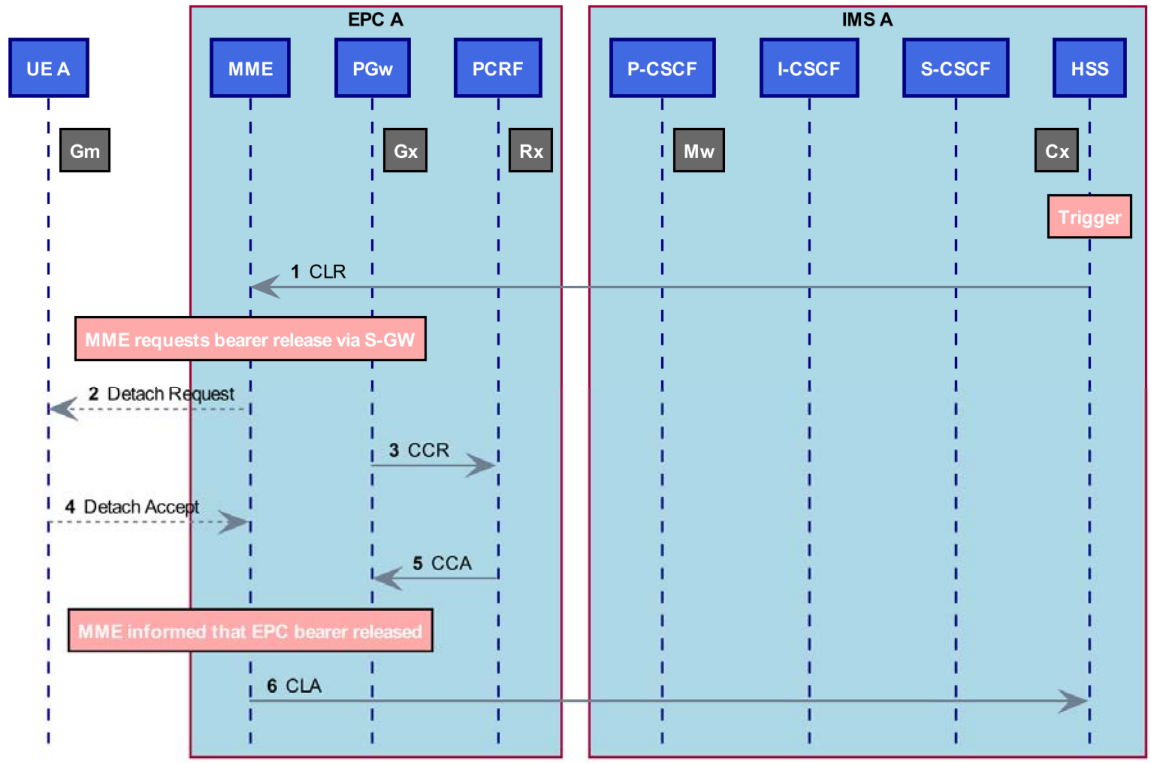


Figure 27: HSS Initiated Network Detachment (not IMS Registered)

1) HSS initiates detachment on UE-A (e.g. by withdrawing subscription from the UE). HSS sends a CLR message to the EPC MME.

2) The UE is requested to Detach.

3) The EPC MME initiates the release of the EPC bearer via the EPC S-GW. The P-GW sends a CCR message to the PCRF to inform the PCRF that the default bearer is being released.

4) The UE responds to the MME UE, confirming the Detach request.

5) The PCRF responds with a CCA.

6) The MME responds to the HSS with CLA.

The flows for the cases where the UE is IMS registered or IMS registered with active IMS sessions at the point of HSS initiated detachment may be derived from figures 24 and 25 respectively with appropriate messages being triggered at the PCRF on receipt of the DIAMETER CCR message.

5.5.5 MME Purge User Data

Interoperability Test Description	
Identifier:	TD_VxLTE_INT_PUR_05
Objective:	To demonstrate MME initiated purging of previously stored UE data. The purging may be triggered by MMI action at the MME, prolonged inactivity of the attached UE or (optionally) following UE initiated detachment.
Summary:	On triggering the procedure, the MME deletes the user data and inform the HSS that it has done so.
Configuration:	CF_VxLTE_INT
SUT:	IMS A and EPC A

Interoperability Test Description		
Interfaces:	S6a	
References:	S6a	ETSI TS 129 272 [8], clause 5.2.1.3 (Purge UE data over S6a reference point).
Pre-test conditions:	• UE A previously attached to EPC with a single attachment and inactive for a sufficiently long time; or • UE initiated detachment has occurred.	
Test Sequence:	**Step**	
	1	MME triggers purging of UE data via MMI, prolonged inactivity of an attached UE or following a UE initiated detachment.
	2	Verify that MME deletes the user data and informs the HSS.
Conformance criteria of test sequence step:	1, 2	S6a TP_S6A_MME_PUR_01 (PUR - Event 1) S6a TP_S6A_HSS_PUA_01 (PUA - Event 2)

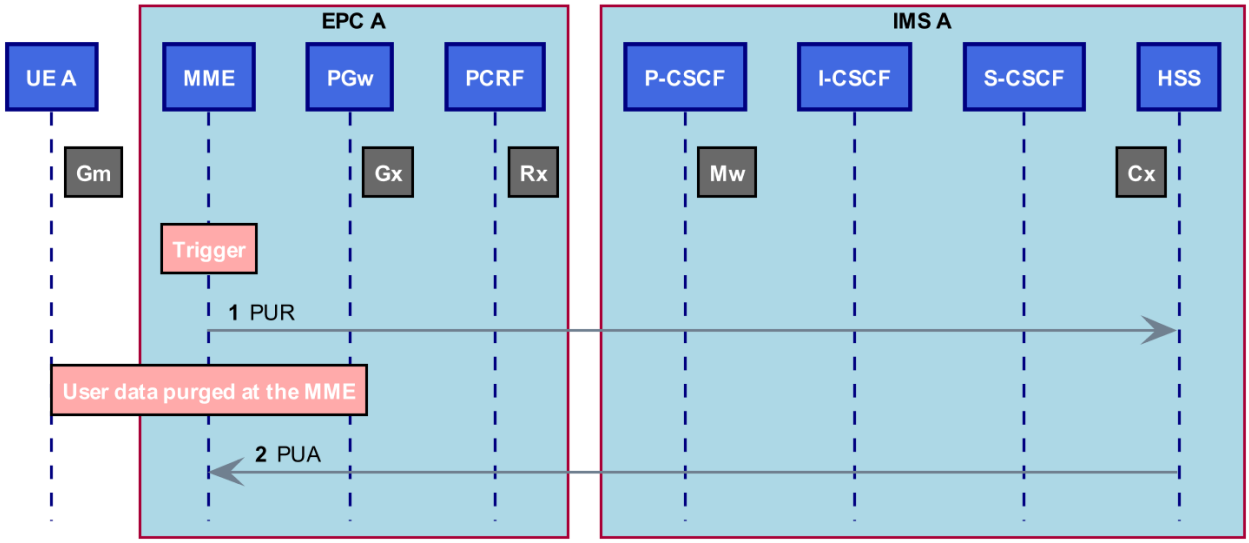


Figure 28: MME Purging of User data

1) MME triggers purging of user data. MME sends a PUR message to the HSS.

2) The HSS responds to the MME. The user data is deleted at the MME.

6 Test Descriptions (Roaming)

6.1 Network Attachment

6.1.1 UE Initial Network Attachment and Establishment of the Default Bearer

Interoperability Test Description	
Identifier:	TD_VxLTE_RMI_ATT_01
Objective:	To perform UE initial attachment to the network and establish a default bearer.
Summary:	On successful initial network attachment, the roaming UE should discover the P-CSCF IP address. The EPC will create the Default Bearers which will allow communication only between the UE and the P-CSCF.
Configuration:	CF_VxLTE_RMI_B
SUT:	IMS A and EPC B

Interoperability Test Description		
Interfaces:	S9 ,Gx, S6a	
References:	Gm, Mw	ETSI TS 124 229 [2], clauses 9.2.1 and L.2.2.1
	S9	ETSI TS 129 215 [9], clauses 4.5.1.1 and 4.5.3.1
	Gx	ETSI TS 129 212 [7], clauses 4.5.1 (item 1) and 4a.5.1 (item 1)
	S6a	ETSI TS 129 272 [8], clauses 5.2.1.1 and 5.2.3.1
Pre-test conditions:	• Network attachment credential provisioned in UE A, HSS/SPR and PCRF. • HSS/SPR and UE A provisioned with selectable APN configurations for IPv4, IPv6 or IPv4&IPv6 PDN types. • P-CSCF address provisioned in the PCRF for the purpose of delivery to UE on attachment. • Default Bearer PCRF policies set to allow UE A - P-CSCF communication. • Default EPC Gating Policy set to "Deny". • UE A not attached to network and EPC.	
Test Sequence:	**Step**	
	1	UE A starts initial network attachment to EPC.
	2	Verify that the message sequence is correct.
	3	Verify that EPC establishes Default Bearer for allowing UE A - P-CSCF communication, by starting at UE A an IMS registration.
	4	Verify that UE A attached successfully and received the following information: • suitable IPv4 and/or IPv6 address(es) • DNS configuration information P-CSCF IP address or FQDN
	5	Verify that arbitrary IP packets from UE A to arbitrary node, other than the P-CSCF, are filtered-out by EPC and not visible on PO_SGi.
	6	Verify that arbitrary IP packets from another node (e.g. UE B sent over PO_SGi) to UE A, are filtered-out by EPC and not visible on PO_UE A.
Conformance criteria of test sequence step:	1	S6a TP_S6A_MME_AIR_02 (AIR - Event 2) S6a TP_S6A_HSS_AIA_02 (AIA - Event 3)
	2	S6a TP_S6A_MME_ULR_02 (ULR - Event 4) S6a TP_S6A_HSS_ULA_02 (ULA - Event 5)
	3	Gx TP_GX_PGW_CCR_01 (CCR - Event 6)
	4	S9 TP_S9_PCRF_CCR_01 (CCR - Event 7) S9 TP_S9_PCRF_CCA_01 (CCA - Event 8) Gx TP_GX_PCRF_CCA_01 (CCA - Event 9)

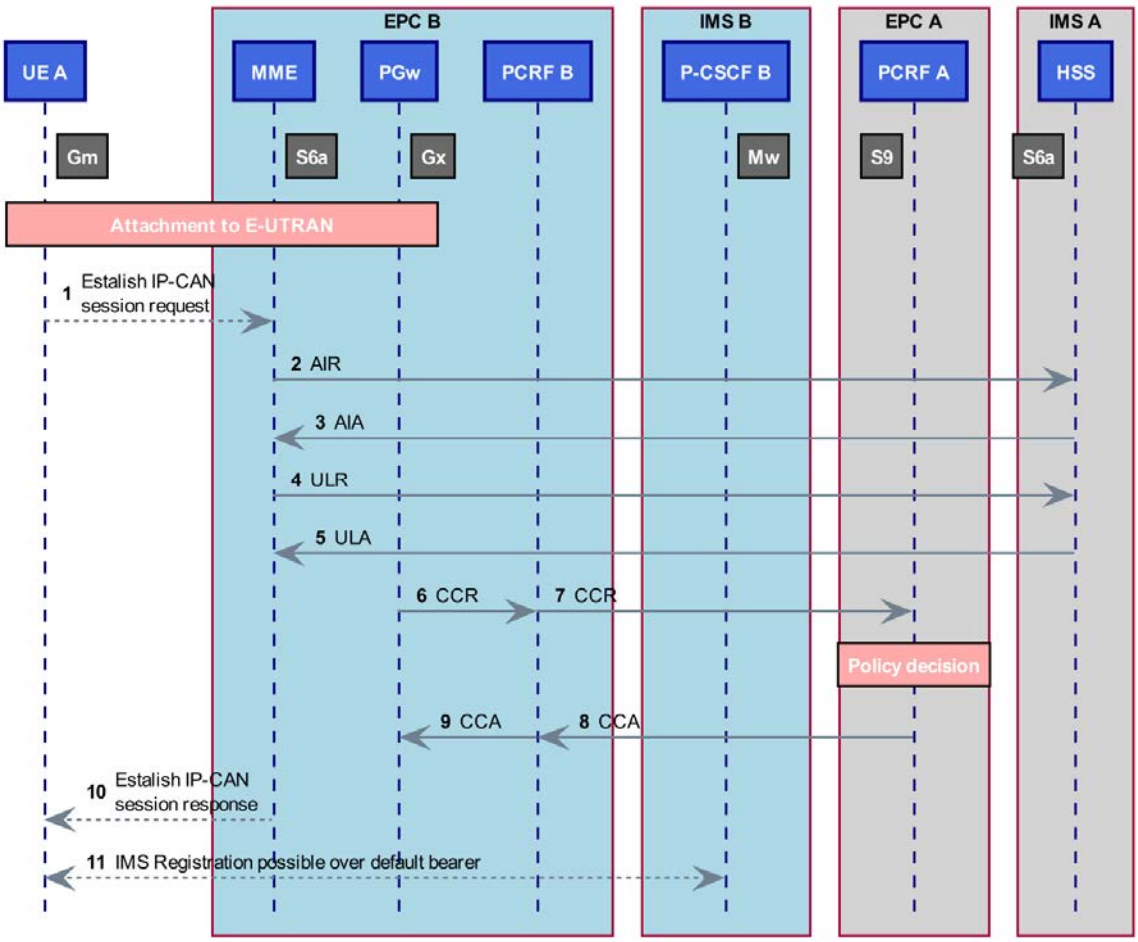


Figure 29: Initial Network Attachment (Roaming)

1) User initiates attachment on UE-A. The UE-A requests IP-CAN session establishment to the EPC (MME).

2) The MME sends an AIR message to the HSS/SPR.

3) The HSS responds AIA.

4) The MME sends a ULR message to the HSS/SPR.

5) The HSS responds ULA.

6) The P-GW sends a CCR message to the visited PCRF to request the default bearer.

7) The visited PCRF invokes the home PCRF. The home PCRF checks if the user is entitled to set up the requested bearer.

8) The home PCRF responds with a CCA to the visited PCRF.

9) The visited PCRF responds to the EPC (P-GW).

10) The MME responds to the UE, confirming that the IP-CAN has been successfully set up.

11) User is informed that the default bearer has been successfully set up.

The default bearer is established with the following parameters (see ETSI TS 123 203 [i.2]) and is used to transport the IMS signalling.

QoS Class Identifier	Resource-Type	Priority	Packet Delay Budget	Packet Error Loss Rate	Example Services
5	Non-GBR	1	100 ms	10^{-6}	IMS Signalling

6.2 IMS Registration

6.2.1 User via EPC - IMS Initial registration - Successful

Interoperability Test Description		
Identifier:	TD_VxLTE_RMI_REG_01	
Objective:	To perform initial IMS registration via the established default bearer for a roaming UE. Note that some UEs perform IMS registration automatically on attachment - in which case this test becomes merged with the previous one.	
Summary:	On successful initial registration, the P-CSCF shall request the PCRF to perform session binding onto the underlying default bearer for the IMS application. The PCRF should act on the request and modify the bearer. Subsequent signalling should make use of the respective bearer's QoS and priority characteristics.	
Configuration:	CF_VxLTE_RMI_B	
SUT:	IMS A, IMS B and EPC B	
Interfaces:	Gm, Mw, Cx, Rx, Gx, S9	
References:	Gm, Mw	ETSI TS 124 229 [2], clause 5.1.1.1 and clause 5.2.3B and clause 5.2.2.1 and clause 5.3.1.1 and clause 5.4.1.2 and clause 5.4.2 and clauses 6.2 and 6.3
	Ic	ETSI TS 124 229 [2], clause 5.10.2.1 and clause 5.10.3.1 and clause 5.10.4.2 and clause 5.10.3.2
	Cx	ETSI TS 129 228 [4], clauses 6.1.1, 6.1.2 and 6.3 ETSI TS 129 229 [5], clauses 6.1.1, 6.1.2, 6.1.3, 6.1.4, 6.1.7 and 6.1.8
	Rx	ETSI TS 129 214 [6], clauses 4.4.5a, A.8 and annex B
	S9	ETSI TS 129 215 [9], clause 4.5.3.6
	Gx	ETSI TS 129 212 [7], clauses 4.5.2 and 4.5.3
Pre-test conditions:	• Roaming UE A previously attached to EPC, but not registered to IMS, and a default bearer has been established a Default Bearer allowing UE A - P-CSCF IP communication. • HSS provisioned with UE A' subscription. • UE A discovered the P-CSCF address.	
Test Sequence:	**Step**	
	1	UE A triggers IMS registration.
	2	Verify that the message sequence is correct.
	3	Verify that, in Diameter AA-Request/Answer, IMS included a Media Description for signalling according to UE A.IP_Address, UE A.SIP_Port, PCSCF.IP_Address, PCSCF.SIP_Port.
	4	Verify that the PCRF successfully provisioned QOS rules to the EPC on the default bearer.
	5	Verify that the Rx messages for IMS session binding are exchanged via the home and visited n/w PCRFs.
	6	Verify that UE A can exchange subsequent signalling with IMS.
	7	Verify that UE A subsequent signalling is transported with appropriate PCC characteristics.

Interoperability Test Description			
Conformance criteria of test sequence step:	1-2	Gm	TP_GM_PCSCF_REGISTER_04 (Events 1, 14)
		Gm	TP_GM_PCSCF_REGISTER_05 (Events 15, 28)
		Gm	TP_GM_PCSCF_SUBSCRIBE_02 (Events 29, 36)
		MwPS	TP_MW_PCSCF_REGISTER_04 (Events 2, 13)
		MwPS	TP_MW_PCSCF_REGISTER_05 (Events 16, 27)
		MwIS	TP_MW_ICSCF_REGISTER_04 (Events 7, 10)
		MwIS	TP_MW_ICSCF_REGISTER_05 (Events 21, 24)
		MwPS	TP_MW_PCSCF_SUBSCRIBE_02 (Events 30, 35)
		Ic	TP_IC_IBCF_REGISTER 01 (Events 3, 12)
		Ic	TP_IC_IBCF_REGISTER 02 (Events 17, 26)
		Ic	TP_IC_IBCF_SUBSCRIBE 01 (Events 31, 34)
		Cx	TP_CX_HSS_UAA_01 (UAR, UAA - Events 5, 6)
		Cx	TP_CX_HSS_MAA_01 (MAR, MAA - Events 8, 9)
		Cx	TP_CX_HSS_UAA_02 (UAR, UAA - Events 19, 20)
		Cx	TP_CX_HSS_SAA_01 (SAR, SAA - Events 22, 23)
	3	Rx	TP_RX_PCSCF_AAR_01 (AAR - Event 37)
		S9	TP_S9_PCRF_AAR_01 (AAR - Event 38)
		S9	TP_S9_PCRF_AAA_01 (AAA - Event 39)
	4, 5	Rx	TP_RX_PCRF_AAA_03 (AAA - Event 40)
	6, 7	Gx	TP_GX_PGW_RAA_01 (RAR, RAA - Events 41, 42)

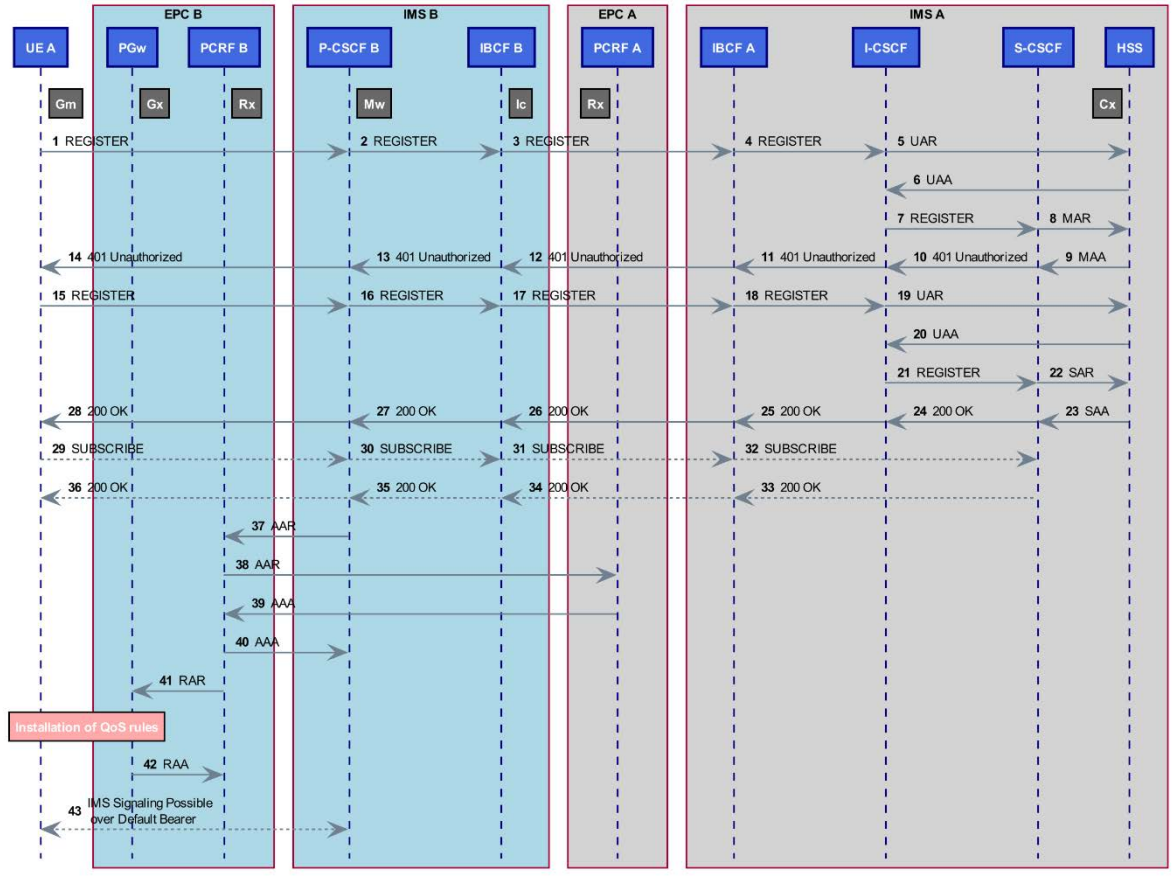


Figure 30: IMS Initial Registration - success (Roaming)

1) The UE-A in roaming requests IMS A Registration.

2) Visited P-CSCF forwards the REGISTER to visited IBCF B.

3) Visited IBCF B forwards REGISTER to home IBCF A

4) IBCF A sends REGISTER to I-CSCF

5) I-CSCF sends UAR to HSS.

6) HSS responds with UAA.
7) I-CSCF forwards the REGISTER to S-CSCF.
8) S-CSCF sends MAR to HSS.
9) HSS responds with MAA.
10) IMS home rejects the REGISTER and issues a challenge.
11) I-CSCF forwards 401 response to IBCF A.
12) Home IBCF A forwards 401 response to visited IBCF B.
13) Visited IBCF B forwards 401 response to visited P-CSCF B.
14) Visited P-CSCF forwards 401 response to UE-A.
15) The REGISTER is re-sent with an Authorization header.
16) Visited P-CSCF forwards the REGISTER to visited IBCF B.
17) Visited IBCF B forwards REGISTER to home IBCF A.
18) IBCF A sends REGISTER to I-CSCF.
19) I-CSCF sends UAR to HSS.
20) HSS responds with UAA.
21) I-CSCF forwards the REGISTER to S-CSCF.
22) S-CSCF sends SAR to HSS.
23) HSS responds with SAA.
24) Home S-CSCF sends 200 OK response to home I-CSCF.
25) I-CSCF forwards 200 OK response to IBCF A.
26) Home IBCF A forwards 200 OK response to visited IBCF B.
27) Visited IBCF B forwards 200 OK response to visited P-CSCF B.
28) Visited P-CSCF forwards 200 OK response to UE-A.
29) The P-CSCF subscribes to the registration event package to be notified of a de-registration.
30) P-CSCF forwards the SUBSCRIBE to visited IBCF B.
31) Visited IBCF B forwards the SUBSCRIBE to home IBCF A.
32) Home IBCF A forwards the SUBSCRIBE to home S-CSCF.
33) S-CSCF responds with 200 OK to home IBCF A.
34) Home IBCF A forwards 200 OK to visited IBCF B.
35) Visited IBCF B forwards 200 OK to visited P-CSCF.
36) P-CSCF forwards the 200 OK to UE-A.
37) The P-CSCF visited initiates session binding to the default bearer with AAR.
38) The PCRF forwards AAR to the PCRF home.
39) The PCRF home responds with AAA.
40) The PCRF visited send AAA to the P-CSCF.

41) The PCRF pushes a flow description with RAR to the P-GW to modify the default bearer.

42) The P-GW in the EPC responds with RAA to the PCRF.

43) The default bearer has been successfully modified and bi-directional IMS signalling is possible.

6.2.2 User via EPC - IMS Initial Registration - Unsuccessful

This test description is identical to clause 5.2.2. The only difference is that the P-CSCF resides in the visited network and the S-CSCF resides in the home network. The MwPS reference point therefore crosses the n/w boundary between the visited and home networks.

6.2.3 User - IMS Initial registration - thirdparty register to AS

Interoperability Test Description		
Identifier:	TD_VxLTE_RMI_REG_03	
Objective:	To perform initial IMS registration via the established default bearer for a roaming UE. Note that some UEs perform IMS registration automatically on attachment - in which case this test becomes merged with the previous one.	
Summary:	On successful initial registration, the P-CSCF shall request the PCRF to perform session binding onto the underlying default bearer for the IMS application. The PCRF should act on the request and modify the bearer. Subsequent signalling should make use of the respective bearer's QoS and priority characteristics.	
Configuration:	CF_VxLTE_RMI_B	
SUT:	IMS A, IMS B and EPC B	
Interfaces:	Gm, Mw, Isc, Ic, Cx, Rx, Gx, S9	
References:	Gm, Mw	ETSI TS 124 229 [2], clause 5.1.1.1 and clause 5.2.2.1 and clause 5.2.3B and clause 5.3.1.1 and clause 5.4.1.2 and clause 5.4.2 and clauses 6.2 and 6.3
	Isc	ETSI TS 124 229 [2], clause 5.4.1.7
	Ic	ETSI TS 124 229 [2], clause 5.10.2.1 and clause 5.10.3.1 and clause 5.10.4.2 and clause 5.10.3.2
	Cx	ETSI TS 129 228 [4], clauses 6.1.1, 6.1.2 and 6.3 ETSI TS 129 229 [5], clauses 6.1.1, 6.1.2, 6.1.3, 6.1.4, 6.1.7 and 6.1.8
	Rx	ETSI TS 129 214 [6], clauses 4.4.5a, A.8 and annex B
	S9	ETSI TS 129 215 [9], clause 4.5.3.6
	Sh	ETSI TS 129 328 [10], clause 6.1.1.1
	Gx	ETSI TS 129 212 [7], clauses 4.5.2 and 4.5.3
Pre-test conditions:	• Roaming UE A previously attached to EPC, but not registered to IMS, and a default bearer has been established a Default Bearer allowing UE A - P-CSCF IP communication. • HSS provisioned with UE A' subscription. • UE A discovered the P-CSCF address.	
Test Sequence:	**Step**	
	1	UE A triggers IMS registration.
	2	Verify that the message sequence is correct.
	3	Verify that, in Diameter AA-Request/Answer, IMS included a Media Description for signalling according to UE A.IP_Address, UE A.SIP_Port, PCSCF.IP_Address, PCSCF.SIP_Port.
	4	Verify that the PCRF successfully provisioned QOS rules to the EPC on the default bearer.
	5	Verify that the Rx messages for IMS session binding are exchanged via the home and visited n/w PCRFs.
	6	Verify that UE A can exchange subsequent signalling with IMS.

Interoperability Test Description			
	7	Verify that UE A subsequent signalling is transported with appropriate PCC characteristics.	
Conformance criteria of test sequence step:	1, 2	Gm	TP_GM_PCSCF_REGISTER_04 (Events 1, 14)
		Gm	TP_GM_PCSCF_REGISTER_05 (Events 15, 32)
		Gm	TP_GM_PCSCF_SUBSCRIBE_02 (Events 33, 40)
		MwPS	TP_MW_PCSCF_REGISTER_04 (Events 2, 13)
		MwPS	TP_MW_PCSCF_REGISTER_05 (Events 16, 31)
		MwIS	TP_MW_ICSCF_REGISTER_04 (Events 7, 10)
		MwIS	TP_MW_ICSCF_REGISTER_05 (Events 21, 28)
		MwPS	TP_MW_PCSCF_SUBSCRIBE_02 (Events 36, 37)
		Ic	TP_IC_IBCF_REGISTER_01 (Events 3, 12)
		Ic	TP_IC_IBCF_REGISTER_02 (Events 17, 30)
		Ic	TP_IC_IBCF_SUBSCRIBE_01 (Events 35, 38)
		Cx	TP_CX_HSS_UAA_01 (UAR, UAA - Events 5, 6)
		Cx	TP_CX_HSS_MAA_01 (MAR, MAA - Events 8, 9)
		Cx	TP_CX_HSS_UAA_02 (UAR, UAA - Events 19, 20)
		Cx	TP_CX_HSS_SAA_01 (SAR, SAA - Events 22, 23)
		Isc	TP_ISC_SCSCF_REG_01 - (Events 24, 27)
		Sh	TP_SH_HSS_UDA_01 (UDR, UDA - Events 25, 26)
	3	Rx	TP_RX_PCSCF_AAR_01 (AAR - Event 41)
		S9	TP_S9_PCRF_AAR_01 (AAR - Event 42)
		S9	TP_S9_PCRF_AAA_01 (AAA - Event 43)
	4, 5	Rx	TP_RX_PCRF_AAA_03 (AAA - Event 44)
	6, 7	Gx	TP_GX_PGW_RAA_01 (RAR, RAA - Events 45, 46)

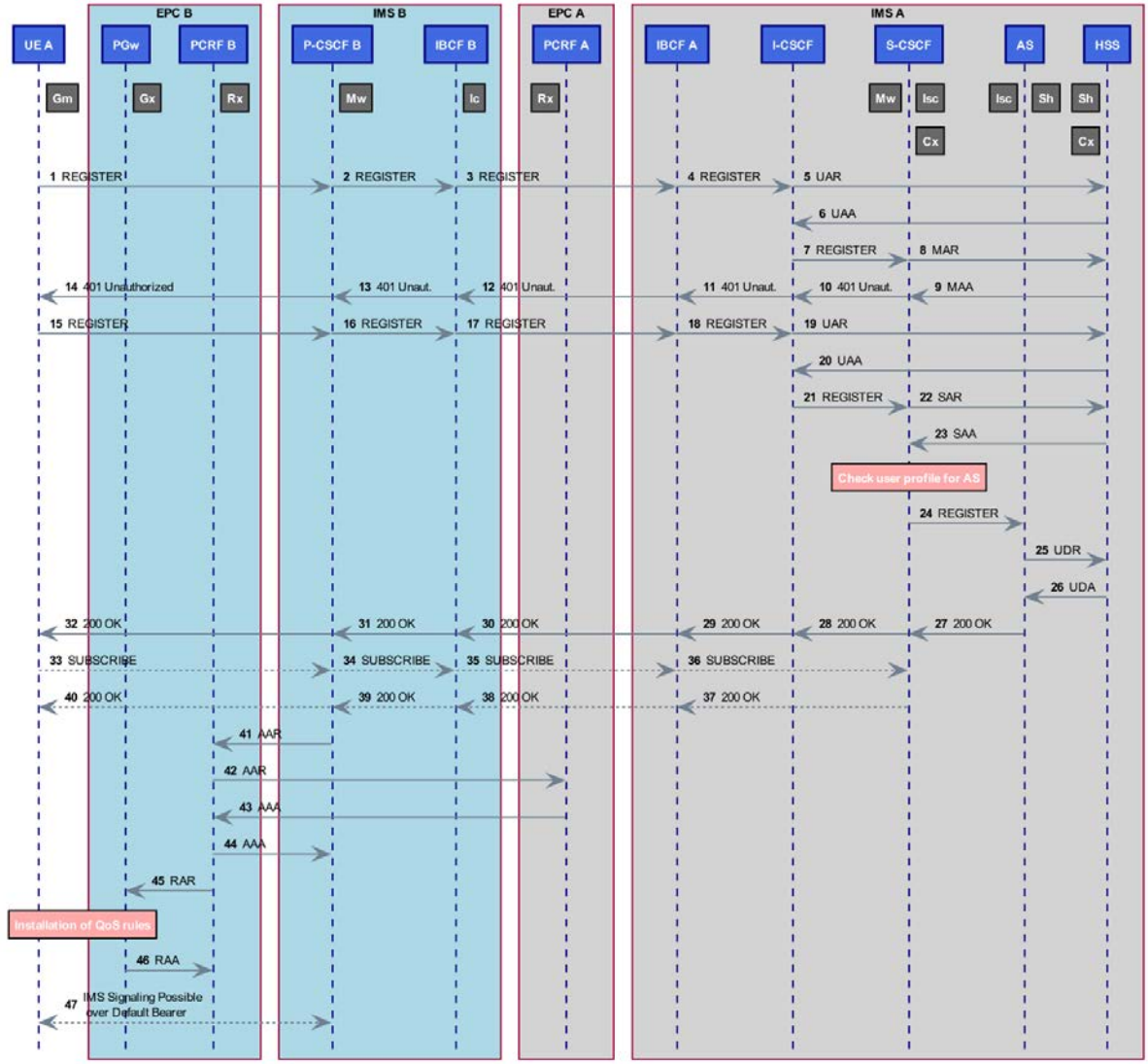


Figure 31: IMS Initial Registration - third party register to AS (Roaming)

1) The UE-A in roaming requests IMS A Registration.
2) Visited P-CSCF forwards the REGISTER to visited IBCF B.
3) Visited IBCF B forwards the REGISTER to home IBCF A.
4) Home IBCF A forwards the REGISTER to home I-CSCF.
5) I-CSCF sends UAR to HSS.
6) HSS responds with UAA.
7) I-CSCF forwards the REGISTER to S-CSCF.
8) S-CSCF sends MAR to HSS.
9) HSS responds with MAA.
10) IMS home rejects the REGISTER and issues a challenge.
11) I-CSCF forwards 401 response to IBCF A.
12) Home IBCF A forwards 401 response to visited IBCF B.
13) Visited IBCF B forwards 401 response to visited P-CSCF B.

14) Visited P-CSCF forwards 401 response to UE-A.

15) The REGISTER is re-sent with an Authorization header.

16) Visited P-CSCF forwards the REGISTER to visited IBCF B.

17) Visited IBCF B forwards REGISTER to home IBCF A.

18) IBCF A sends REGISTER to I-CSCF.

19) I-CSCF sends UAR to HSS.

20) HSS responds with UAA.

21) I-CSCF forwards the REGISTER to S-CSCF.

22) S-CSCF sends SAR to HSS.

23) HSS responds with SAA.

24) S-CSCF sends REGISTER to AS.

25) AS via Sh sends UDR to the HSS.

26) HSS answers with UDA.

27) AS confirms REGISTER with 200OK to home S-CSCF. The IMS registration is successful.

28) S-CSCF forwards 200 response to home I-CSCF.

29) I-CSCF forwards 200 response to home IBCF A.

30) Home IBCF A forwards response to visited IBCF B.

31) Visited IBCF B forwards 200 response to visited P-CSCF.

32) Visited P-CSCF forwards 200 response to UE-A.

33) The P-CSCF subscribes to the registration event package to be notified of a de-registration.

34) P-CSCF forwards the SUBSCRIBE to visited IBCF B.

35) Visited IBCF B forwards the SUBSCRIBE to home IBCF A.

36) Home IBCF A forwards the SUBSCRIBE to home S-CSCF.

37) S-CSCF responds with 200 OK to home IBCF A.

38) Home IBCF A forwards 200 OK to visited IBCF B.

39) Visited IBCF B forwards 200 OK to visited P-CSCF.

40) P-CSCF forwards the 200 OK to UE-A.

41) The visited P-CSCF initiates session binding to the default bearer with AAR.

42) The PCRF forwards AAR to the PCRF home.

43) The PCRF home responds with AAA.

44) The PCRF visited send AAA to the P-CSCF.

45) The PCRF pushes a flow description with RAR to the P-GW to modify the default bearer.

46) The P-GW in the EPC responds with RAA to the PCRF.

47) The default bearer has been successfully modified and bi-directional IMS signalling is possible.

6.3 SIP Session and Dedicated Bearer Operations

6.3.0 Introduction

As in clause 5.3, this clause builds on the previous attachment and IMS registration flows and considers SIP session establishment and cleardown and the resulting interactions between the UE, EPC, PCRF and IMS for the establishment, modification and release of dedicated bearers for media flows associated with SIP sessions involving a roaming UE.

As for the single network test descriptions, these test descriptions assume SDP Offer in INVITE and SDP Answer in the 180 (Ringing) response and are split into separate originating and terminating flows.

6.3.1 SIP Session Establishment

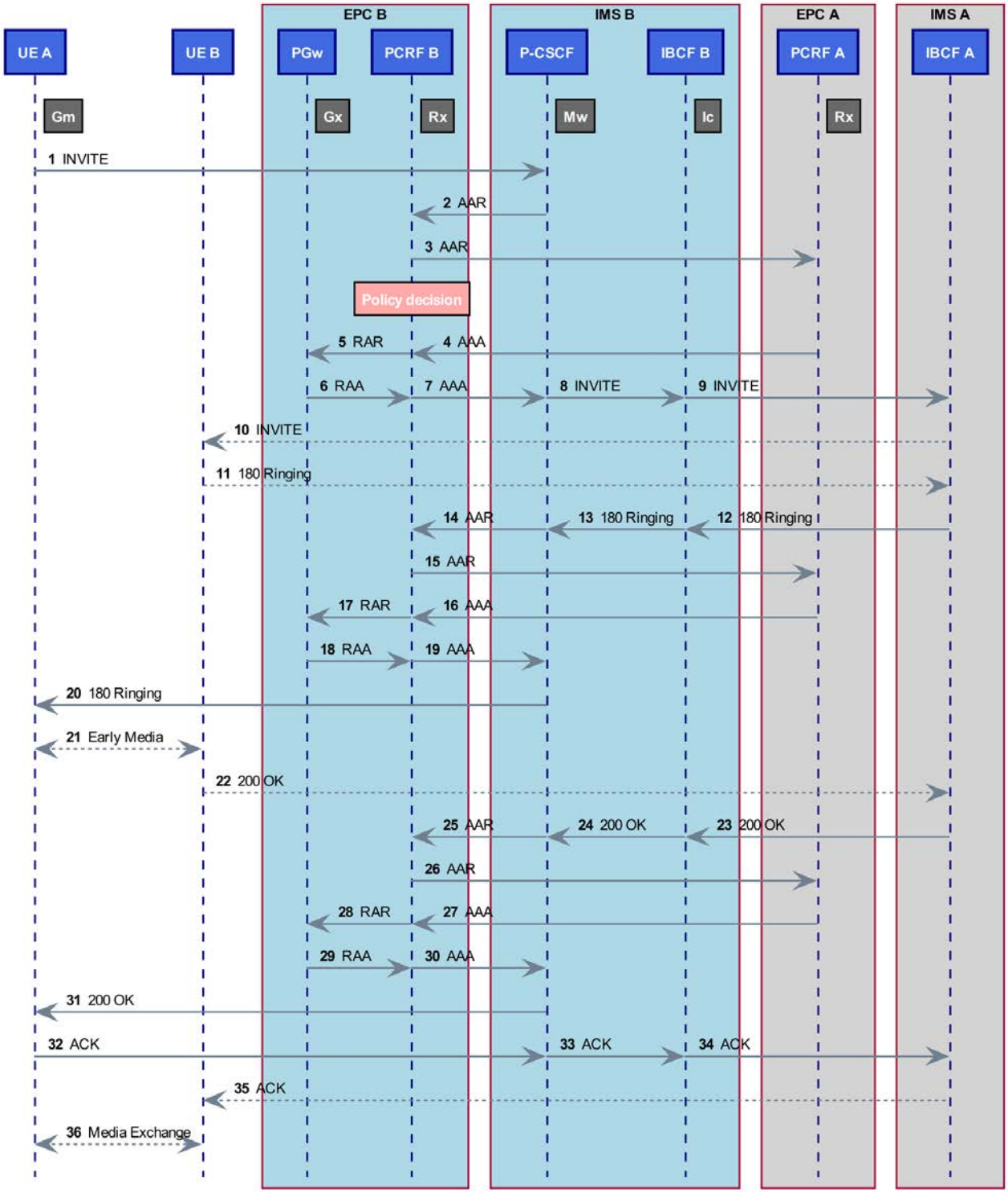
6.3.1.0 General

The test assumes that the UE A for originating cases and UE B for terminating cases are roaming and have been previously attached to EPC and registered to IMS. The details verified by these tests are as clause 5.3.1.

6.3.1.1 Originating Leg

Interoperability Test Description		
Identifier:	TD_VxLTE_RMI_INI_01	
Objective:	To demonstrate the establishment of dedicated bearers at the originating EPC due to SIP session establishment for a roaming UE.	
Summary:	On successful call setup, the P-CSCF should derive from the SDP offer and answer, descriptions of the Service Data Flow. These are pushed towards PCRF and EPC as request for creation of adequate bearers. EPC creates based on the EPC's operator policies the bearers for media. When transporting media, the EPC will employ the respective bearer's characteristics. Media transport is possible only after the successful establishment of the session. Media negotiation happens during INVITE/200 OK (UE A sends SDP-offer, UE B responds with SDP-answer).	
Configuration:	CF_VxLTE_RMI_B	
SUT:	IMS A, IMS B and EPC A	
Interfaces:	Gm, Mw, Rx, Gx, Ic, S9	
References:	Ic	ETSI TS 124 229 [2], clause 5.2.6.3.3 (1st numbered list) and clause 5.2.7.3 and clause 5.4.3.2 (item 1 in 7th numbered list) clause 5.2.6.4.4 (1st numbered list) clause 5.10.3.2
	Gm, Mw	ETSI TS 124 229 [2], clause 5.2.7.2 and clause 5.3.2.1 and clause 5.3.2.1A and clause 5.4.4.1 and clause 5.4.4.2
	Rx	ETSI TS 129 214 [6], clauses 4.4.1, A.1, A.2 and annex B
	Gx	ETSI TS 129 212 [7], clause 4.5.2
	S9	ETSI TS 129 215 [9], clause 4.5.3.6
Pre-test conditions:	• Roaming UE A previously attached to EPC B. • EPC B established a Default Bearer allowing UE A - P-CSCF IP communication. • UE A previously registered to IMS A. • EPC B established an IMS A signalling bearer. • UE B ready to accept the session establishment.	

Interoperability Test Description			
Test Sequence:	**Step**		
	1	Verify that media between UE A and UE B is not delivered in any direction before call establishment.	
	2	UE A calls UE B and establishes a communication session.	
	3	Verify that, in Diameter AA-Request/Answer, the IMS produced a Media Description for the session according to SDP-offer in SIP INVITE Request and SDP-answer in SIP 180 to the PCRF.	
	4	Verify that the Rx messages are sent over S9 between the visited and home PCRFs respectively.	
	5	Verify that the visited PCRF invokes the EPC P-GW with a DAMETER RA-Request to create a new bearer for the requested media.	
	6	Verify that PCRF requested media description was found acceptable by EPC and dedicated bearers are established and that a RA-Answer is sent to the PCRF.	
	7	Verify that media between UE A and UE B is successfully routed over the dedicated bearer and transported with appropriate PCC characteristics.	
Conformance criteria of test sequence step:	2	Gm Gm Gm Gm MwPS MwPS MwPS MwPS Ic Ic Ic Ic Ic	TP_GM_PCSCF_INVITE_03 (Event 1) TP_GM_PCSCF_180RINGING_03 (Event 20) TP_GM_PCSCF_200OK_03 (Event 31) TP_GM_PCSCF_ACK_03 (Event 32) TP_MW_PCSCF_INVITE_03 (Event 8) TP_MW_PCSCF_180RINGING_03 (Event 13) TP_MW_PCSCF_200OK_03 (Event 24) TP_MW_PCSCF_ACK_03 (Event 33) TP_IC_IBCF_INVITE_04 (INVITE - Event 9) TP_IC_IBCF_100TRY_02 (INVITE, 100 Trying - Event 9) TP_IC_IBCF_1XXRESP_03 (180 Ringing - Event 12) TP_IC_IBCF_2XXRESP_05 (200 OK Event 23) TP_IC_IBCF_ACK_01 (ACK - Event 34)
	3, 4	Rx Rx Rx S9 S9 Rx	TP_RX_PCSCF_AAR_03 (AAR - Events 2) TP_RX_PCSCF_AAR_04 (AAR - Events 14) TP_RX_PCSCF_AAR_05 (AAR - Events 25) TP_S9_PCRF_AAR_01 (AAR - Events 3, 15, 26) TP_S9_PCRF_AAA_02 (AAA - Events 4, 16, 27) TP_RX_PCRF_AAA_02 (AAA - Events 7, 19, 30)
	5	Gx	TP_GX_PCRF_RAR_03 (RAR - Events 5, 17, 28)
	6	Gx	TP_GX_PGW_RAA_02 (RAA - Events 6, 18, 29)
	7	Rtp	TP_RTP_06 (Event 36)



NOTE 1: Call is routed towards NWK A and terminating roaming TD_VxLTE_RMI_INI_02 or terminating interoperability TD_VxLTE_INT_INI_02 scenario may be checked for NWK UE B.
NOTE 2: Dashed connections between UE B and IBCF A represents the signalling which passes different entities but due to the scope of TD those are not points of observation.

Figure 32: SIP Session Establishment - Originating Leg (Roaming)

1) UE A roaming initiates the SIP session with an INVITE containing the SDP offer.

2) The IMS B P-CSCF invokes visited PCRF with AAR.

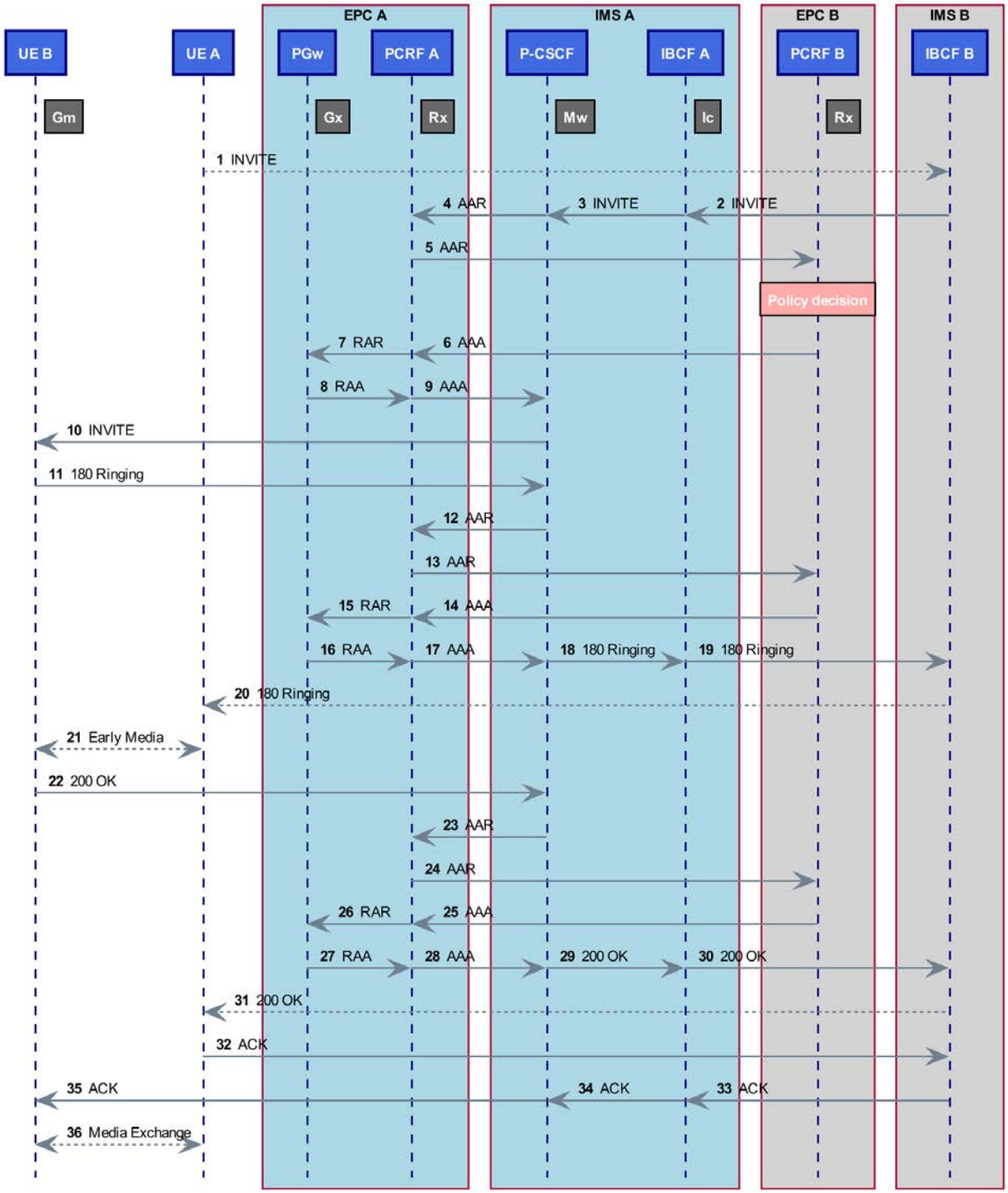
3) Visited PCRF sends AAR to home PCRF.

4) Home PCRF responds with AAA.
5) Visited PCRF sends RAR to EPC B P-GW.
6) EPC B P-GW responds with RAA.
7) Visited PCRF responds to IMS B P-CSCF with AAA.
8) P-CSCF forwards the INVITE to IBCF B.
9) IBCF B forwards the INVITE to IBCF A.
10) IBCF A forwards the INVITE towards UE B.
11) The UE B responds with the 180 (Ringing) with SDP answer.
12) IBCF A forwards the 180 (Ringing) to IBCF B.
13) IBCF B forwards the 180(Ringing) towards P-CSCF.
14) The IMS B P-CSCF invokes visited PCRF to modify the bearer.
15) Visited PCRF forwards AAR to home PCRF.
16) Home PCRF responds with AAA.
17) Visited PCRF sends RAR to EPC B P-GW.
18) EPC B P-GW responds with RAA.
19) Visited PCRF responds to IMS B P-CSCF with AAA.
20) P-CSCF forwards the SIP 180 (SDP) to UE A.
21) Early media may flow between the UEs.
22) The UE B responds with the 200 OK (SDP) answer.
23) IBCF A forwards the 200 OK to IBCF B.
24) IBCF B forwards the 200 OK to P-CSCF.
25) The IMS B P-CSCF invokes visited PCRF with AAR to modify the bearer.
26) Visited PCRF forwards AAR to home PCRF.
27) Home PCRF responds with AAA.
28) Visited PCRF sends RAR to EPC B P-GW.
29) EPC B P-GW responds with RAA.
30) Visited PCRF responds to IMS B P-CSCF with AAA.
31) P-CSCF forwards the SIP 200 OK to UE A.
32) The UE A sends ACK to 200 OK (INVITE).
33) P-CSCF forwards the ACK towards IBCF B.
34) IBCF B forwards the ACK to IBCF A.
35) IBCF A forwards the ACK to NWK A towards UE B.
36) The dedicated bearer(s) is/are set up and media can flow between the UEs.

6.3.1.2 Terminating Leg

Interoperability Test Description		
Identifier:	TD_VxLTE_RMI_INI_02	
Objective:	To demonstrate the establishment of dedicated bearers at the terminating EPC due to SIP session establishment for a roaming UE B.	
Summary:	On successful call setup, the P-CSCF should derive from the SDP offer and answer, descriptions of the Service Data Flow. These are pushed towards EPC as request for creation of adequate bearers. EPC creates based on the EPC's operator policies the bearers for media. When transporting media, the EPC will employ the respective bearer's characteristics. Media transport is possible only after the successful establishment of the session. Media negotiation happens during INVITE/180 (UE A sends SDP-offer, UE B responds with SDP-answer).	
Configuration:	CF_VxLTE_RMI_A	
SUT:	IMS A, IMS B and EPC A	
Interfaces:	Gm, Mw, Rx, Gx, Ic, S9	
References:	Ic	ETSI TS 124 229 [2], clause 5.2.6.3.3 (1st numbered list) and clause 5.2.7.3 and clause 5.4.3.2 (item 1 in 7th numbered list) and clause 5.4.3.3 (9th numbered list) and clause 5.2.6.4.4 (1st numbered list) and clause 5.10.3.2
	Gm, Mw	ETSI TS 124 229 [2], clause 5.2.7.3 and clause 5.3.2.1 and clause 5.3.2.1A and clause 5.4.4.1 and clause 5.4.4.2
	Rx	ETSI TS 129 214 [6], clauses 4.4.1, A.1, A.2 and annex B
	Gx	ETSI TS 129 212 [7], clause 4.5.2
	S9	ETSI TS 129 215 [9], clause 4.5.3.6
Pre-test conditions:	• Roaming UE B previously attached to EPC A. • EPC A established a Default Bearer allowing UE B - P-CSCF IP communication. • UE B previously registered to IMS B. • EPC A established an IMS B signalling bearer. • UE A ready to initiate the session establishment.	
Test Sequence:	**Step**	
	1	Verify that media between UE A and UE B is not delivered in any direction before call establishment.
	2	UE B receives a call request and establishes a communication session.
	3	Verify that, in Diameter AA-Request/Answer, the IMS produced a Media Description for the session according to SDP-offer in SIP INVITE Request and SDP-answer in 180 (Ringing) response.
	4	Verify that the Rx messages are sent over S9 between the visited and home PCRFs respectively.
	5	Verify that IMS requested media description was found acceptable by EPC.
	6	Verify that media between UE A and UE B is successfully routed and transported with appropriate PCC characteristics.

Interoperability Test Description			
Conformance criteria of test sequence step:	2	Gm	TP_GM_PCSCF_INVITE_04 (Event 10)
		Gm	TP_GM_PCSCF_180RINGING_04 (Event 11)
		Gm	TP_GM_PCSCF_200OK_04 (Event 22)
		Gm	TP_GM_PCSCF_ACK_04 (Event 35)
		MwPS	TP_MW_PCSCF_INVITE_04 (Event 3)
		MwPS	TP_MW_PCSCF_180RINGING_04 (Event 18)
		MwPS	TP_MW_PCSCF_200OK_04 (Event 29)
		MwPS	TP_MW_PCSCF_ACK_04 (Event 34)
		Ic	TP_IC_IBCF_INVITE_04 (INVITE - Event 2)
		Ic	TP_IC_IBCF_100TRY_01 (INVITE, 100 Trying - Event 2)
		Ic	TP_IC_IBCF_1XXRESP_04 (180 Ringing - Event 19)
		Ic	TP_IC_IBCF_2XXRESP_06 (200 OK Event 30)
		Ic	TP_IC_IBCF_ACK_01 (ACK - Event 33)
	3	Rx	TP_RX_PCSCF_AAR_06 (AAR - Events 4)
		Rx	TP_RX_PCSCF_AAR_07 (AAR - Events 12)
		Rx	TP_RX_PCSCF_AAR_08 (AAR - Events 23)
		S9	TP_S9_PCRF_AAR_01 (AAR - Events 5, 13, 24)
		S9	TP_S9_PCRF_AAA_02 (AAA - Events 6, 14, 25)
		Rx	TP_RX_PCRF_AAA_02 (AAA - Events 9, 17, 28)
	4	Gx	TP_GX_PCRF_RAR_03 (RAR - Events 7, 15, 26)
	5	Gx	TP_GX_PGW_RAA_02 (RAA - Events 8, 16, 27)
	6	Rtp	TP_RTP_06 (Event 36)



NOTE 1: Call is routed towards NWK B and originating roaming TD_VxLTE_RMI_INI_01 or originating interoperability TD_VxLTE_INT_INI_01 scenario may be checked for NWK UE A.
NOTE 2: Dashed connections between UE A and IBCF B represents the signalling which passes different entities but due to the scope of TD those are not points of observation.

Figure 33: SIP Session Establishment - Terminating Leg (Roaming)

1) UE A initiates the SIP session with an INVITE containing the SDP offer towards roaming UE B.

2) IBCF B forwards the INVITE to the IBCF A.

3) IBCF A forwards the INVITE towards P-CSCF.

4) The IMS A P-CSCF invokes visited PCRF with AAR.

5) Visited PCRF sends AAR to home PCRF.
6) Home PCRF responds with AAA.
7) Visited PCRF sends RAR to EPC A P-GW.
8) EPC A P-GW responds with RAA.
9) Visited PCRF responds to IMS A P-CSCF with AAA.
10) P-CSCF forwards the INVITE to UE B.
11) The UE B responds with the 180 (Ringing) with SDP answer.
12) The IMS A P-CSCF invokes visited PCRF with AAR to modify the bearer.
13) Visited PCRF forwards AAR to home PCRF.
14) Home PCRF responds with AAA.
15) Visited PCRF sends RAR to EPC A P-GW.
16) EPC A P-GW responds with RAA.
17) Visited PCRF responds to IMS A P-CSCF with AAA.
18) P-CSCF forwards the SIP 180 (SDP) to IBCF A.
19) IBCF A forwards the SIP 180 (SDP) to IBCF B.
20) IBCF B forwards the SIP 180 (SDP) towards UE A.
21) Early media may flow between the UEs.
22) The UE B responds with the 200 OK.
23) The IMS A P-CSCF invokes visited PCRF with AAR to modify the bearer.
24) Visited PCRF forwards AAR to home PCRF.
25) Home PCRF responds with AAA.
26) Visited PCRF sends RAR to EPC A P-GW.
27) EPC A P-GW responds with RAA.
28) Visited PCRF responds to IMS A P-CSCF with AAA.
29) P-CSCF forwards the SIP 200 OK to IBCF A.
30) IBCF A forwards the SIP 200 OK to IBCF B.
31) IBCF B forwards the SIP 200 OK towards UE A.
32) The UE A sends ACK to 200 OK (INVITE) towards UE B.
33) IBCF B forwards the ACK to IBCF A.
34) IBCF A forwards the ACK to P-CSCF.
35) P-CSCF forwards the ACK to UE B.
36) The dedicated bearer(s) is/are set up and media can flow between the UEs.

6.3.2 SIP Session Modification

6.3.2.0 General

These tests cover SIP session modification during an active SIP session involving a roaming UE.

These tests build on previous ones and assume that the UE A/B have been previously attached to EPC, registered to IMS with a session successfully established, and media is flowing. In the originating case, UE-A is roaming whilst in the terminating test, UE-B is roaming.

These tests will verify that:

1) The P-CSCF will act on successful call session modification as signalled in SIP signalling and trigger modification of call bearer via the home and visited PCRFs and EPC.

2) The EPC will modify the call's media bearers accordingly.

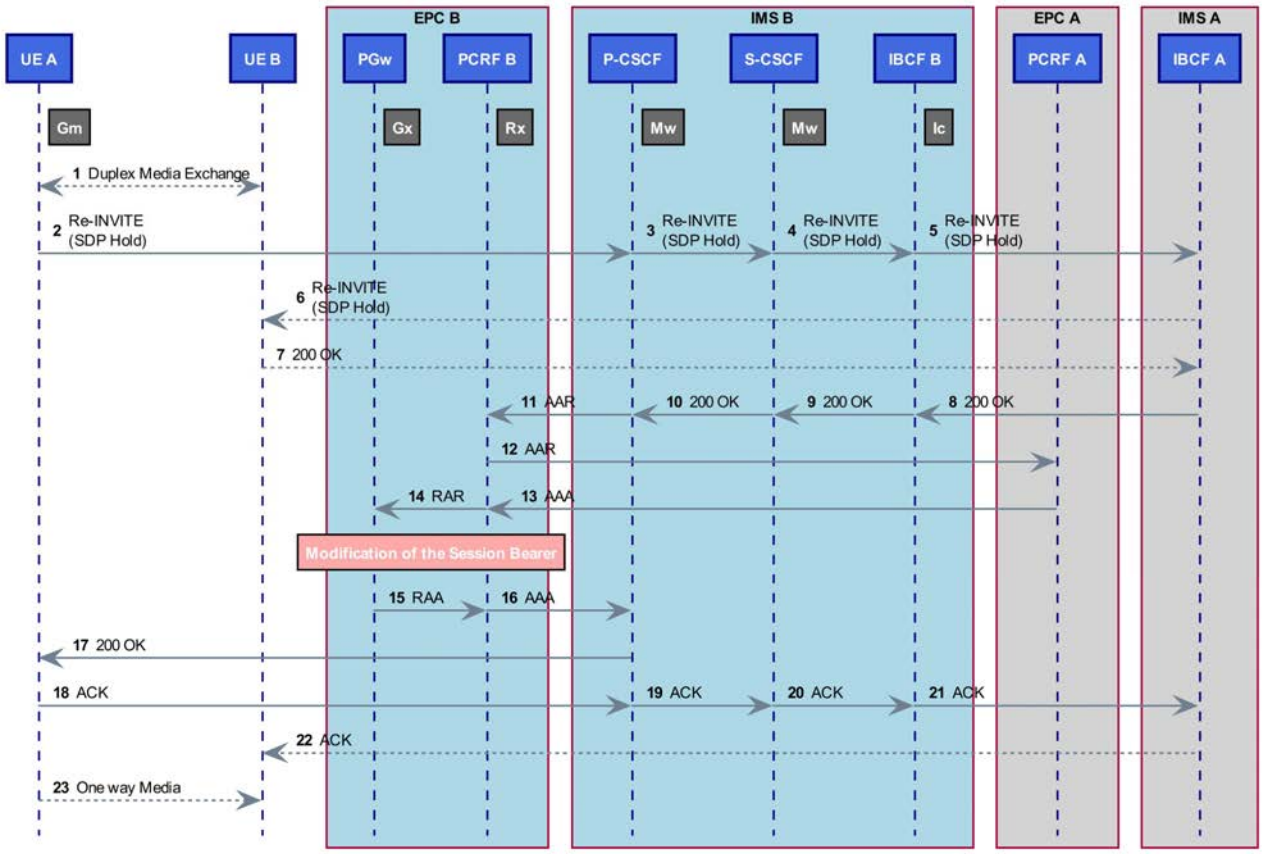
3) Media flows are impacted accordingly (e.g. new flow added, existing flow stopped, etc.).

6.3.2.1 Originating Leg

The test descriptions included here use the MMTEL Call-Hold/Call Resume features to illustrate the modification of a media flow(s) in an existing active session involving a roaming UE.

Interoperability Test Description		
Identifier:	TD_VxLTE_RMI_INI_03	
Objective:	To demonstrate the modification of an existing media flow mid session.	
Summary:	On successful call hold, the P-CSCF should derive from the SDP offer and answer, updates for the Service Data Flows. These are pushed towards PCRF/EPC as request for modification of the previously created bearers. EPC modifies, based on the EPC's operator policies, the bearers for media. When transporting media, the EPC will employ the respective bearer's characteristics. Media transport is possible, after the successful modification of the session, modified according to the new offer/answer exchange.	
Configuration:	CF_VxLTE_RMI_B	
SUT:	IMS A, IMS B and EPC A	
Interfaces:	Gm, Mw, Rx, Gx, Ic, S9	
References:	Ic	ETSI TS 124 229 [2], clause 5.4.3.2 (6th numbered list) clause 5.4.3.3 (9th numbered list)
	Gm, Mw	ETSI TS 124 229 [2], clause 5.1.4A and clause 5.2.7.2 and clause 5.7.1.24 and clause 6.1.4.2 and clause 6.1.4.3
	Rx	ETSI TS 129 214 [6], clauses 4.4.2, A.1, A.2 and annex B
	Gx	ETSI TS 129 212 [7], clause 4.5.2
	S9	ETSI TS 129 215 [9], clause 4.5.3.6
Pre-test conditions:	• UE A and UE B previously attached to EPC. UE-A is roaming. • EPC established a Default Bearer allowing UE A to P-CSCF IP communication and UE-B to P-CSCF communication. • UE A and UE B previously registered to IMS. • UE A previously established a call with UE B, encompassing either audio only or both audio and video media.	

Interoperability Test Description			
Test Sequence:	**Step**		
	1	Verify that media between UE A and UE B is delivered in both directions and for audio or audio/video after call establishment.	
	2	UE A initiates Call-Hold operation for all media types and removes audio or audio/video media from the communication session.	
	3	Verify that, in Diameter AA-Request generated by IMS P-CSCF contains a Media Description for session modification according to the new SDP-offer in SIP INVITE Request and resultant SDP-answer in SIP 200 INVITE response.	
	4	Verify that the Rx messages are sent over S9 between the visited and home PCRFs respectively.	
	5	Verify that IMS requested media description update was found acceptable by EPC.	
	6	Verify that one way media between UE A and UE B is still successfully exchanged.	
Conformance criteria of test sequence step:	1	Rtp	TP_RTP_06 (Event 1)
	2	Gm	TP_GM_PCSCF_RE_INVITE_03 (Event 2)
		Gm	TP_GM_PCSCF_200OK_03 (Event 17)
		Gm	TP_GM_PCSCF_ACK_03 (Event 18)
		MwPS	TP_MW_PCSCF_RE_INVITE_03 (Event 3)
		MwPS	TP_MW_PCSCF_ACK_03 (Event 19)
		MwSI	TP_MW_SCSCF_RE_INVITE_03 (Event 4)
		Ic	TP_IC_IBCF_REINVITE_01 (INVITE - Event 5)
		Ic	TP_IC_IBCF_2XXRESP_04 (200 OK - Event 8)
	3	Rx	TP_RX_PCSCF_AAR_09 (AAR - Events 11)
		S9	TP_S9_PCRF_AAR_01 (AAR - Event 12)
		S9	TP_S9_PCRF_AAA_02 (AAA - Event 13)
		Rx	TP_RX_PCRF_AAA_02 (AAA - Event 16)
	4	Gx	TP_GX_PCRF_RAR_03 (RAR - Event 14)
	5	Gx	TP_GX_PGW_RAA_02 (RAA - Event 15)
	6	Rtp	TP_RTP_05 (Event 23)



NOTE 1: A SIP UPDATE message may also be used instead of re-INVITE to initiate a new offer/answer exchange.
NOTE 2: The Rx exchange need not wait for the Gx exchange to complete.
NOTE 3: Dashed connections between UE B and IBCF A represents the signalling which passes different entities but due to the scope of TD those are not points of observation.

Figure 34: SIP Session Modification - Originating Leg (Roaming)

1) Media exchange between UE A and UE B.

2) UE A initiates the SIP session with a Re-INVITE containing the new SDP offer. In this case, the SDP will differ in a media attribute line(s) set to "sendonly" indicating the existing media stream(s) are being placed on hold.

3) P-CSCF forwards the Re-INVITE to S-CSCF.

4) S-CSCF forwards the Re-INVITE to IBCF B.

5) IBCF B forwards the Re-INVITE to IBCF A.

6) IBCF A forwards the Re-INVITE towards UE B.

7) The UE B responds with the SIP 200 OK (SDP).

8) IBCF A forwards SIP 200 OK (SDP) to IBCF B.

9) IBCF B forwards the SIP 200 OK (SDP) to S-CSCF.

10) S-CSCF forwards the SIP 200 OK (SDP) to P-CSCF.

11) The IMS A P-CSCF invokes the PCRF to complete the bearer set up with AAR.

12) The visited PCRF invokes the home PCRF with AAR.

13) The home PCRF responds to the visited PCRF with AAA.

14) PCRF sends RAR to EPC A P-GW.

15) EPC A P-GW responds with RAA.

16) PCRF responds to IMS A P-CSCF with AAA.

17) P-CSCF forwards the SIP 200 OK (SDP) to UE A.

18) The UE A sends ACK to 200 OK (Re-INVITE).

19) P-CSCF forwards the ACK to S-CSCF.

20) S-CSCF forwards the ACK to IBCF B.

21) IBCF B forwards the ACK to IBCF A.

22) IBCF A forwards the ACK towards UE B.

23) The dedicated bearer(s) is/are modified and media can flow only one way from UE-A to UE-B.

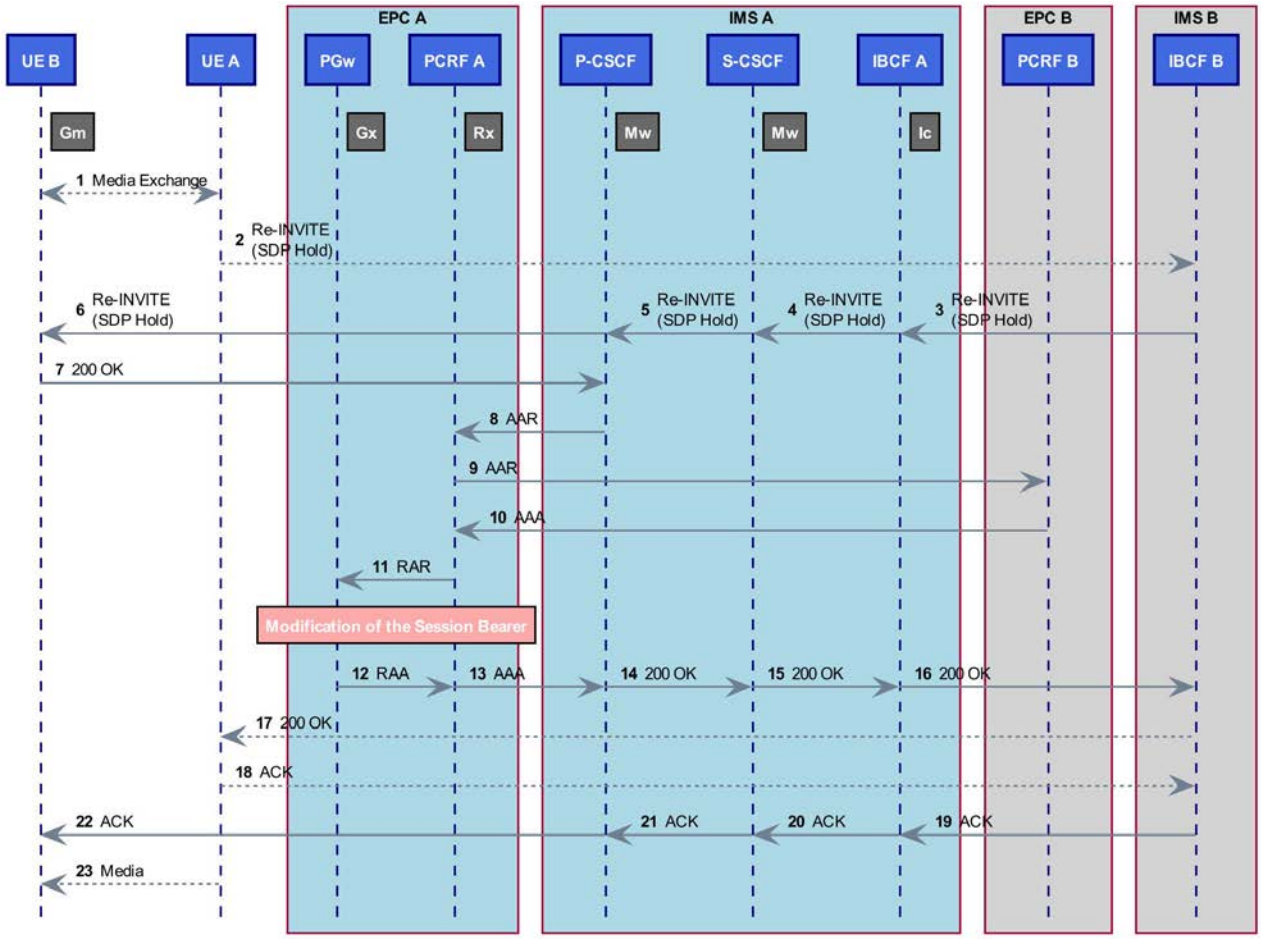
Note that a subsequent Call Resume has an identical message flow (with the SDP media attribute being set to "sendrecv") and the resulting Flow-Status AVP being set to ENABLED (2) to return to a duplex media connection.

6.3.2.2 Terminating Leg

The test descriptions included here use the MMTEL Call-Hold/Call Resume features to illustrate the modification of a media flow(s) in an existing active session.

Interoperability Test Description		
Identifier:	TD_VxLTE_RMI_INI_04	
Objective:	To demonstrate the modification of an existing media flow mid session	
Summary:	On successful call hold, the P-CSCF should derive from the SDP offer and answer, updates for the Service Data Flows. These are pushed towards PCFRF/EPC as request for modification of the previously created bearer(s). EPC modifies, based on the EPC's operator policies, the bearers for media. When transporting media, the EPC will employ the respective bearer's characteristics. Media transport is possible, after the successful modification of the session, modified according to the new offer/answer exchange.	
Configuration:	CF_VxLTE_RMI_A	
SUT:	IMS A, IMS B and EPC A	
Interfaces:	Gm, Mw, Rx, Gx, Ic, S9	
References:	Ic	ETSI TS 124 229 [2], clause 5.4.3.2 (6th numbered list) clause 5.4.3.3 (9th numbered list)
	Gm, Mw	ETSI TS 124 229 [2], clause 5.1.4A and clause 5.2.7.2 and clause 5.7.1.24 and clause 6.1.4.2 and clause 6.1.4.3
	Rx	ETSI TS 129 214 [6], clauses 4.4.2, A.1, A.2 and annex B
	Gx	ETSI TS 129 212 [7], clause 4.5.2
	S9	ETSI TS 129 215 [9], clause 4.5.3.6
Pre-test conditions:	• Roaming UE B previously attached to EPC. • EPC provisioned a Default Bearer allowing UE B - P-CSCF IP communication. • UE B previously registered to IMS. • EPC provisioned an IMS signalling bearer. • UE A or another endpoint ready to accept the session establishment. • UE B previously established a call with UE A, encompassing both audio and video media.	

Interoperability Test Description			
Test Sequence:	**Step**		
	1	Verify that media between UE A and UE B is delivered in both directions and for both media stream types after call establishment.	
	2	UE A initiates a Call-Hold operation and removes audio media from the communication session.	
	3	Verify that, in Diameter AA-Request generated by IMS P-CSCF contains a Media Description for session modification according to the new SDP-offer in SIP INVITE Request and resultant SDP-answer in SIP 200 INVITE response.	
	4	Verify that the Rx messages are sent over S9 between the visited and home PCRFs respectively.	
	5	Verify that IMS requested media description update was found acceptable by EPC.	
	6	Verify that one way media between UE A and UE B is still successfully exchanged.	
Conformance criteria of test sequence step:	1	Rtp	TP_RTP_06 (Event 1)
	2	Gm	TP_GM_PCSCF_RE_INVITE_04 (Event 6)
		Gm	TP_GM_PCSCF_200OK_04 (Event 7)
		Gm	TP_GM_PCSCF_ACK_04 (Event 22)
		MwPS	TP_MW_PCSCF_RE_INVITE_04 (Event 5)
		MwPS	TP_MW_PCSCF_200OK_04 (Event 14)
		MwPS	TP_MW_PCSCF_ACK_04 (Event 21)
		MwSI	TP_MW_SCSCF_RE_INVITE_04 (Event 4)
		Ic	TP_IC_IBCF_REINVITE_01 (INVITE - Event 3)
		Ic	TP_IC_IBCF_2XXRESP_04 (200 OK - Event 16)
	3	Rx	TP_RX_PCSCF_AAR_10 (AAR - Events 8)
		S9	TP_S9_PCRF_AAR_01 (AAR - Event 9)
		S9	TP_S9_PCRF_AAA_02 (AAA - Event 10)
		Rx	TP_RX_PCRF_AAA_02 (AAA - Event 13)
	4	Gx	TP_GX_PCRF_RAR_03 (RAR - Event 11)
	5	Gx	TP_GX_PGW_RAA_02 (RAA - Event 12)
	6	Rtp	TP_RTP_05 (Event 23)



NOTE 1: A SIP UPDATE message may also be used instead of re-INVITE to initiate a new offer/answer exchange.
NOTE 2: The Rx exchange need not wait for the Gx exchange to complete.
NOTE 3: Dashed connections between UE A and IBCF B represents the signalling which passes different entities but due to the scope of TD those are not points of observation.

Figure 35: SIP Session Modification - Terminating Leg (Roaming)

1) Media exchange between UE A and UE B

2) UE A initiates the SIP session with a Re-INVITE containing the new SDP offer. In this case, the SDP will differ in a media attribute line(s) set to "sendonly" indicating the existing media stream(s) are being placed on hold.

3) IBCF B forwards the Re-INVITE to IBCF A.

4) IBCF A forwards the Re-INVITE to S-CSCF.

5) S-CSCF forwards the Re-INVITE to P-CSCF.

6) P-CSCF forwards the Re-INVITE to UE B.

7) The UE B responds with the 200 OK.

8) The IMS B P-CSCF invokes the PCRF to modify the bearer with AAR.

9) The visited PCRF invokes the home PCRF with AAR.

10) The home PCRF responds with AAA to the visited PCRF.

11) PCRF sends RAR to EPC B P-GW.

12) EPC B P-GW responds with RAA.

13) PCRF responds to IMS B P-CSCF with AAA.

14) P-CSCF forwards the SIP 200 OK to S-CSCF.

15) S-CSCF forwards the SIP 200 OK to IBCF A.

16) IBCF A forwards the SIP 200 OK to IBCF B.

17) IBCF B forwards the SIP 200 OK towards UE A.

18) The UE A sends ACK to 200 OK (Re-INVITE).

19) IBCF B forwards ACK to the IBCF A.

20) IBCF A forwards the ACK to S-CSCF.

21) S-CSCF forwards the ACK to P-CSCF.

22) P-CSCF forwards the ACK to UE B.

23) The dedicated bearer(s) is/are modified and media can flow only one way from UE-A to UE-B.

Note that a subsequent Call Resume has an identical message flow (with the SDP media attribute being set to "sendrecv") and the resulting Flow-Status AVP being set to ENABLED (2) to return to a duplex media connection.

6.3.3 SIP Session Release

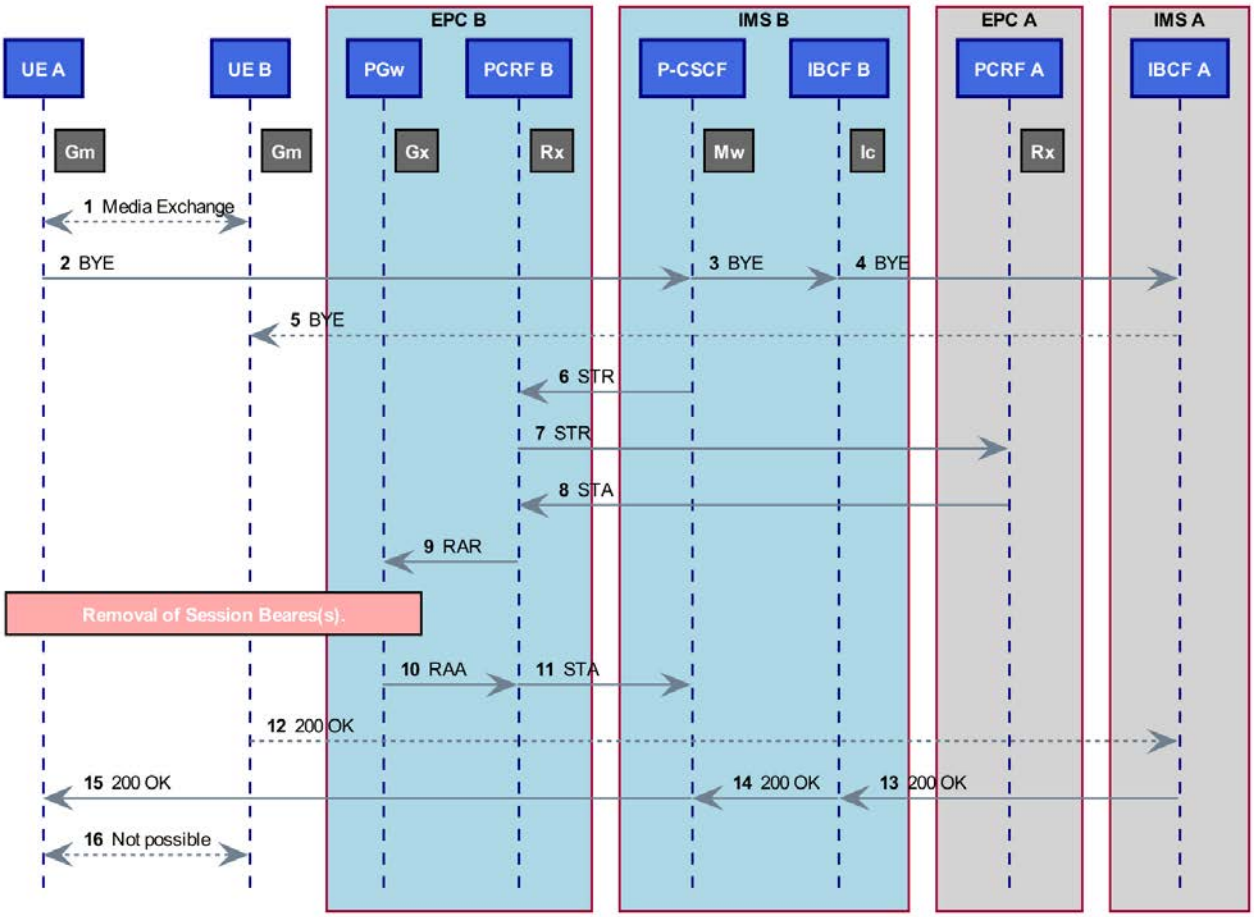
6.3.3.0 General

These tests show the removal of the session bearers during the normal release procedures of an already established session involving a roaming UE. The assumptions and purpose of these tests are as for clause 5.3.3 but involving a roaming UE.

6.3.3.1 Originating UE Initiated Session Release

Interoperability Test Description		
Identifier:	TD_VxLTE_RMI_REL_01	
Objective:	To demonstrate IMS session release (originating UE initiated) and the tear down of related dedicated bearers. The UE is roaming.	
Summary:	On call release, the IMS B P-CSCF should trigger the removal of all relevant previously created bearers. EPC B removes the bearers for media. Media transport is no longer possible, after the session release.	
Configuration:	CF_VxLTE_RMI_B	
SUT:	IMS A and EPC A, IMS B and EPC B	
Interfaces:	Gm, Mw, Ic, Gx, Rx, S9	
References:	Gm, Mw	ETSI TS 124 229 [2], clause 5.1.5 (1st paragraph) and clause 5.2.8.2 clause 5.4.5.2 clause 6.2 clause 6.3
	Ic	ETSI TS 124 229 [2], clause 5.4.3.2 (item 1 in 7th numbered list)
	Gx	ETSI TS 129 212 [7], clause 4.5.2
	Rx	ETSI TS 129 214 [6], clause 4.4.4
	S9	ETSI TS 129 215 [9], clause 4.5.3.6
Pre-test conditions:	• UE A and UE B previously attached to EPC B • UE A is roaming. • EPC A established a Default Bearer allowing UE A to IMS A P-CSCF IP communication and UE B to IMS B P-CSCF IP communication. • UE A & UE B previously registered to IMS A and IMS B, and IMS A/B signalling bearers provisioned. • UE A previously established a call with UE B.	

Test Sequence:	**Step**		
	1	Verify that media between UE A and UE B is delivered in both directions and for all negotiated media stream types after the call establishment.	
	2	UE A initiates a Call-Release operation, ending the session.	
	3	Verify that IMS A P-CSCF terminates the Rx session, triggering removal of all session related bearers.	
	4	Verify that the Rx messages are sent over S9 between the IMS B and IMS A PCRFs respectively.	
	5	Verify that EPCs removes all session related bearers.	
	6	Verify that media between UE A and UE B can no longer be exchanged and is filtered out by EPCs.	
Conformance criteria of test sequence step:	1	Rtp	TP_RTP_06 (Event 1)
	2	Gm MwPS Ic	TP_GM_PCSCF_BYE_04 (Event 2) TP_MW_PCSCF_BYE_04 (Event 3) TP_IC_IBCF_BYE_01 (Event 4)
	3, 4	Gm MwPS Rx S9 S9 Gx Gx Rx	TP_GM_PCSCF_200OK_BYE_04 (Event 15) TP_MW_PCSCF_200OK_BYE_04 (Event 14) TP_RX_PCSCF_STR_01 (STR - Event 6) TP_S9_PCRF_STR_01 (STR - Event 7) TP_S9_PCRF_STA_02 (STA - Event 8) TP_GX_PCRF_RAR_04 (RAR - Event 9) TP_GX_PGW_RAA_02 (RAA - Event 10) TP_RX_PCRF_STA_01 (STA - Event 11)
	5, 6	Rtp	TP_RTP_04 (Events 16)



NOTE 1: The Rx exchange need not wait for the Gx exchange to complete.
NOTE 2: Dashed connections between UE B and IBCF A represents the signalling which passes different entities but due to the scope of TD those are not points of observation.

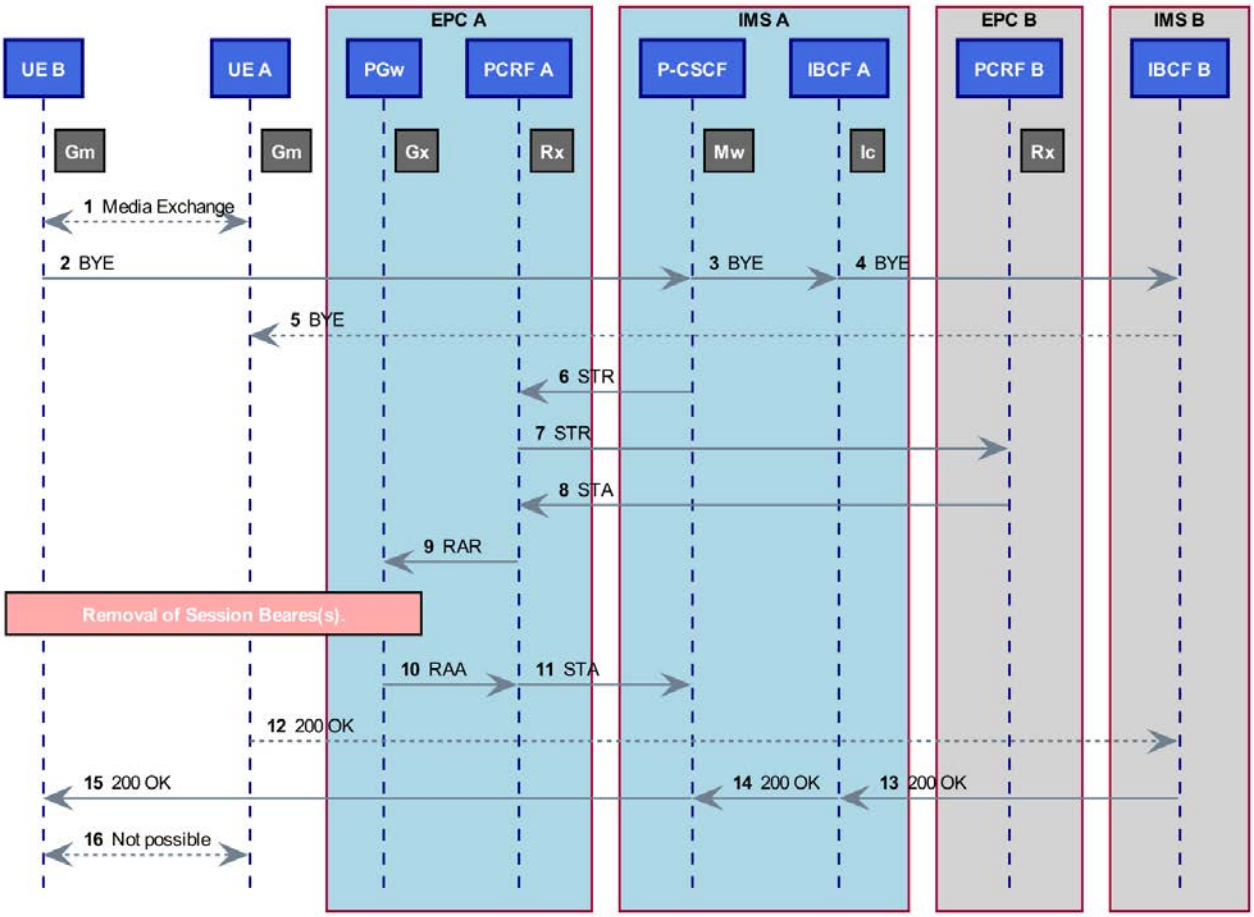
Figure 36: SIP Session Tear-down - Originating UE Initiated Session Release (Roaming)

1) UE A roaming established a call with UE B
2) UE A initiates the SIP session release with a BYE.
3) IMS B P-CSCF forwards the BYE towards IBCF B.
4) IBCF B forwards the BYE to IBCF A.
5) IBCF A forwards the BYE towards UE B.
6) P-CSCF sends a ST-Request to the EPC B PCRF (Session-Termination request).
7) EPC B PCRF forwards the STR to the EPC A PCRF.
8) EPC A PCRF sends a STA to EPC B PCRF.
9) EPC B PCRF sends a RAR to the PGw (Re-Auth request).
10) P-GW responds with RAA to EPC B PCRF.
11) EPC B PCRF responds with STA to IMS B P-CSCF.
12) UE B sends 200 OK (BYE) towards IBCF A.
13) IBCF A sends 200 OK (BYE) to IBCF B.
14) IBCF B forwards the 200 OK (BYE) towards IMS B P-CSCF.
15) IMS B P-CSCF forwards the 200 OK (BYE) towards UE A.
16) The dedicated bearer(s) is/are down and no media can flow between the UEs.

6.3.3.2 Terminating UE Initiated Session Release

Interoperability Test Description		
Identifier:	TD_VxLTE_RMI_REL_02	
Objective:	To perform terminating UE session release and the tear down of related dedicated bearers involving a roaming UE.	
Summary:	On call release, the P-CSCF should trigger the removal of all relevant previously created bearers. EPC removes the bearers for media. Media transport is no longer possible, after the session release.	
Configuration:	CF_VxLTE_RMI_A	
SUT:	IMS A and EPC A, IMS B and EPC B	
Interfaces:	Gm, Mw, Ic, Gx, Rx, S9	
References:	Gm, Mw	ETSI TS 124 229 [2], clause 5.1.5 (1st paragraph) and clause 5.2.8.2 clause 5.4.5.2 clause 6.2 clause 6.3
	Ic	ETSI TS 124 229 [2], clause 5.4.3.2 (item 1 in 7th numbered list)
	Gx	ETSI TS 129 212 [7], clause 4.5.2
	Rx	ETSI TS 129 214 [6], clause 4.4.4
	S9	ETSI TS 129 215 [9], clause 4.5.3.6
Pre-test conditions:	• UE A and UE B previously attached to EPC A • UE B is roaming. • EPC A established a Default Bearer allowing UE A to IMS A P-CSCF IP communication and UE B to IMS B P-CSCF IP communication. • UE A & UE B previously registered to IMS A and IMS B, and IMS A/B signalling bearers provisioned. • UE A previously established a call with UE B.	

Interoperability Test Description			
Test Sequence:	**Step**		
	1	Verify that media between UE A and UE B is delivered in both directions and for negotiated media stream types after call establishment	
	2	UE B initiates a Call-Release (BYE) operation to UE A, ending the session.	
	3	Verify that P-CSCF terminates the Rx session, triggering the removal of all session related bearers.	
	4	Verify that the Rx messages are sent over S9 between the visited and home PCRFs respectively.	
	5	Verify that EPC removes all session related bearers.	
	6	Verify that the media between UE A and UE B can no longer be exchanged and is filtered out by EPC.	
Conformance criteria of test sequence step:	1	Rtp	TP_RTP_06 (Event 1)
	2	Gm MwPS Ic	TP_GM_PCSCF_BYE_05 (Event 2) TP_MW_PCSCF_BYE_05 (Event 3) TP_IC_IBCF_BYE_01 (BYE - Event 4)
	3, 4	Gm MwPS Rx S9 S9 Gx Gx Rx	TP_GM_PCSCF_200OK_BYE_05 (Event 15) TP_MW_PCSCF_200OK_BYE_05 (Event 14) TP_RX_PCSCF_STR_01 (STR - Event 6) TP_S9_PCRF_STR_01 (STR - Event 7) TP_S9_PCRF_STA_02 (STA - Event 8) TP_GX_PCRF_RAR_04 (RAR - Event 9) TP_GX_PGW_RAA_02 (RAA - Event 10) TP_RX_PCRF_STA_01 (STA - Event 11)
	5, 6	Rtp	TP_RTP_04 (Events 16)



NOTE 1: The Rx exchange need not wait for the Gx exchange to complete.
NOTE 2: Dashed connections between UE A and IBCF B represents the signalling which passes different entities but due to the scope of TD those are not points of observation.

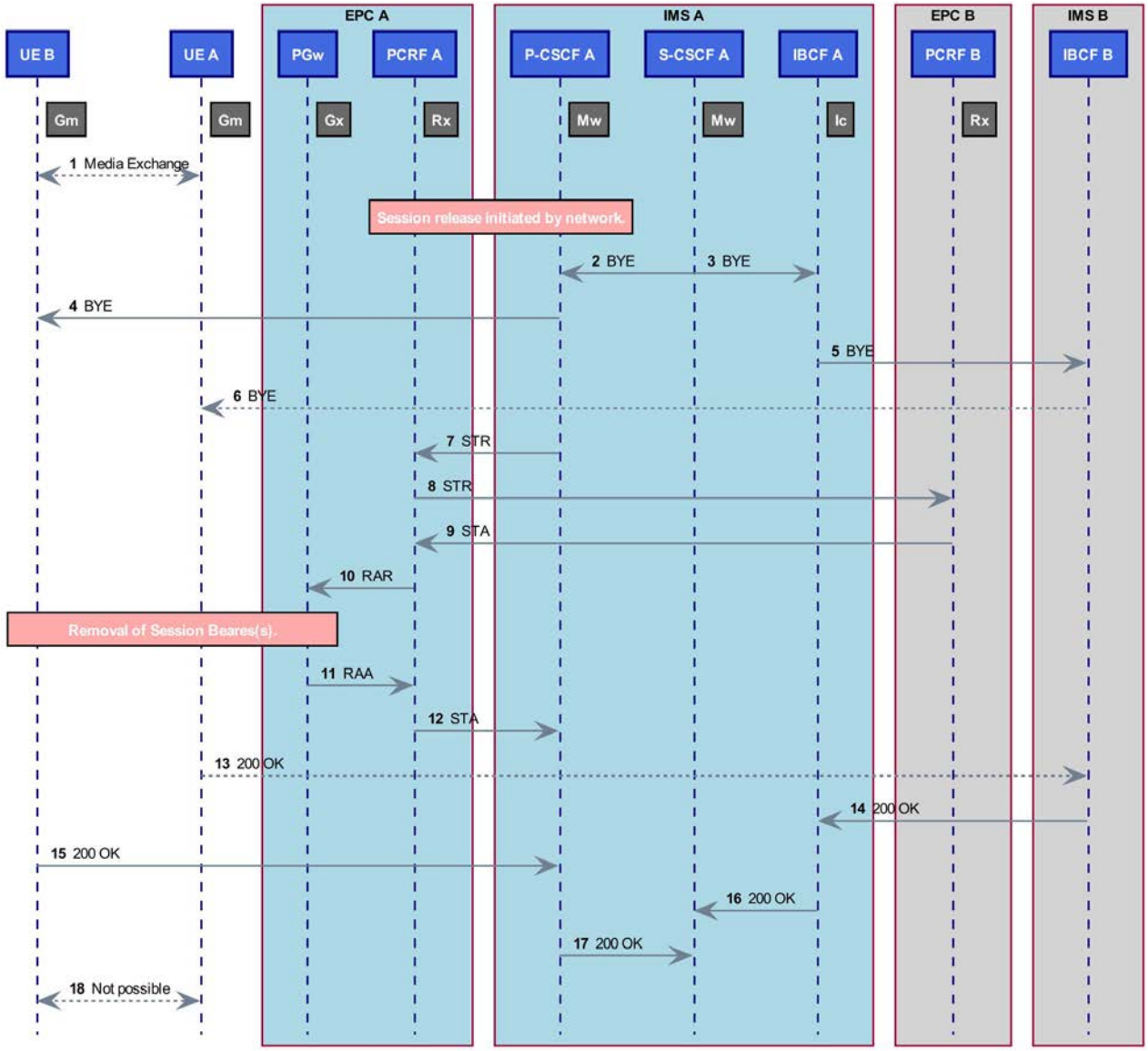
Figure 37: SIP Session Tear-down - Terminating UE Initiated Session Release (Roaming)

1) UE A roaming established a call with UE B.
2) UE B initiates the SIP session release with a BYE.
3) P-CSCF A forwards the BYE to IBCF A.
4) IBCF A forwards the BYE to IBCF B.
5) IBCF B forwards the BYE towards UE A.
6) P-CSCF A sends a STR to the EPC A PCRF (Session-Termination request).
7) EPC A PCRF forwards the STR to the EPC B PCRF.
8) EPC B PCRF sends a STA to EPC A PCRF.
9) EPC A PCRF sends a RAR to the PGw (Re-Auth request).
10) P-GW responds with RAA to EPC A PCRF.
11) EPC A PCRF responds with STA to IMS A P-CSCF.
12) UE A sends 200 OK (BYE) towards IBCF B.
13) IBCF B forwards 200 OK (BYE) to IBCF A.
14) IBCF A forwards the 200 OK (BYE) to IMS A P-CSCF.
15) IMS A P-CSCF forwards the 200 OK (BYE) towards UE B.
16) The dedicated bearer(s) is/are down and no media can flow between the UEs.

6.3.3.3 Originating Network Initiated Session Release

Interoperability Test Description		
Identifier:	TD_VxLTE_RMI_REL_03	
Objective:	To demonstrate IMS session release (network initiated) and the tear down of related dedicated bearers. The UE is roaming.	
Summary:	The S-CSCF A should trigger the Call-Release operation and remove all relevant previously created bearers . EPC A removes the bearers for media. Media transport is no longer possible, after the session release.	
Configuration:	CF_VxLTE_RMI_A	
SUT:	IMS A and EPC A, IMS B and EPC B	
Interfaces:	Gm, Mw, Ic, Gx, Rx, S9	
References:	Gm, Mw	ETSI TS 124 229 [2], clause 5.1.5 (1st paragraph) and clause 5.2.8.2 clause 6.2 clause 6.3
	Ic	ETSI TS 124 229 [2], clause 5.4.3.2 (item 1 in 7th numbered list)
	Gx	ETSI TS 129 212 [7], clause 4.5.2
	Rx	ETSI TS 129 214 [6], clause 4.4.4
	S9	ETSI TS 129 215 [9], clause 4.5.3.6
Pre-test conditions:	• UE A and UE B previously attached to EPC A • UE B is roaming. • EPC A established a Default Bearer allowing UE A to IMS A P-CSCF IP communication and UE B to IMS B P-CSCF IP communication. • UE A & UE B previously registered to IMS A and IMS B, and IMS A/B signalling bearers provisioned. UE A registered only for limited time. • UE A previously established a call with UE B.	

Interoperability Test Description			
Test Sequence:	**Step**		
	1	Verify that media between UE A and UE B is delivered in both directions and for all negotiated media stream types after the call establishment.	
	2	IMS A initiates a Call-Release operation, ending the session. due to UE A registration expiration.	
	3	Verify that IMS A P-CSCF terminates the Rx session, triggering removal of all session related bearers.	
	4	Verify that the Rx messages are sent over S9 between the IMS B and IMS A PCRFs respectively.	
	5	Verify that EPCs removes all session related bearers.	
	6	Verify that media between UE A and UE B can no longer be exchanged and is filtered out by EPCs.	
Conformance criteria of test sequence step:	1	Rtp	TP_RTP_06 (Event 1)
	2	Gm	TP_GM_PCSCF_BYE_06 (Event 4)
		MwPS	TP_MW_PCSCF_BYE_06 (Event 2)
		Ic	TP_IC_IBCF_BYE_01 (BYE - Event 5)
	3, 4	Gm	TP_GM_PCSCF_200OK_BYE_06 (Event 15)
		MwPS	TP_MW_PCSCF_200OK_BYE_06 (Event 17)
		MwSI	TP_MW_PCSCF_200OK_BYE_05 (Event 16)
		Rx	TP_RX_PCSCF_STR_01 (STR - Event 7)
		S9	TP_S9_PCRF_STR_01 (STR - Event 8)
		S9	TP_S9_PCRF_STA_02 (STA - Event 9)
		Gx	TP_GX_PCRF_RAR_04 (RAR - Event 10)
		Gx	TP_GX_PGW_RAA_02 (RAA - Event 11)
		Rx	TP_RX_PCRF_STA_01 (STA - Event 12)
	5, 6	Rtp	TP_RTP_04 (Events 18)



NOTE 1: The Rx exchange need not wait for the Gx exchange to complete.
NOTE 2: Dashed connections between UE A and IBCF B represents the signalling which passes different entities but due to the scope of TD those are not points of observation.

Figure 38: SIP Session Tear-down - Originating Network Initiated Session Release (Roaming)

1) UE A roaming established a call with UE B

2) S-CSCF A initiates the SIP session release with a BYE to P-CSCF A.

3) S-CSCF A initiates the SIP session release with a BYE to IBCF A.

4) IMS A P-CSCF forwards the BYE to UE B.

5) IBCF A forwards the BYE to IBCF B.

6) IBCF B forwards the BYE towards UE A.

7) P-CSCF sends a STR to the EPC B PCRF (Session-Termination request).

8) EPC B PCRF forwards the STR to the EPC A PCRF.

9) EPC A PCRF sends a STA to EPC B PCRF.

10) EPC B PCRF sends a RAR to the PGw (Re-Auth request).

11) P-GW responds with RAA to EPC B PCRF.

12) EPC B PCRF responds with STA to IMS B P-CSCF.

13) UE A sends 200 OK (BYE) towards IBCF B.

14) IBCF B sends 200 OK to IBCF A.

15) UE B sends 200 OK (BYE).

16) IBCF A forwards the 200 OK (BYE) to IMS A S-CSCF.

17) IMS A P-CSCF forwards the 200 OK (BYE) to IMS A S-CSCF.

18) The dedicated bearer(s) is/are down and no media can flow between the UEs.

6.3.4 SIP Session Abort/Reject

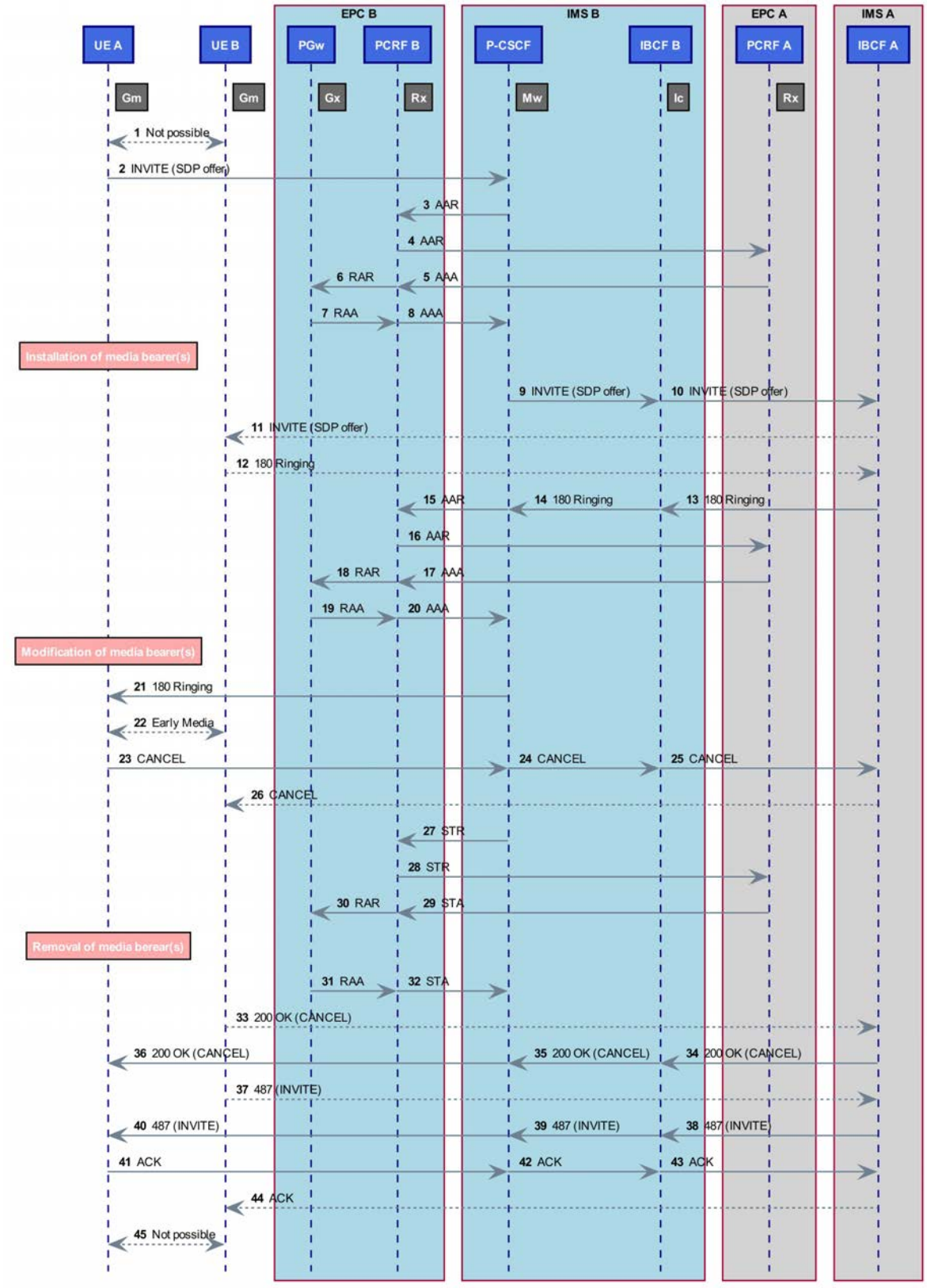
6.3.4.0 General

These test cases cover unsuccessful session setup. Either the call is aborted in the originating side or rejected in the terminating side. The assumptions and purpose of these tests are as for clause 5.3.4 but involving a roaming UE.

6.3.4.1 SIP Session Abort - Originating Leg

Interoperability Test Description		
Identifier:	TD_VxLTE_RMI_ABT_01	
Objective:	To demonstrate SIP session abort (originating side) and the related interactions with PCRF and EPC B for a roaming UE.	
Summary:	On session abort, the P-CSCF should trigger the removal of all relevant previously created early media bearers. EPC B removes the bearers for early media. Media transport is no longer possible, after the session abort.	
Configuration:	CF_VxLTE_RMI_B	
SUT:	IMS A and EPC A, IMS B and EPC B	
Interfaces:	Gm, Mw, Ic, Rx, Gx, S9	
References:	Gm, Mw	ETSI TS 124 229 [2], clause 5.1.5 (2nd paragraph) and clause 5.1.3 and clause 6.2
	Ic	ETSI TS 124 229 [2], clause 5.2.6.3.3 (1st numbered list) and clause 5.2.6.4.4 (1st numbered list) and clause 5.4.3.2 and clause 5.10.3.2 and clause 5.2.8.1.1 and IETF RFC 3261 [12], clause 9.2
	Gx	ETSI TS 129 212 [7], clause 4.5.2
	Rx	ETSI TS 129 214 [6], clause 4.4.4
	S9	ETSI TS 129 215 [9], clause 4.5.3.6
Pre-test conditions:	• UE A & UE B previously attached to EPC B. • UE A is roaming. • EPC established a Default Bearer allowing UE A to P-CSCF & UE B to P-CSCF IP communication. • UE A & UE B previously registered to IMS. • EPCs provisioned IMS signalling bearers.	

Interoperability Test Description			
Test Sequence:	**Step**		
	1	Verify that media between UE A and UE B is not delivered in any direction.	
	2	UE A calls UE B and establishes a communication session.	
	3	UE B answers with SIP 180 Ringing INVITE Response and starts sending early media.	
	4	Verify that early media is delivered from UE B to UE A.	
	5	UE A cancels the session establishment.	
	6	Verify that P-CSCF terminates the Rx session, triggering removal of all early media related bearers.	
	7	Verify that the Rx messages are sent over S9 between the visited and home PCRFs respectively.	
	8	Verify that EPC removes all early media related bearers.	
	9	Verify that media between UE B and UE A can no longer be exchanged and is filtered out by EPC.	
Conformance criteria of test sequence step:	1	Rtp	TP_RTP_04 (Events 1)
	2, 3	Gm	TP_GM_PCSCF_INVITE_03 (Event 2)
		Rx	TP_RX_PCSCF_AAR_03 (AAR - Event 3)
		S9	TP_S9_PCRF_AAR_01 (AAR - Event 4)
		S9	TP_S9_PCRF_AAA_02 (AAA - Event 5)
		Gx	TP_GX_PCRF_RAR_03 (RAR - Event 6)
		Gx	TP_GX_PGW_RAA_02 (RAA - Event 7)
		Rx	TP_RX_PCRF_AAA_02 (AAA - Event 8)
		MwPS	TP_MW_PCSCF_INVITE_03 (Event 9)
		Ic	TP_IC_IBCF_INVITE_04 (INVITE - Event 10)
		Ic	TP_IC_IBCF_100TRY_02 (INVITE, 100 Trying - Event 10)
		Ic	TP_IC_IBCF_1XXRESP_03 (180 Ringing - Event 13)
		Rx	TP_RX_PCSCF_AAR_04 (AAR - Event 15)
		S9	TP_S9_PCRF_AAR_01 (AAR - Event 16)
		S9	TP_S9_PCRF_AAA_02 (AAA - Event 17)
		Gx	TP_GX_PCRF_RAR_03 (RAR - Event 18)
		Gx	TP_GX_PGW_RAA_02 (RAA - Event 19)
		Rx	TP_RX_PCRF_AAA_02 (AAA - Event 20)
	4	Rtp	TP_RTP_05 (Event 22)
	5	Gm	TP_GM_PCSCF_CANCEL_03 (Event 23)
		MwPS	TP_MW_PCSCF_CANCEL_03 (Event 24)
		Ic	TP_IC_IBCF_CANCEL_01 (CANCEL - Event 25)
	6, 7	Rx	TP_RX_PCSCF_STR_04 (STR - Event 27)
		S9	TP_S9_PCRF_STR_01 (STR - Event 28)
		S9	TP_S9_PCRF_STA_01 (STA - Event 29)
		Gx	TP_GX_PCRF_RAR_02 (RAR - Event 30)
		Gx	TP_GX_PGW_RAA_02 (RAA - Event 31)
		Rx	TP_RX_PCRF_STA_01 (STA - Event 32)
		Gm	TP_GM_PCSCF_200OK_CANCEL_03 (Event 36)
		MwPS	TP_MW_PCSCF_200OK_CANCEL_03 (Event 35)
		Gm	TP_GM_PCSCF_487INVITE_03 (Event 40)
		MwPS	TP_MW_PCSCF_487INVITE_03 (Event 39)
		Ic	TP_IC_IBCF_CANCEL_OK_03 (OK - Event 34)
		Ic	TP_IC_IBCF_487INVITE_01 (487 INVITE - Event 38)
		Ic	TP_IC_IBCF_487INVITE_ACK_01 (ACK - Event 43)
	8, 9	Rtp	TP_RTP_04 (Event 45)



NOTE: Dashed connections between UE B and IBCF A represents the signalling which passes different entities but due to the scope of TD those are not points of observation.

Figure 39: SIP Session Abort - Originating Leg (Roaming)

1) No media exchange between UE A and UE B.

2) UE A roaming initiates the SIP session with an INVITE containing the SDP offer.

3) The IMS B P-CSCF invokes visited PCRF.
4) Visited PCRF sends AAR to home PCRF.
5) Home PCRF responds with AAA.
6) Visited PCRF sends RAR to EPC B P-GW.
7) EPC B P-GW responds with RAA.
8) Visited PCRF responds to IMS B P-CSCF with AAA.
9) P-CSCF forwards the INVITE towards IBCF B.
10) IBCF B forwards the INVITE to IBCF A.
11) IBCF A forwards the INVITE towards UE B.
12) The UE B responds with the 180 (Ringing) with SDP answer.
13) IBCF A forwards the 180 (Ringing) to IBCF B.
14) IBCF B forwards the 180(Ringing) towards P-CSCF.
15) The IMS B P-CSCF invokes visited PCRF to modify the bearer.
16) Visited PCRF forwards AAR to home PCRF.
17) Home PCRF responds with AAA.
18) Visited PCRF sends RAR to EPC B P-GW.
19) EPC B P-GW responds with RAA.
20) Visited PCRF responds to IMS B P-CSCF with AAA.
21) P-CSCF forwards the SIP 180 (SDP) to UE A.
22) Early media may flow between the UEs.
23) The UE A responds with the CANCEL.
24) P-CSCF forwards the CANCEL to S-CSCF and S-CSCF forwards the CANCEL to IBCF B.
25) IBCF B forwards the CANCEL to the IBCF A
26) IBCF A forwards the CANCEL towards UE B.
27) P-CSCF sends STR to EPC B PCRF.
28) EPC B PCRF forwards the STR to the EPC A PCRF.
29) EPC A PCRF sends STA to EPC B PCRF.
30) EPC B PCRF sends RAR to EPC B PGw.
31) EPC B PGw sends RAA to EPC B PCRF.
32) EPC B PCRF forwards STA to IMS B P-CSCF.
33) UE B responds with 200 OK (CANCEL).
34) IBCF A forwards 200 OK (CANCEL) to IBCF B.
35) IBCF B forwards 200 OK (CANCEL) to S-CSCF and S-CSCF forwards the 200 OK (CANCEL) to P-CSCF.
36) P-CSCF forwards OK (CANCEL) to UE A.
37) UE B sends 487 (INVITE) towards IBCF A.

38) IBCF A forwards 487 (INVITE) to IBCF B.

39) IBCF B forwards 487 (INVITE) to S-CSCF and S-CSCF forwards the 487 (INVITE) to P-CSCF.

40) P-CSCF forwards 487 (INVITE) to UE A.

41) UE A responds with ACK.

42) P-CSCF forwards ACK to S-CSCF and S-CSCF forwards the ACK to IBCF B.

43) IBCF B forwards ACK to IBCF A.

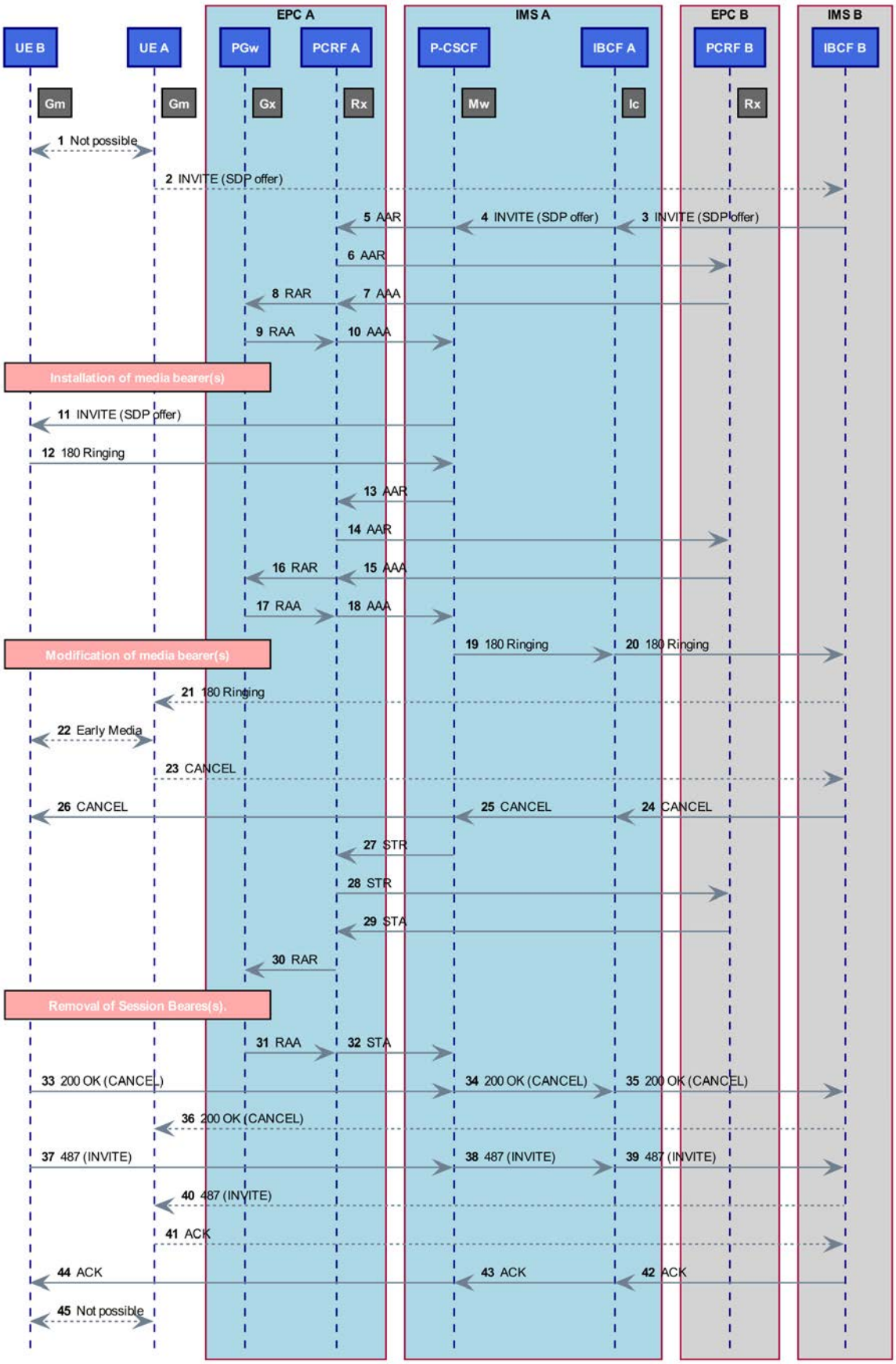
44) IBCF A forwards ACK to UE B.

45) The dedicated bearer(s) is/are down and no media can flow between the UEs.

6.3.4.2 SIP Session Abort - Termination Leg

Interoperability Test Description		
Identifier:	TD_VxLTE_RMI_ABT_02	
Objective:	To demonstrate SIP session abort (originating side) and the related interactions with PCRF and EPC for a roaming UE.	
Summary:	On session abort, the P-CSCF should trigger the removal of all relevant previously created early media bearers. EPC removes the bearers for early media. Media transport is no longer possible, after the session abort.	
Configuration:	CF_VxLTE_RMI_A	
SUT:	IMS A and EPC A, IMS B and EPC B	
Interfaces:	Gm, Mw, Ic, Rx, Gx, S9	
References:	Gm, Mw	ETSI TS 124 229 [2], clause 5.1.5 (2nd paragraph) and clause 5.1.3 and clause 6.2
	Ic	ETSI TS 124 229 [2], clause 5.2.6.3.3 (1st numbered list) and clause 5.2.6.4.4 (1st numbered list) and clause 5.4.3.2 and clause 5.10.3.2 and clause 5.2.8.1.1 and clause 5.3.2.2 and IETF RFC 3261 [12], clause 9.2
	Gx	ETSI TS 129 212 [7], clause 4.5.2
	Rx	ETSI TS 129 214 [6], clause 4.4.4
	S9	ETSI TS 129 215 [9], clause 4.5.3.6
Pre-test conditions:	• UE A & UE B previously attached to EPC A. • UE B is roaming. • EPC established a Default Bearer allowing UE A to P-CSCF & UE B to P-CSCF IP communication. • UE A & UE B previously registered to IMS. • EPCs provisioned IMS signalling bearers.	
Test Sequence:	**Step**	
	1	Verify that media between UE A and UE B is not delivered in any direction.
	2	UE A initiates a session establishment operation.
	3	UE B answers with SIP 180 Ringing INVITE Response and starts sending early media.
	4	Verify that early media is delivered from UE B to UE A.
	5	UE A cancels the session establishment.
	6	Verify that P-CSCF terminates the Rx session, triggering removal of all early media related bearers.
	7	Verify that the Rx messages are sent over S9 between the visited and home PCRFs respectively.
	8	Verify that EPC removes all early media related bearers.

Interoperability Test Description			
	9	Verify that media between UE B and UE A can no longer be exchanged and is filtered out by EPC.	
Conformance criteria of test sequence step:	1	Rtp	TP_RTP_04 (Events 1)
	2, 3	Rx	TP_RX_PCSCF_AAR_06 (AAR - Event 5)
		S9	TP_S9_PCRF_AAR_01 (AAR - Event 6)
		S9	TP_S9_PCRF_AAA_02 (AAA - Event 7)
		Gx	TP_GX_PCRF_RAR_03 (RAR - Event 8)
		Gx	TP_GX_PGW_RAA_02 (RAA - Event 9)
		Rx	TP_RX_PCRF_AAA_02 (AAA - Event 10)
		Gm	TP_GM_PCSCF_INVITE_04 (Event 11)
		MwPS	TP_MW_PCSCF_INVITE_04 (Event 4)
		Ic	TP_IC_IBCF_INVITE_04 (INVITE - Event 3)
		Ic	TP_IC_IBCF_100TRY_01 (INVITE, 100 Trying - Event 3)
		Ic	TP_IC_IBCF_1XXRESP_04 (180 Ringing - Event 20)
		Rx	TP_RX_PCSCF_AAR_07 (AAR - Event 13)
		S9	TP_S9_PCRF_AAR_01 (AAR - Event 14)
		S9	TP_S9_PCRF_AAA_02 (AAA - Event 15)
		Gx	TP_GX_PCRF_RAR_03 (RAR - Event 16)
		Gx	TP_GX_PGW_RAA_02 (RAA - Event 17)
		Rx	TP_RX_PCRF_AAA_02 (AAA - Event 18)
	4	Rtp	TP_RTP_05 (Event 22)
	5	Gm	TP_GM_PCSCF_CANCEL_04 (Event 26)
		MwPS	TP_MW_PCSCF_CANCEL_04 (Event 25)
		Ic	TP_IC_IBCF_CANCEL_02 (CANCEL - Event 24)
		Gm	TP_GM_PCSCF_487INVITE_04 (Event 37)
		MwPS	TP_MW_PCSCF_487INVITE_04 (Event 38)
		Ic	TP_IC_IBCF_CANCEL_OK_02 (OK - Event 35)
		Ic	TP_IC_IBCF_487INVITE_02 (487 INVITE - Event 39)
		Ic	TP_IC_IBCF_487INVITE_ACK_02 (ACK - Event 42)
	6, 7	Rx	TP_RX_PCSCF_STR_03 (STR - Event 27)
		S9	TP_S9_PCRF_STR_01 (STR - Event 28)
		S9	TP_S9_PCRF_STA_01 (STA - Event 29)
		Gx	TP_GX_PCRF_RAR_02 (RAR - Event 30)
		Gx	TP_GX_PGW_RAA_02 (RAA - Event 31)
		Rx	TP_RX_PCRF_STA_01 (STA - Event 32)
	8, 9	Rtp	TP_RTP_04 (Events 45)



NOTE: Dashed connections between UE A and IBCF B represents the signalling which passes different entities but due to the scope of TD those are not points of observation.

Figure 40: SIP Session Abort - Terminating Leg (Roaming)

1) No media exchange between UE A and UE B.
2) UE A initiates the SIP session with an INVITE containing the SDP offer towards roaming UE B.
3) IBCF B forwards the INVITE to IBCF A
4) IBCF A forwards the INVITE to P-CSCF.
5) The IMS A P-CSCF invokes visited PCRF.
6) Visited PCRF sends AAR to home PCRF.
7) Home PCRF responds with AAA.
8) Visited PCRF sends RAR to EPC A P-GW.
9) EPC A P-GW responds with RAA.
10) Visited PCRF responds to IMS A P-CSCF with AAA.
11) P-CSCF forwards the INVITE to UE B.
12) The UE B responds with the 180 (Ringing) with SDP answer.
13) The IMS A P-CSCF invokes visited PCRF to modify the bearer.
14) Visited PCRF forwards AAR to home PCRF.
15) Home PCRF responds with AAA.
16) Visited PCRF sends RAR to EPC A P-GW.
17) EPC A P-GW responds with RAA.
18) Visited PCRF responds to IMS A P-CSCF with AAA.
19) P-CSCF forwards the SIP 180 (SDP) towards IBCF A.
20) IBCF A forwards the SIP 180 (SDP) to IBCF B
21) IBCF B forwards the SIP 180 (SDP) towards UE A.
22) Early media may flow between the UEs.
23) UE A sends CANCEL towards UE B.
24) IBCF B forwards the CANCEL to IBCF A
25) IBCF A forwards the CANCEL towards P-CSCF.
26) P-CSCF forwards the CANCEL to UE B.
27) P-CSCF sends STR to EPC A PCRF
28) EPC A PCRF forwards the STR to the EPC B PCRF.
29) EPC B PCRF sends with STA.
30) EPC A PCRF sends RAR to EPC A PGw.
31) EPC A PGw sends RAA to EPC B PCRF.
32) EPC A PCRF forwards STA to IMS A P-CSCF.
33) UE B responds with 200 OK (CANCEL).
34) P-CSCF forwards 200 OK (CANCEL) to S-CSCF and S-CSCF forwards the 200 OK (CANCEL) to IBCF A.
35) IBCF A forwards 200 OK (CANCEL) to IBCF B

36) IBCF B forwards OK (CANCEL) towards UE A.

37) UE B sends 487 (INVITE) to P-CSCF.

38) P-CSCF forwards 487 (INVITE) to S-CSCF and S-CSCF forwards the 487 (INVITE) to IBCF A.

39) IBCF A forwards 487 (INVITE) to IBCF B

40) IBCF B forwards 487 (INVITE) towards UE A.

41) UE A responds with ACK.

42) IBCF B sends ACK to IBCF A

43) IBCF A forwards ACK to S-CSCF and S-CSCF forwards the ACK to P-CSCF.

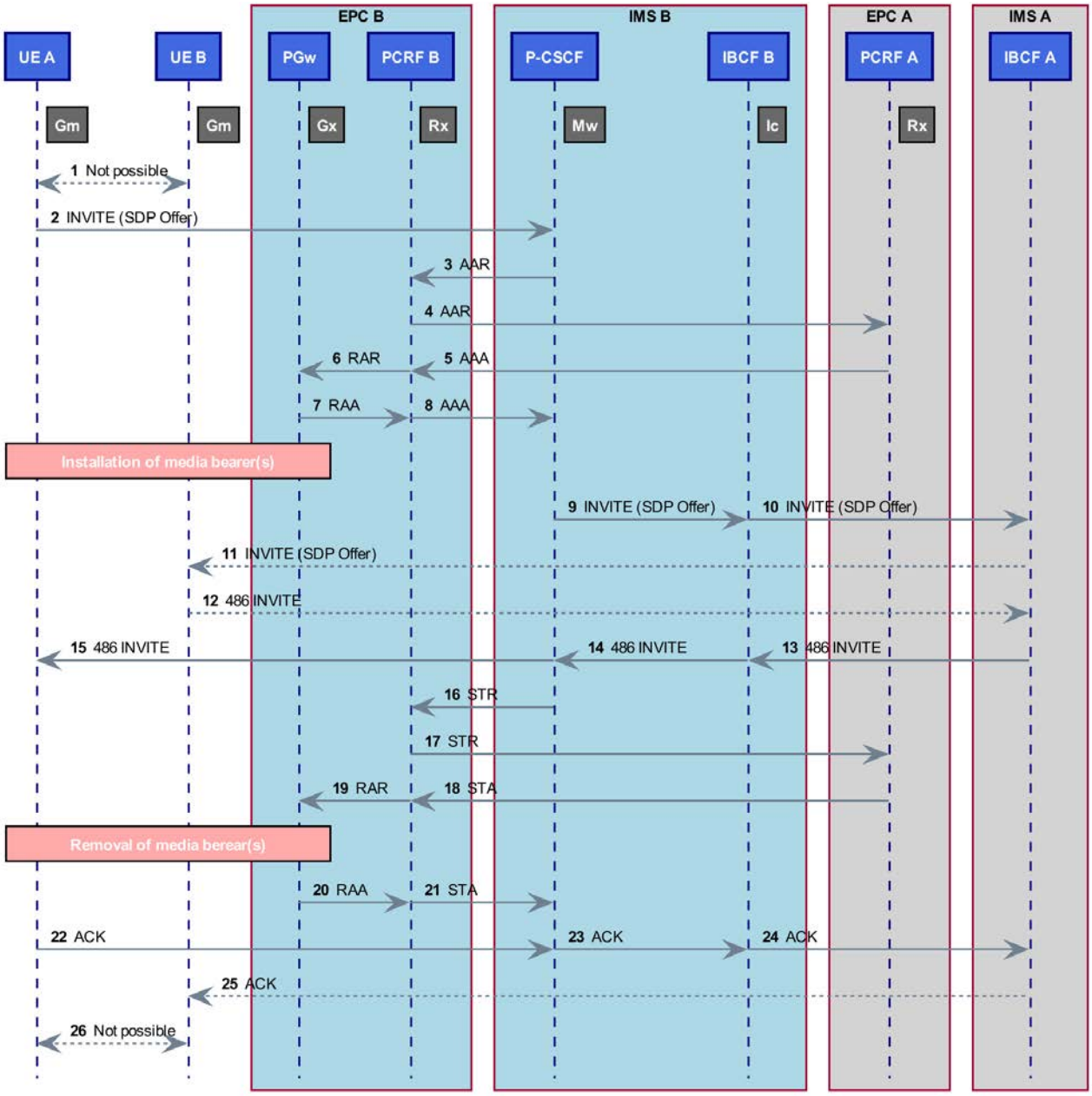
44) P-CSCF forwards ACK to UE B.

45) The dedicated bearer(s) is/are down and no media can flow between the UEs

6.3.4.3 SIP Session Reject - Originating Leg

Interoperability Test Description		
Identifier:	TD_VxLTE_RMI_REJ_01	
Objective:	To demonstrate interaction between IMS and PCRF/EPC at the originating side when an IMS session is rejected for a roaming UE.	
Summary:	On session reject, the P-CSCF should trigger the removal of all relevant previously created early media bearers. EPC removes the bearers for early media. Media transport is no longer possible, after the session reject.	
Configuration:	CF_VxLTE_RMI_B	
SUT:	IMS A and EPC A, IMS B and EPC B	
Interfaces:	Gm, Mw, Ic, Rx, Gx, S9	
References:	Gm, Mw	ETSI TS 124 229 [2], clause 5.1.5 (2nd paragraph) and clause 5.1.3 and clause 6.2
	Ic	ETSI TS 124 229 [2], clause 5.2.6.3.3 (1st numbered list) and clause 5.10.3.2 and IETF RFC 3261 [12], clause 13.3.1.3
	Gx	ETSI TS 129 212 [7], clause 4.5.2
	Rx	ETSI TS 129 214 [6], clause 4.4.4
	S9	ETSI TS 129 215 [9], clause 4.5.3.6
Pre-test conditions:	• UE A & UE B previously attached to EPC B. • UE A is roaming. • EPC B established a Default Bearer allowing UE A to P-CSCF & UE B to P-CSCF IP communication. • UE A & UE B previously registered to IMS. • EPCs provisioned IMS signalling bearers. • UE B rejects the incoming call.	
Test Sequence:	**Step**	
	1	Verify that media between UE A and UE B is not delivered in any direction.
	2	UE A calls UE B and establishes a communication session.
	3	Verify that media bearer is initiated and reflects the SDP offer.
	4	UE rejects the session establishment.
	5	Verify that P-CSCF terminates the Rx session, triggering removal of all early media related bearers.
	6	Verify that the Rx messages are sent over S9 between the visited and home PCRFs respectively.
	7	Verify that EPC removes all early media related bearers.
	8	Verify that media between UE B and UE A can no longer be exchanged and is filtered out by EPC.

Interoperability Test Description			
Conformance criteria of test sequence step:	1	Rtp	TP_RTP_04 (Events 1)
	2	Gm	TP_GM_PCSCF_INVITE_03 (Event 2)
		Rx	TP_RX_PCSCF_AAR_03 (AAR - Event 3)
		S9	TP_S9_PCRF_AAR_01 (AAR - Event 4)
		S9	TP_S9_PCRF_AAA_02 (AAA - Event 5)
		Gx	TP_GX_PCRF_RAR_03 (RAR - Event 6)
		Gx	TP_GX_PGW_RAA_02 (RAA - Event 7)
		Rx	TP_RX_PCRF_AAA_02 (AAA - Event 8)
		MwPS	TP_MW_PCSCF_INVITE_03 (Event 9)
		Ic	TP_IC_IBCF_INVITE_04 (INVITE - Event 10)
		Ic	TP_IC_IBCF_100TRY_02 (INVITE, 100 Trying - Event 10)
	4	Gm	TP_GM_PCSCF_486INVITE_03 (Event 15)
		MwPS	TP_MW_PCSCF_486INVITE_03 (Event 14)
		Ic	TP_IC_IBCF_486INVITE_03 (Event 13)
	5, 6	Rx	TP_RX_PCSCF_STR_06 (STR - Event 16)
		S9	TP_S9_PCRF_STR_01 (STR - Event 17)
		S9	TP_S9_PCRF_STA_01 (STA - Event 18)
		Gx	TP_GX_PCRF_RAR_02 (RAR - Event 19)
		Gx	TP_GX_PGW_RAA_02 (RAA - Event 20)
		Rx	TP_RX_PCRF_STA_01 (STA - Event 21)
	7, 8	Rtp	TP_RTP_04 (Events 26)



NOTE: Dashed connections between UE B and IBCF A represents the signalling which passes different entities but due to the scope of TD those are not points of observation.

Figure 41: SIP Session Reject - Originating Leg (Roaming)

1) No media exchange between UE A and UE B.
2) UE A roaming initiates the SIP session with an INVITE containing the SDP offer.
3) The IMS B P-CSCF invokes visited PCRF.
4) Visited PCRF sends AAR to home PCRF.
5) Home PCRF responds with AAA.
6) Visited PCRF sends RAR to EPC B P-GW.
7) EPC B P-GW responds with RAA.
8) Visited PCRF responds to IMS B P-CSCF with AAA.

9) P-CSCF forwards the INVITE to IBCF B.

10) IBCF B forwards the INVITE to IBCF A.

11) IBCF A forwards the INVITE towards UE B.

12) The UE B responds with the 486 INVITE (Busy).

13) IBCF A forwards the 486 INVITE to the IBCF B.

14) IBCF B forwards the 486 INVITE to S-CSCF and S-CSCF forwards the 486 INVITE to P-CSCF.

15) P-CSCF forwards the 486 INVITE to UE A.

16) P-CSCF sends STR to EPC B PCRF.

17) EPC B PCRF forwards the STR to the EPC A PCRF.

18) EPC A PCRF sends STA to EPC B PCRF.

19) EPC B PCRF sends RAR to EPC B PGw.

20) EPC B PGw sends RAA to EPC B PCRF.

21) EPC B PCRF sends STA to IMS B P-CSCF.

22) UE A sends ACK to P-CSCF.

23) P-CSCF forwards ACK to S-CSCF and S-CSCF forwards the ACK to IBCF A.

24) IBCF A forwards ACK to the IBCF B.

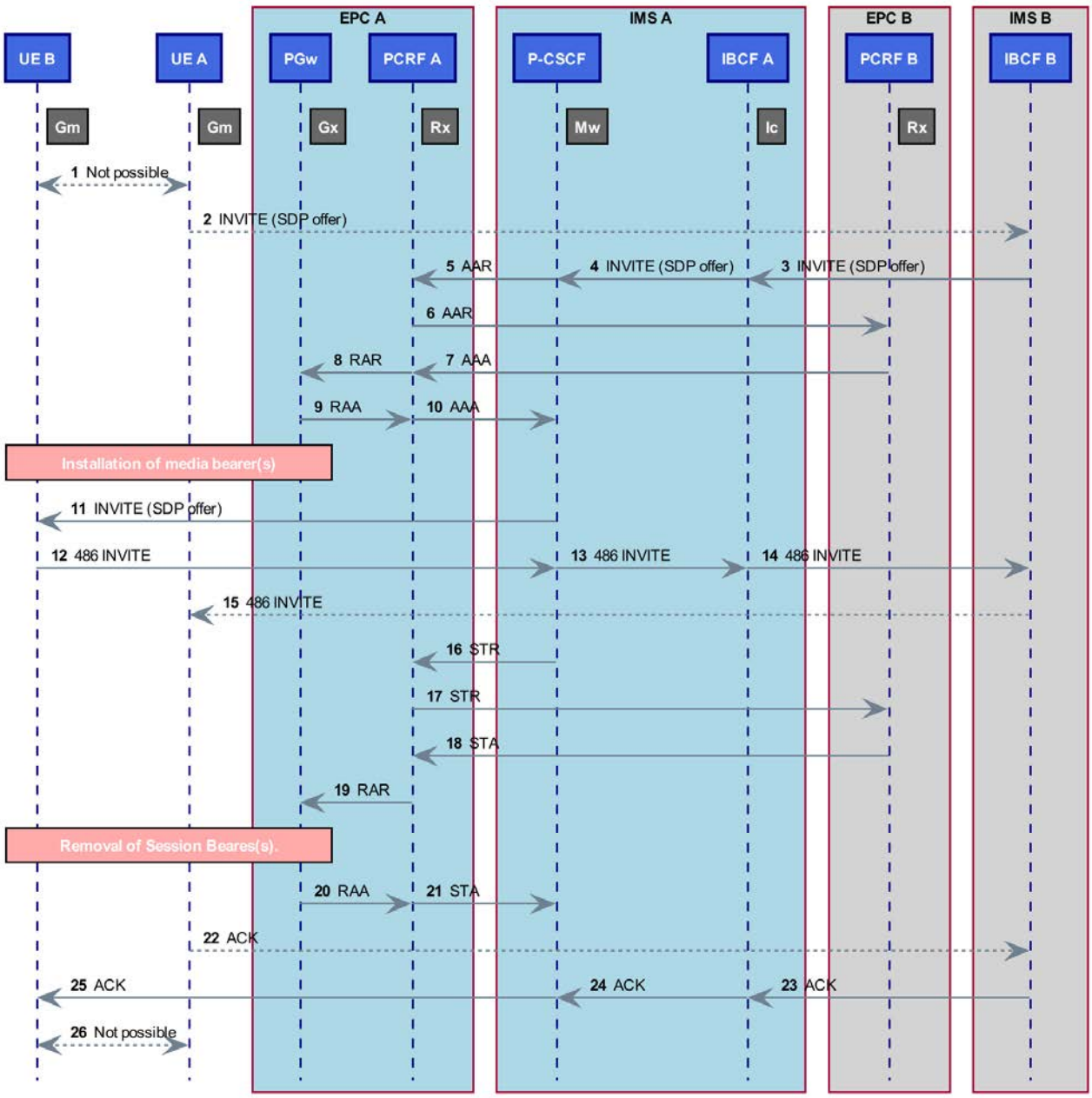
25) IBCF B forwards ACK towards UE B.

26) No media can flow between the UEs.

6.3.4.4 SIP Session Reject - Termination Leg

Interoperability Test Description		
Identifier:	TD_VxLTE_RMI_REJ_02	
Objective:	To demonstrate interaction between IMS and PCRF/EPC at the originating side when an IMS session is rejected for a roaming UE.	
Summary:	On session reject, the P-CSCF should trigger the removal of all relevant previously created early media bearers. EPC removes the bearers for early media. Media transport is no longer possible, after the session reject.	
Configuration:	CF_VxLTE_RMI_A	
SUT:	IMS A and EPC A, IMS B and EPC B	
Interfaces:	Gm, Mw, Ic, Rx, Gx, S9	
References:	Gm, Mw	ETSI TS 124 229 [2], clause 5.1.5 (2nd paragraph) and clause 5.1.3 and clause 6.2
	Ic	ETSI TS 124 229 [2], clause 5.2.6.3.3 (1st numbered list) and clause 5.10.3.2 and IETF RFC 3261 [12], clause 13.3.1.3
	Gx	ETSI TS 129 212 [7], clause 4.5.2
	Rx	ETSI TS 129 214 [6], clause 4.4.4
	S9	ETSI TS 129 215 [9], clause 4.5.3.6

Interoperability Test Description			
Pre-test conditions:	• UE A & UE B previously attached to EPC A. • UE B is roaming. • EPC A established a Default Bearer allowing UE B to P-CSCF & UE A to P-CSCF IP communication. • UE A & UE B previously registered to IMS. • EPCs provisioned IMS signalling bearers. • UE B is already busy on another call.		
Test Sequence:	**Step**		
	1	Verify that media between UE A and UE B is not delivered in any direction.	
	2	UE A initiates a session establishment operation.	
	3	UE B answers with SIP 486 (busy) Response.	
	4	Verify that P-CSCF terminates the Rx session, triggering removal of all early media related bearers.	
	5	Verify that the Rx messages are sent over S9 between the visited and home PCRFs respectively.	
	6	Verify that EPC removes all early media related bearers.	
	7	Verify that media between UE B and UE A can no longer be exchanged and is filtered out by EPC.	
Conformance criteria of test sequence step:	1	Rtp	TP_RTP_04 (Events 1)
	2	Rx	TP_RX_PCSCF_AAR_06 (AAR - Event 5)
		S9	TP_S9_PCRF_AAR_01 (AAR - Event 6)
		S9	TP_S9_PCRF_AAA_02 (AAA - Event 7)
		Gx	TP_GX_PCRF_RAR_03 (RAR - Event 8)
		Gx	TP_GX_PGW_RAA_02 (RAA - Event 9)
		Rx	TP_RX_PCRF_AAA_02 (AAA - Event 10)
		Gm	TP_GM_PCSCF_INVITE_04 (Event 11)
		MwPS	TP_MW_PCSCF_INVITE_04 (Event 4)
		Ic	TP_IC_IBCF_INVITE_05 (INVITE - Event 3)
		Ic	TP_IC_IBCF_100TRY_01 (INVITE, 100 Trying - Event 3)
	3, 4	Gm	TP_GM_PCSCF_486INVITE_04 (Event 12)
		MwPS	TP_MW_PCSCF_486INVITE_04 (Event 13)
		Ic	TP_IC_IBCF_486INVITE_04 (Event 14)
	5	Rx	TP_RX_PCSCF_STR_03 (STR - Event 16)
		S9	TP_S9_PCRF_STR_01 (STR - Event 17)
		S9	TP_S9_PCRF_STA_01 (STA - Event 18)
		Gx	TP_GX_PCRF_RAR_02 (RAR - Event 19)
		Gx	TP_GX_PGW_RAA_02 (RAA - Event 20)
		Rx	TP_RX_PCRF_STA_01 (STA - Event 21)
	6, 7	Rtp	TP_RTP_04 (Event 26)



NOTE: Dashed connections between UE A and IBCF B represents the signalling which passes different entities but due to the scope of TD those are not points of observation.

Figure 42: SIP Session Reject - Terminating Leg (Roaming)

1) No media exchange between UE A and UE B.

2) UE A roaming initiates the SIP session with an INVITE containing the SDP offer.

3) The IBCF B sends INVITE to IBCF A.

4) The IBCF A sends INVITE to P-CSCF.

5) The IMS B P-CSCF invokes visited PCRF.

6) Visited PCRF sends AAR to home PCRF.

7) Home PCRF responds with AAA.

8) Visited PCRF sends RAR to EPC B P-GW.

9) EPC A P-GW responds with RAA.

10) Visited PCRF responds to IMS A P-CSCF with AAA.

11) P-CSCF forwards the INVITE to UE B.

12) UE B sends the 486 INVITE to P-CSCF towards UE B.

13) P-CSCF forwards the 486 INVITE to S-CSCF and S-CSCF forwards the 486 INVITE to IBCF B.

14) IBCF A forwards the 486 INVITE to IBCF B.

15) IBCF B forwards the 486 INVITE towards UE A.

16) P-CSCF sends STR to EPC A PCRF.

17) EPC A PCRF forwards the STR to the EPC B PCRF.

18) EPC B PCRF sends STA to EPC A PCRF.

19) EPC A PCRF sends RAR to EPC A PGw.

20) EPC A PGw sends RAA to EPC A PCRF.

21) EPC B PCRF forwards STA to IMS A P-CSCF.

22) UE A responds with ACK.

23) IBCF B forwards ACK to IBCF A.

24) IBCF A forwards ACK to P_CSCF.

25) P-CSCF forwards ACK to UE B.

26) No media can flow between the UEs.

6.4 IMS De-Registration

6.4.0 General

These tests cover interaction between the EPC, PCRF and IMS when IMS de-registration takes place for a roaming user.

The assumptions and purpose of these tests are as for clause 5.4 but involving a roaming UE.

6.4.1 User via EPC - IMS De-registration (no SIP session active)

Interoperability Test Description	
Identifier:	TD_VxLTE_RMI_DRG_01
Objective:	To perform initial IMS de-registration and remove the session binding from the underlying default bearer for a roaming UE.
Summary:	On UE A de-registration, P-CSCF signals to PCRF the termination of the IMS signalling session. EPC removes the QOS rules of the IMS signalling bearer. Initial registration are still possible, but traffic will be categorized in the Default Bearer.
Configuration:	CF_VxLTE_RMI_B
SUT:	IMS A, IMS B and EPC B
Interfaces:	Gm, Mw, Cx, Rx, Gx, S9, Ic

Interoperability Test Description		
References:	Gm, Mw	ETSI TS 124 229 [2], clause 5.2.5.1and clause 5.4.1.5 and clauses 6.2 and 6.3
	Ic	ETSI TS 124 229 [2], clause 5.10.2.1 and clause 5.10.3.1 and clause 5.10.4.2
	Rx	ETSI TS 129 214 [6], clauses 4.4.4, 4.4.5a and A.8
	Gx	ETSI TS 129 212 [7], clause 4.5.2
	Cx	ETSI TS 129 228 [4], clauses 6.1.1.1, 6.1.2.1 and A.4.3 ETSI TS 129 229 [5], clauses 6.1.1, 6.1.2, 6.1.3 and 6.1.4
	S9	ETSI TS 129 215 [9], clause 4.5.3.6
Pre-test conditions:	• UE A is roaming and previously attached to EPC. • EPC established a Default Bearer allowing UE A - P-CSCF IP communication. • UE A previously registered to IMS. • EPC provisioned the IMS signalling bearer allowing UE A - P-CSCF IP communication with AF Signalling QoS characteristics.	
Test Sequence:	**Step**	
	1	UE A triggers IMS de-registration, removing all registered contacts at respective P-CSCF.
	2	Verify that P-CSCF invokes the PCRF to remove the session binding established at IMS registration.
	3	Verify that the Rx messages are sent over S9 between the visited and home PCRFs respectively.
	4	Verify that signalling between UE A and P-CSCF is still possible, by using a registration status pull (no contacts in SIP REGISTER request). Verify that this signalling is transported in the still active Default Bearer.
Conformance criteria of test sequence step:	1, 2	Gm TP_GM_PCSCF_REGISTER_08 (Event 1) MwPS TP_MW_PCSCF_REGISTER_08 (Event 2) Ic TP_IC_IBCF_REGISTER_03 (Events 3, 12) MwIS TP_MW_ICSCF_REGISTER_08 (Event 4) Cx TP_CX_HSS_UAA_04 (UAR,UAA - Events 5, 6) Cx TP_CX_HSS_SAA_02 (SAR,SAA - Events 8, 9)
	3	Rx TP_RX_PCSCF_STR_07 (STR - Event 15) S9 TP_S9_PCRF_STR_01 (STR - Event 16) S9 TP_S9_PCRF_STA_02 (STA - Event 17) Gx TP_GX_PCRF_RAR_04 (RAR - Event 18) Gx TP_GX_PGW_RAA_02 (RAA - Event 19) Rx TP_RX_PCRF_STA_01 (STA - Event 20)

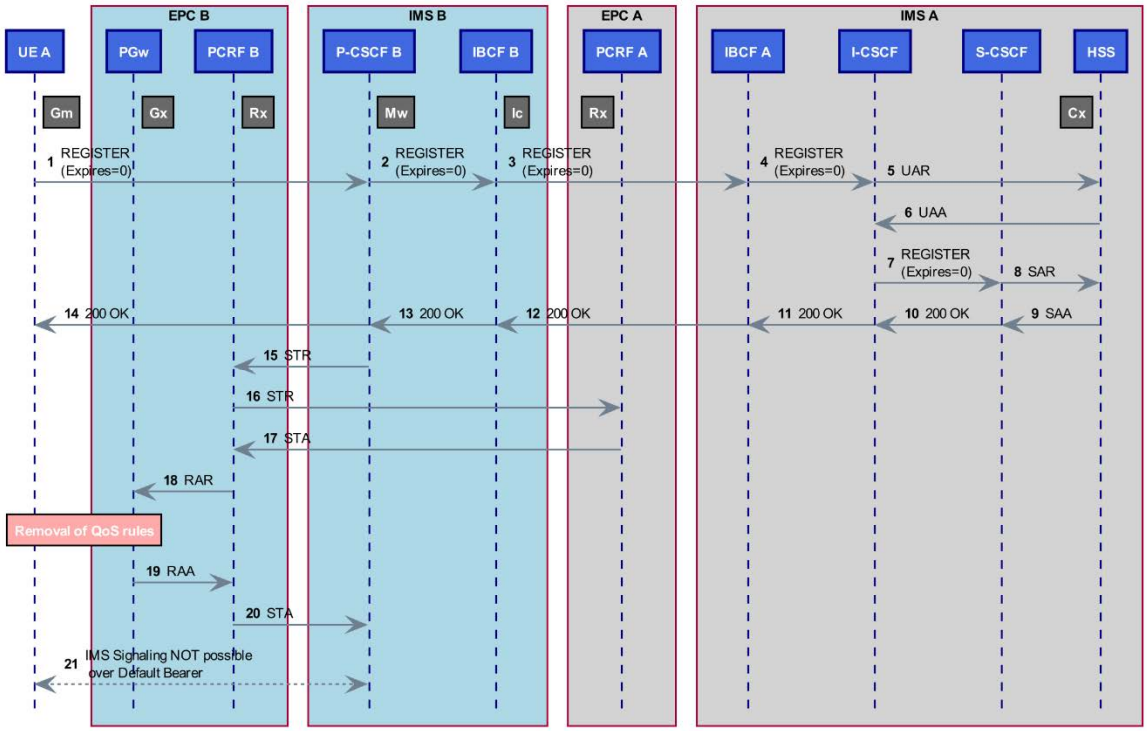


Figure 43: IMS De-registration (Roaming)

1) The UE-A in roaming requests IMS A De-Registration.
2) Visited P-CSCF forwards the REGISTER(Expires=0) to visited IBCF B.
3) Visited IBCF B forwards the REGISTER(Expires=0) to home IBCF A.
4) Home IBCF A forwards the REGISTER(Expires=0) to home I-CSCF.
5) Home I-CSCF sends UAR to HSS.
6) HSS responds with UAA.
7) Home I-CSCF forwards the REGISTER to home S-CSCF.
8) S-CSCF sends SAR to HSS.
9) HSS responds with SAA.
10) The IMS de-registration is successful.
11) I-CSCF forwards 200 response to home IBCF A.
12) Home IBCF A forwards 200 response to visited IBCF B.
13) Visited IBCF B forwards 200 response to visited P-CSCF.
14) Visited P-CSCF forwards 200 response to UE-A.
15) The P-CSCF visited initiates session termination with STR.
16) PCRF visited forwards STR to PCRF home.
17) The PCRF home responds with STA to the PCRF visited.
18) The PCRF visited removes the QOS rules at the P-GW to modify the default bearer- sends RAR.
19) The P-GW in the EPC responds with RAA to the PCRF.
20) PCRF visited sends STA to the visited P-CSCF.

21) IMS signalling not possible over default bearer.

6.4.2 User via EPC - IMS Administrative De-Registration (no SIP session active)

Interoperability Test Description			
Identifier:	TD_VxLTE_RMI_DRG_02		
Objective:	To perform IMS admin initiated de-registration and remove the session binding from the underlying default bearer for a roaming UE.		
Summary:	On administrative de-registration, S-CSCF notifies the UE A and P-CSCF about the event. P-CSCF signals to PCRF the termination of the session binding to the default bearer and the EPC removes the previously provisioned QOS rules. Initial registration are still possible, but traffic will be categorized in the Default Bearer.		
Configuration:	CF_VxLTE_RMI_B		
SUT:	IMS A, IMS B and EPC B		
Interfaces:	Gm, Mw, Cx, Rx, Gx, S9, Ic		
References:	Gm, Mw	ETSI TS 124 229 [2], clause 5.2.5.1 and clause 5.4.1.5 and clauses 6.2 and 6.3	
	Ic	ETSI TS 124 229 [2], clause 5.10.3.2	
	Rx	ETSI TS 129 214 [6], clauses 4.4.4, 4.4.5a and A.8	
	Gx	ETSI TS 129 212 [7], clause 4.5.2	
	Cx	ETSI TS 129 228 [4], clause 6.1.3 ETSI TS 129 229 [5], clauses 6.1.9 and 6.1.10	
	S9	ETSI TS 129 215 [9], clause 4.5.3.6	
Pre-test conditions:	• Roaming UE A previously attached to EPC. • EPC established a Default Bearer allowing UE A - P-CSCF IP communication. • UE A previously registered to IMS. • EPC provisioned the IMS signalling bearer allowing UE A - P-CSCF IP communication with AF Signalling QoS characteristics.		
Test Sequence:	**Step**		
	1	S-CSCF/HSS triggers administrative de-registration, removing all registered contacts of UE A.	
	2	Verify that S-CSCF signals de-registration to the P-CSCF.	
	3	Verify that P-CSCF invokes the PCRF to remove the session binding to the default bearer.	
	4	Verify that the Rx messages are sent over S9 between the visited and home PCRFs respectively.	
	5	Verify that signalling between UE A and P-CSCF is still possible, by using a registration status pull (no contacts in SIP REGISTER request). Verify that this signalling is transported in the still active Default Bearer.	
Conformance criteria of test sequence step:	1, 2	Cx MwSI	TP_CX_HSS_RTA_01 (RTR, RTA - Events 1, 16) TP_GM_SCSCF_NOTIFY_03 (Events 2, 9)
	3	Ic Ic Gm MwPS MwSI	TP_IC_IBCF_NOTIFY_01 (Events 3, 8) TP_IC_IBCF_NOTIFY_01 (Events 11, 14) TP_GM_PCSCF_NOTIFY_02 (Events 5, 6) TP_GM_PCSCF_NOTIFY_03 (Events 4, 7) TP_GM_SCSCF_NOTIFY_03 (Events 10, 15)
	4	Rx S9 S9 Gx Gx Rx	TP_RX_PCSCF_STR_08 (STR - Event 17) TP_S9_PCRF_STR_01 (STR - Event 18) TP_S9_PCRF_STA_02 (STA - Event 19) TP_GX_PCRF_RAR_04 (RAR - Event 20) TP_GX_PGW_RAA_02 (RAA - Event 21) TP_RX_PCRF_STA_01 (STA - Event 22)

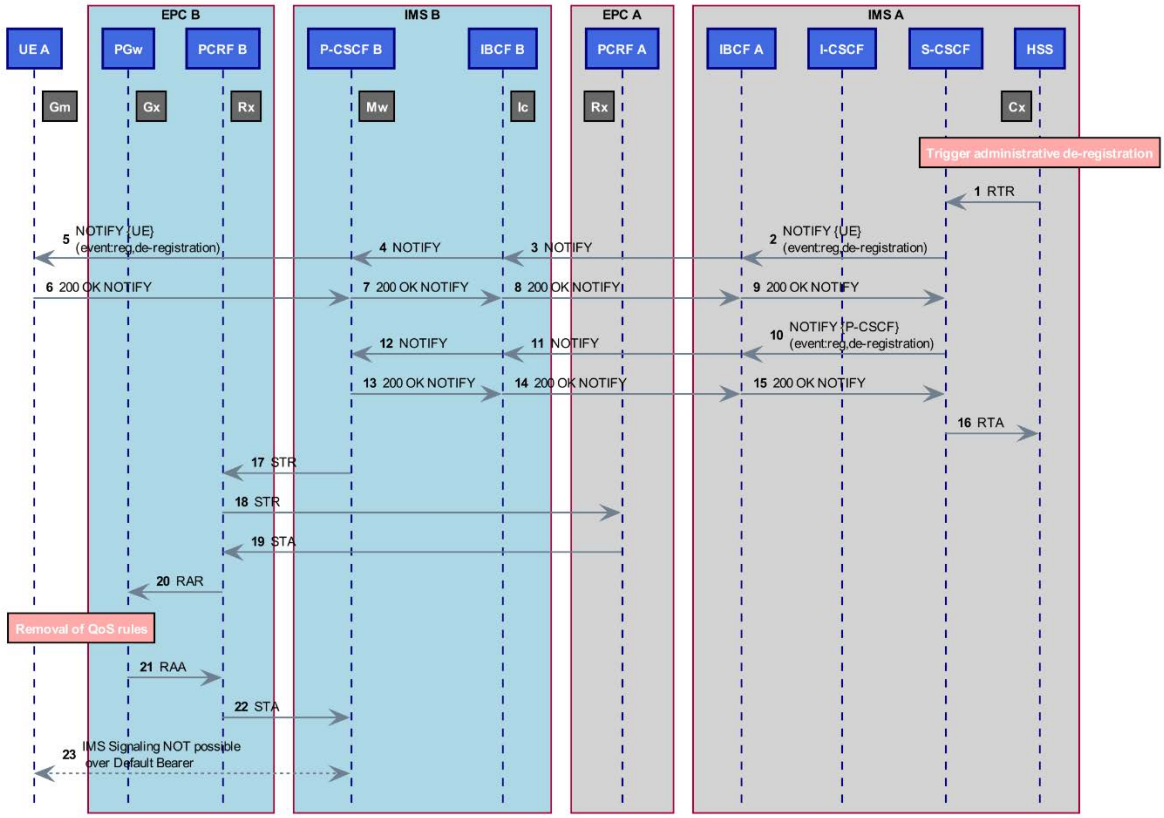


Figure 44: IMS Administrative De-Registration (Roaming)

1) Operator triggers administrative de-registration. HSS sends RTR to S-CSCF.
2) S-CSCF sends the NOTIFY(reg-event, UE) to home IBCF A.
3) Home IBCF A sends the NOTIFY(reg-event, UE) to visited IBCF B.
4) Visited IBCF B sends the NOTIFY(reg-event, UE) to visited P-CSCF.
5) Visited P-CSCF forwards the NOTIFY to UE-A.
6) UE-A responds with 200 OK.
7) Visited P-CSCF forwards 200 OK to visited IBCF B.
8) Visited IBCF B forwards 200 OK to home IBCF A.
9) Home IBCF A forwards 200 OK to S-CSCF.
10) S-CSCF sends the NOTIFY(reg-event, P-CSCF) to home IBCF A.
11) Home IBCF A sends the NOTIFY(reg-event, UE) to visited IBCF B.
12) Visited IBCF B sends the NOTIFY(reg-event, UE) to visited P-CSCF.
13) Visited P-CSCF responds with 200 OK visited IBCF B.
14) Visited IBCF B forwards 200 OK to home IBCF A.
15) Home IBCF A forwards 200 OK to S-CSCF.
16) S-CSCF sends RTA to HSS.
17) The P-CSCF visited initiates session termination with STR.
18) PCRF visited forwards STR to PCRF home.

19) The PCRF home responds with STA to the PCRF visited.

20) The PCRF visited removes the QOS rules at the P-GW to modify the default bearer- sends RAR.

21) IMS signalling not possible over default bearer.

6.4.3 User via EPC - IMS Registration expiration (no SIP session active)

Interoperability Test Description		
Identifier:	TD_VxLTE_RMI_DRG_03	
Objective:	To perform IMS de-registration due to expiry of the registration timer and remove the session binding from the underlying default bearer for a roaming UE.	
Summary:	On registration expiration, P-CSCF signals to PCRF the termination of the IMS signalling session. P-CSCF signals to PCRF the termination of the session binding to the default bearer and the EPC removes the previously provisioned QOS rules. Initial registration are still possible, but traffic will be categorized in the Default Bearer.	
Configuration:	CF_VxLTE_RMI_B	
SUT:	IMS A, IMS B and EPC B	
Interfaces:	Gm, Mw, Cx, Rx, Gx, S9, Ic	
References:	Gm, Mw	ETSI TS 124 229 [2], clause 5.2.5.1and clause 5.4.1.5 and clauses 6.2 and 6.3
	Ic	ETSI TS 124 229 [2], clause 5.10.2.1 and clause 5.10.3.1 and clause 5.10.4.2 and clause 5.10.3.2
	Rx	ETSI TS 129 214 [6], clauses 4.4.4, 4.4.5a and A.8
	Gx	ETSI TS 129 212 [7], clause 4.5.2
	Cx	ETSI TS 129 228 [4], clauses 6.1.1.1, 6.1.2.1 and A.4.3 ETSI TS 129 229 [5], clauses 6.1.1, 6.1.2, 6.1.3 and 6.1.4
	S9	ETSI TS 129 215 [9], clause 4.5.3.6
Pre-test conditions:	• Roaming UE A previously attached to EPC. • EPC established a Default Bearer allowing UE A - P-CSCF IP communication. • UE A previously registered to IMS. • EPC established session binding and provision of the IMS signalling bearer.	
Test Sequence:	**Step**	
	1	UE A registration expires at P-CSCF, for all contacts of UE A.
	2	Verify that P-CSCF signals termination of IMS signalling bearer.
	3	Verify that the Rx messages are sent over S9 between the visited and home PCRFs.
	4	Verify that signalling between UE A and P-CSCF is still possible, by using a registration status pull (no contacts in REGISTER request). Verify that this signalling is transported in the still active Default Bearer.
Conformance criteria of test sequence step:	1, 2	Rx TP_RX_PCSCF_STR_07 (STR - Event 1) S9 TP_S9_PCRF_STR_01 (STR - Event 2) MwPS TP_MW_PCSCF_REGISTER_12 (Event 3) Ic TP_IC_IBCF_REGISTER_04 (Events 4, 13) MwSI TP_MW_SCSCF_REGISTER_12 (Event 8) Cx TP_CX_HSS_UAA_04 (UAR,UAA - Events 6, 7) Cx TP_CX_HSS_SAA_02 (SAR,SAA - Events 9, 10)
	3, 4	Gm TP_GM_PCSCF_NOTIFY_02 (Events 18, 19) MwPS TP_GM_PCSCF_NOTIFY_03 (Events 17, 20) MwSI TP_GM_SCSCF_NOTIFY_03 (Events 15, 22) Ic TP_IC_IBCF_NOTIFY_01 (Events 16, 21) S9 TP_S9_PCRF_STA_02 (STA - Event 23) Gx TP_GX_PCRF_RAR_04 (RAR - Event 24) Gx TP_GX_PGW_RAA_02 (RAA - Event 25) Rx TP_RX_PCRF_STA_01 (STA - Event 26)

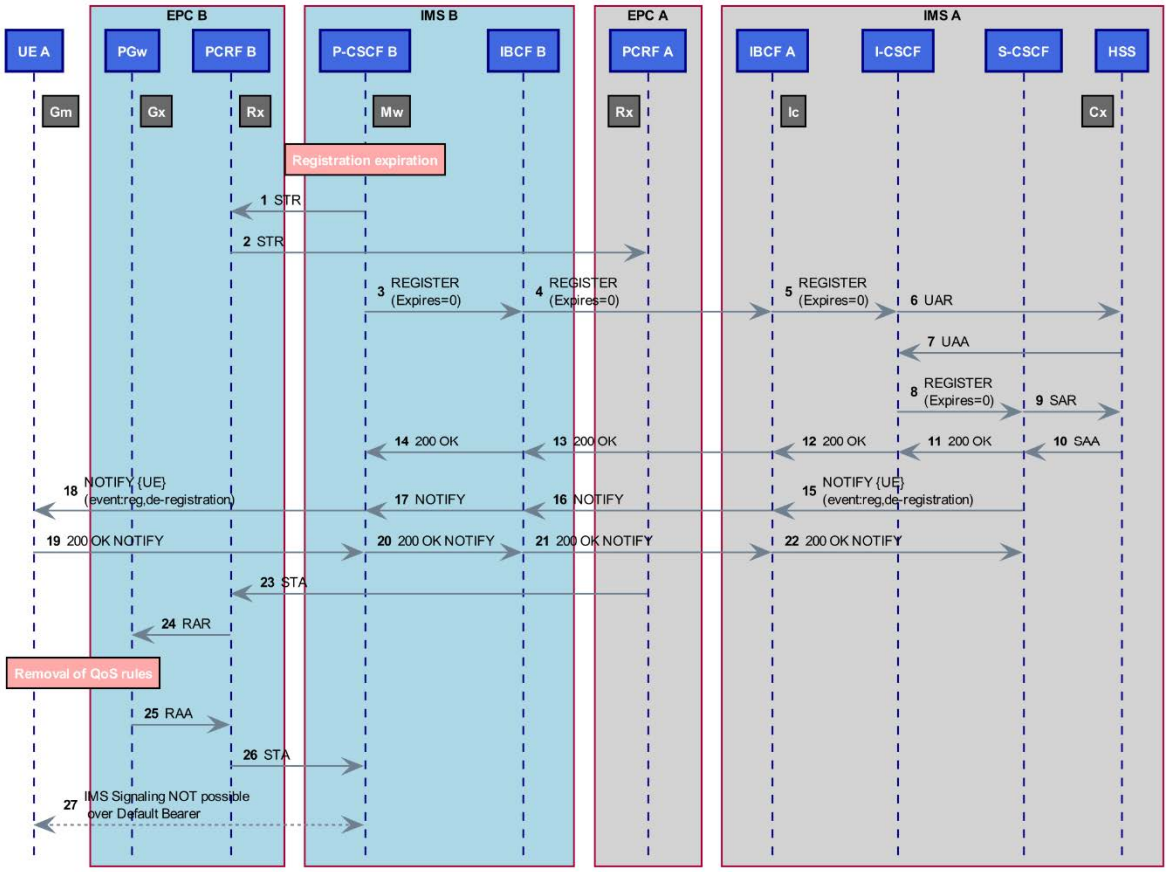


Figure 45: IMS Registration Expiration (Roaming)

1) Registration expires at the visited P-CSCF and initiates session termination with STR.
2) PCRF visited forwards STR to PCRF home.
3) P-CSCF sends the REGISTER(Expires=0) to visited IBCF B.
4) Visited IBCF B forwards the REGISTER (Expires=0) to home IBCF A.
5) Home IBCF A forwards the REGISTER (Expires=0) to home I-CSCF.
6) Home I-CSCF sends UAR to HSS.
7) HSS responds with UAA.
8) Home I-CSCF forwards the REGISTER to home S-CSCF.
9) S-CSCF sends SAR to HSS.
10) HSS responds with SAA.
11) S-CSCF send 200 response to I-CSCF
12) Home I-CSCF forwards 200 response to home IBCF A.
13) Home IBCF A forwards 200 response to visited IBCF B.
14) Visited IBCF B forwards 200 response to visited P-CSCF. The IMS de-registration is successful.
15) Home S-CSCF sends the NOTIFY(reg-event, UE) to IBCF A.
16) Home IBCF A forwards the NOTIFY (reg-event, UE) to visited IBCF B.
17) Visited IBCF B forwards the NOTIFY (reg-event, UE) to visited P-CSCF.

18) Visited P-CSCF forwards the NOTIFY to UE-A.

19) UE-A responds with 200 OK.

20) Visited P-CSCF forwards 200 OK to visited IBCF B.

21) Visited IBCF B forwards 200 OK to home IBCF A.

22) Home IBCF A forwards 200 OK to home S-CSCF.

23) The PCRF home responds with STA to the PCRF visited.

24) The PCRF visited removes the QOS rules at the P-GW to modify the default bearer- sends RAR.

25) The P-GW in the EPC responds with RAA to the PCRF.

26) PCRF visited sends STA to the visited P-CSCF.

27) IMS signalling is not possible over default bearer.

6.4.4 IMS De-registration with Active SIP Sessions

Interoperability Test Description		
Identifier:	TD_VxLTE_RMI_DRG_04	
Objective:	To perform initial IMS de-registration and remove the session binding from the underlying default bearer.	
Summary:	On (roaming) UE A de-registration, the S-CSCF performs S-CSCF-initiated termination of active session. P-CSCF will act on this event and signals to PCRF termination of the SIP session bearers. EPC removes the SIP Session bearer. Media cannot be exchanged on previous SIP Session bearer. The S-CSCF answers to the de-registration. The P-CSCF signals to PCRF the termination of IMS signalling session. EPC removes IMS signalling bearer.	
Configuration:	CF_VxLTE_RMI_B	
SUT:	IMS A, IMS B and EPC B	
Interfaces:	Gm, Mw, Cx, Rx, Gx, S9, Ic	
References:	Gm, Mw	ETSI TS 124 229 [2], clause 5.2.5.1and clause 5.4.1.4.1 and clause 5.4.5.1 and clauses 6.2 and 6.3
	Ic	ETSI TS 124 229 [2], clause 5.10.2.1 and clause 5.10.3.1 and clause 5.10.4.2 and clause 5.4.3.2 (item 1 in 7th numbered list)
	Rx	ETSI TS 129 214 [6], clause 4.4.4, 4.4.5a and A.8
	Gx	ETSI TS 129 212 [7], clause 4.5.2
	Cx	ETSI TS 129 228 [4], clauses 6.1.1.1, 6.1.2.1 and A.4.3 ETSI TS 129 229 [5], clauses 6.1.1, 6.1.2, 6.1.3 and 6.1.4
	S9	ETSI TS 129 215 [9], clause 4.5.3.6
Pre-test conditions:	• Roaming UE A previously attached to EPC. • EPC established a Default Bearer allowing UE A to P-CSCF and UE B to P-CSCF IP communication. • UE A & UE B previously registered to IMS. • EPC established an IMS signalling bearers. • UE A initiated/received a SIP session request such that a SIP session is active with UE B. • EPC established a SIP session bearer for media. • Default EPC gating policy set to "Deny".	

Interoperability Test Description			
Test Sequence:	**Step**		
	1	Verify that media between UE A and UE B is successfully forwarded.	
	2	UE A triggers IMS de-registration, removing all registered contacts at respective P-CSCF.	
	3	Verify that S-CSCF triggers S-CSCF-initiated call release.	
	4	Verify that P-CSCF signals termination of active SIP session media bearers.	
	5	Verify that the Rx messages are sent over S9 between the visited and home PCRFs.	
	6	Verify that EPC removes SIP session media bearers and as such media packets are no longer forwarded between UE A and UE B, in either direction.	
	7	Verify that P-CSCF signals termination of IMS signalling bearer.	
	8	Verify that media between UE A and UE B is not delivered in any direction after termination of SIP session bearers.	
Conformance criteria of test sequence step:	1-4	Rtp	TP_RTP_06 (Event 1)
		Gm	TP_GM_PCSCF_REGISTER_08 (Event 2)
		MwPS	TP_MW_PCSCF_REGISTER_08 (Event 3)
		Ic	TP_IC_IBCF_REGISTER_03 (Events 4, 28)
		MwIS	TP_MW_ICSCF_REGISTER_08 (Event 5)
		MwIS	TP_MW_SCSCF_BYE_07 (Events 9, 13)
		Ic	TP_IC_IBCF_BYE_02 (Events 10,24)
		Cx	TP_CX_HSS_UAA_04 (UAR,UAA - Events 6, 7)
		Cx	TP_CX_HSS_SAA_02 (SAR,SAA - Events 14, 15)
		Rx	TP_RX_PCSCF_STR_01 (STR - Event 16)
		S9	TP_S9_PCRF_STR_01 (STR - Event 17)
		S9	TP_S9_PCRF_STA_02 (AAA - Event 18)
		Gx	TP_GX_PCRF_RAR_04 (RAR - Event 19)
		Gx	TP_GX_PGW_RAA_02 (RAA - Event 20)
		Rx	TP_RX_PCRF_STA_01 (STA - Event 21)
	5-8	Rx	TP_RX_PCSCF_STR_07 (STR - Event 31)
		S9	TP_S9_PCRF_STR_01 (STR - Event 32)
		S9	TP_S9_PCRF_STA_02 (AAA - Event 33)
		Gx	TP_GX_PCRF_RAR_04 (RAR - Event 34)
		Gx	TP_GX_PGW_RAA_02 (RAA - Event 35)
		Rx	TP_RX_PCRF_STA_01 (STA - Event 36)

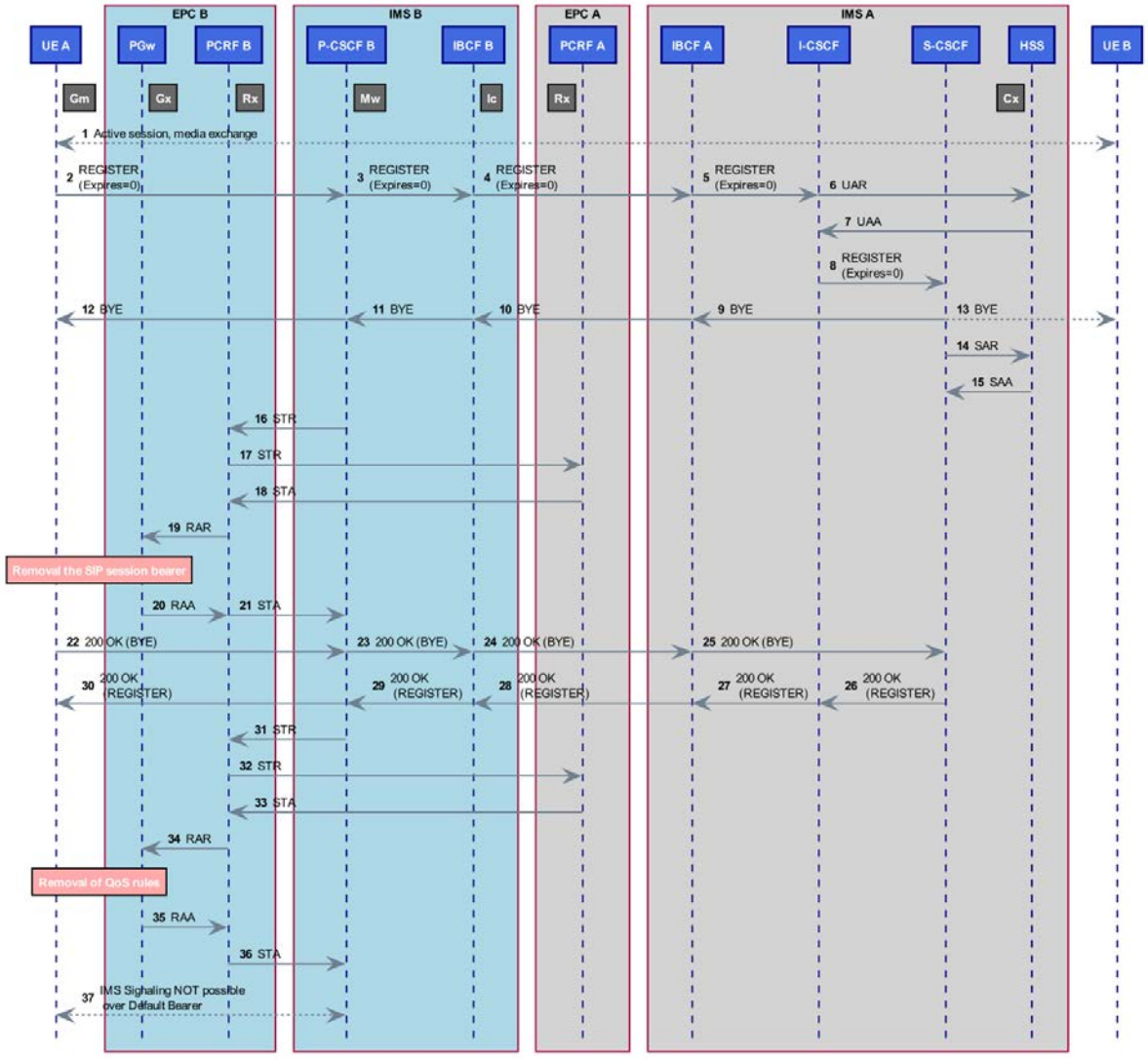


Figure 46: IMS UE De-registration with Active Session (Roaming)

1) UE-A, UE-B active session, media exchange.
2) The UE-A requests IMS A De-Registration.
3) P-CSCF forwards the REGISTER(Expires=0) to visited IBCF B.
4) Visited IBCF B forwards the REGISTER (Expires=0) to home IBCF A.
5) Home IBCF A forwards the REGISTER (Expires=0) to home I-CSCF.
6) Home I-CSCF sends UAR to HSS.
7) HSS responds with UAA.
8) Home I-CSCF forwards the REGISTER to home S-CSCF.
9) S-CSCF sends BYE to IBCF A.
10) Home IBCF A forwards BYE to the visited IBCF B.
11) Visited IBCF B forwards BYE to the visited P-CSCF B.
12) Visited P-CSCF sends BYE for UE-A.
13) S-CSCF forwards BYE to UE-B.

14) S-CSCF sends SAR to HSS.
15) HSS responds with SAA.
16) The visited P-CSCF initiates session termination with STR.
17) PCRF visited forwards STR to PCRF home.
18) The PCRF home responds with STA to the PCRF visited.
19) The PCRF removes the SIP session bearer - RAR.
20) The P-GW in the EPC responds with RAA to the PCRF.
21) The PCRF responds with STA to the P-CSCF.
22) The UE-A confirms BYE with 200 response.
23) Visited P-CSCF forwards 200 response (BYE) to visited IBCF B.
24) Visited IBCF B forwards 200 response (BYE) to home IBCF A.
25) Home IBCF A forwards 200 response (BYE) to S-CSCF.
26) The IMS de-registration is successful. S-CSCF sends 200 response on REGISTER.
27) Home I-CSCF forwards 200 response (REGISTER) to home IBCF A.
28) Home IBCF A forwards 200 response (REGISTER) to visited IBCF B.
29) Visited IBCF B forwards 200 response (REGISTER) to visited P-CSCF.
30) Visited P-CSCF forwards 200 response (REGISTER) to UE-A.
31) The P-CSCF initiates session termination with STR.
32) PCRF visited forwards STR to PCRF home.
33) The PCRF home responds with STA to the PCRF visited.
34) The PCRF at the P-GW modifies the SIP signalling bearer - RAR.
35) The P-GW in the EPC responds with RAA to the PCRF.
36) The PCRF responds with STA to the P-CSCF.
37) IMS signalling is not possible over default bearer.

6.5 Network Detachment

6.5.0 General

These tests cover interaction between the EPC, PCRF and IMS when network detachment takes place for a roaming UE.

The assumptions and purpose of these tests are as for clause 5.5 but involving a roaming UE.

6.5.1 UE Initiated Network Detachment (no IMS Registration)

Interoperability Test Description		
Identifier:	TD_VxLTE_RMI_DTC_01	
Objective:	To demonstrate UE initiated network detachment (IP-CAN session termination) for a roaming UE that has not yet registered to IMS.	
Summary:	On complete network detachment, the EPC removes all relevant bearers.	
Configuration:	CF_VxLTE_ROAM	
SUT:	IMS A, IMS B and EPC B	
Interfaces:	Gm, S9	
References:	S9	ETSI TS 129 215 [9], clauses 4.5.1.2 and 4.5.3.3
	Gx	ETSI TS 129 212 [7], clause 4.5.7
Pre-test conditions:	• Roaming UE A previously attached to EPC with a single attachment	
Test Sequence:	**Step**	
	1	Roaming UE A starts complete network detachment, whilst not being registered at IMS.
	2	Verify that EPC removes the affected bearer.
	3	Verify that EPC P-GW informs the V-PCRF of the loss of the bearer.
	4	Verify that V-PCRF terminates the S9 session with the H-PCRF.
Conformance criteria of test sequence step:	3, 4	Gx TP_GX_PGW_CCR_02 (CCR - Event 1) S9 TP_S9_PCRF_CCR_02 (CCR - Event 2) S9 TP_S9_PCRF_CCA_02 (CCA - Event 3) Gx TP_GX_PCRF_CCA_05 (CCA - Event 4)

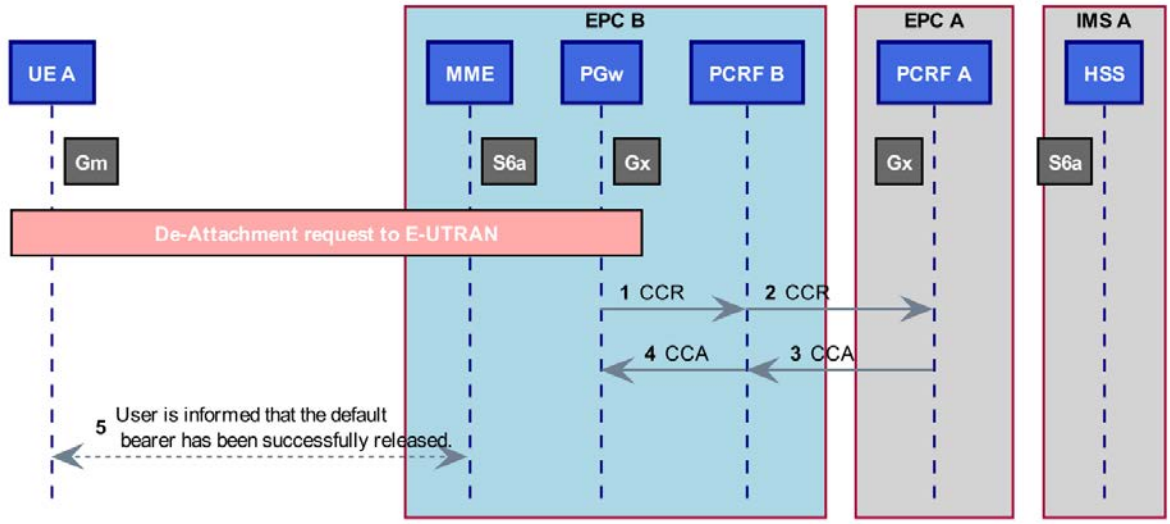


Figure 47: UE Initiated Network Detachment - not IMS Registered (Roaming)

1) User initiates detachment on UE-A. The UE-A requests IP-CAN session dis-establishment to the EPC (MME).The P-GW sends a CCR message to the V-PCRF to inform the PCRF that the default bearer is being released.

2) The visited PCRF invokes the home PCRF.

3) The home PCRF responds.

4) The V-PCRF responds with a CCA.

5) The MME responds to the UE, confirming that the IP-CAN has been successfully released.

6.5.2 UE Initiated Network Detachment with Previously Established IMS Registration

Interoperability Test Description			
Identifier:	TD_VxLTE_RMI_DTC_02		
Objective:	To demonstrate UE initiated network detachment (IP-CAN session termination) for a roaming UE that has also registered to IMS.		
Summary:	On complete network detachment, without previous termination of IMS registration, the EPC informs the IMS about the event. EPC removes all relevant bearers. IMS terminates the IMS registration.		
Configuration:	CF_VxLTE_RMI_B		
SUT:	IMS A, IMS B and EPC B		
Interfaces:	Gm, Mw, Cx, Rx, Gx, S9, Ic		
References:	Gm, Mw	ETSI TS 124 229 [2], clause 5.2.5.1 and clause 5.2.8.1.2 and clause 5.4.1.5 and clauses 6.2 and 6.3	
	Ic	ETSI TS 124 229 [2], clause 5.10.2.1 and clause 5.10.3.1 and clause 5.10.4.2	
	Rx	ETSI TS 129 214 [6], clause 4.4.6.1	
	Gx	ETSI TS 129 212 [7], clause 4.5.7	
	Cx	ETSI TS 129 228 [4], clauses 6.1.1.1, 6.1.2.1 and A.4.3 ETSI TS 129 229 [5], clauses 6.1.1, 6.1.2, 6.1.3 and 6.1.4	
	S9	ETSI TS 129 215 [9], clauses 4.5.1.2, 4.5.3.3 and 4.5.3.6	
Pre-test conditions:	• Roaming UE A previously attached to EPC with a single attachment • Roaming UE A previously registered to IMS		
Test Sequence:	**Step**		
	1	UE A starts complete network detachment, without previously triggering IMS de-registration.	
	2	Verify that EPC removes the affected bearer.	
	3	Verify that EPC P-GW informs the PCRF of the loss of the bearer.	
	4	Verify that PCRF informs IMS P-CSCF of the loss of the bearer.	
	5	Verify that IMS performs P-CSCF-initiated administrative de-registration on	
	6	Verify that IMS P-CSCF terminates the Rx session with PCRF.	
	7	Verify that the Rx messages are sent over S9 between the visited and home PCRFs.	
	8	Verify that the S9 session is terminated.	
Conformance criteria of test sequence step:	3, 4	Gx S9 S9 Gx	TP_GX_PGW_CCR_02 (CCR - Event 1) TP_S9_PCRF_CCR_02 (CCR - Event 2) TP_S9_PCRF_CCA_02 (CCA - Event 3) TP_GX_PCRF_CCA_05 (CCA - Event 4)
	5-8	S9 Rx MwPS Ic MwSI Cx Cx S9 S9 S9	TP_S9_PCRF_ASR_01 (ASR - Event 6) TP_RX_PCSCF_ASR_01 (ASR - Event 7) TP_MW_PCSCF_REGISTER_12 (Event 8) TP_IC_IBCF_REGISTER_05 (Event 9) TP_MW_SCSCF_REGISTER_12 (Event 10) TP_CX_HSS_UAA_04 (UAR,UAA - Events 11, 12) TP_CX_HSS_SAA_02 (SAR,SAA - Events 14, 15) TP_S9_PCRF_ASA_01 (ASA - Events 20, 22) TP_S9_PCRF_STR_01 (STR - Events 21, 23) TP_S9_PCRF_STA_02 (STA - Events 24, 25)

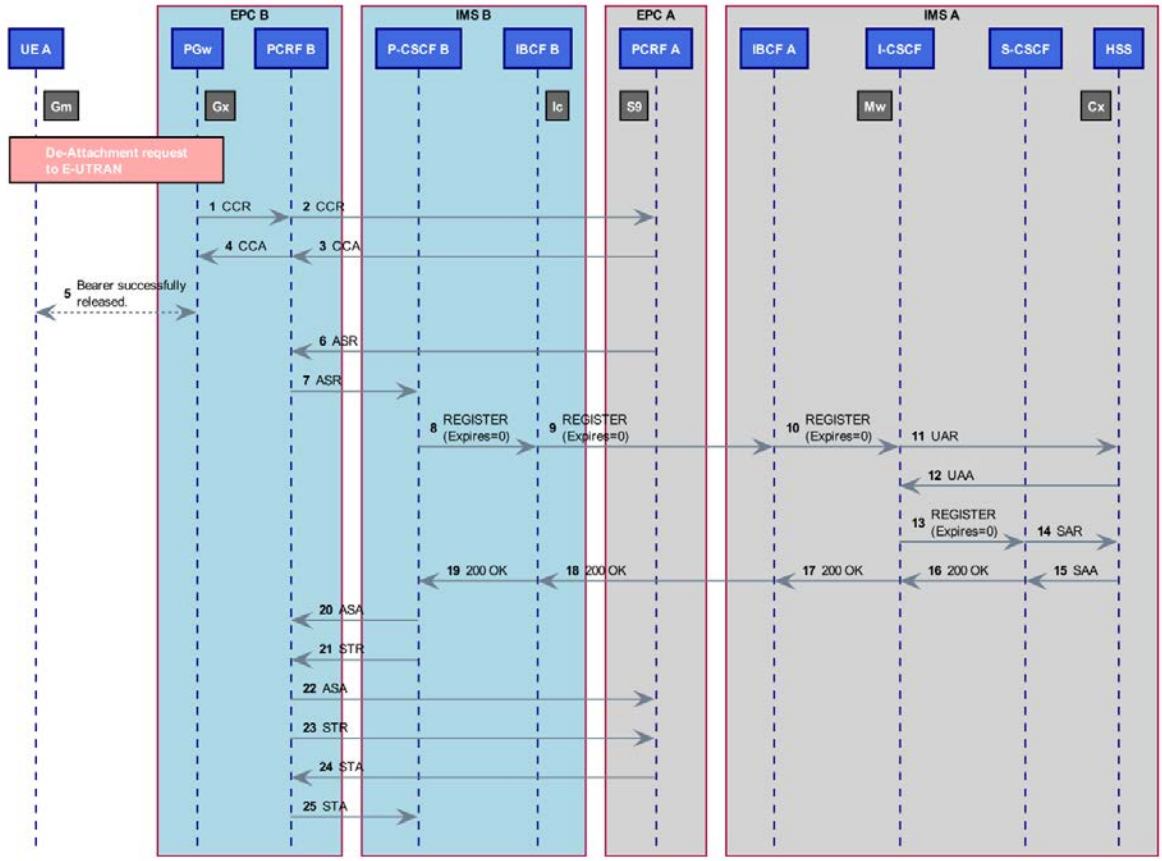


Figure 48: UE Initiated Network Detachment - IMS Registered (Roaming)

1) User initiates detachment on UE-A. The UE-A requests IP-CAN session dis-establishment to the EPC (MME). The P-GW sends a CCR message to the visited PCRF to inform the PCRF that the default bearer is being released.

2) The visited PCRF invokes the home PCRF.

3) The home PCRF responds with a CCA.

4) The visited PCRF responds with a CCA.

5) The MME responds to the UE, confirming that the IP-CAN has been successfully released. User is informed that the default bearer has been successfully released.

6) Home PCRF sends ASR to the P-CSCF (via the visited PCRF).

7) Visited PCRF passes ASR thru to the visited P-CSCF.

8) Visited P-CSCF sends the REGISTER(Expires=0) to visited IBCF B.

9) Visited IBCF B forwards the REGISTER(Expires=0) to home IBCF A.

10) Home IBCF A forwards the REGISTER(Expires=0) to I-CSCF.

11) I-CSCF sends UAR to HSS.

12) HSS responds with UAA.

13) I-CSCF forwards the REGISTER to S-CSCF.

14) S-CSCF sends SAR to HSS.

15) HSS responds with SAA.

16) S-CSCF send 200 response to I-CSCF.

17) I-CSCF forwards 200 response to home IBCF A.

18) Home IBCF-A forwards 200 response to visited IBCF B.

19) Visited IBCF-B forwards 200 response to visited P-CSCF. The IMS de-registration is successful.

20) Visited P-CSCF responds with ASA.

21) Visited P-CSCF sends the STR to abort the Rx session.

22) Visited PCRF passes the ASA to the home PCRF.

23) Visited PCRF passes the STR message to the home PCRF.

24) Home PCRF responds with STA.

25) Visited PCRF passes the response to the P-CSCF.

6.5.3 UE Initiated Network Detachment with Previously Established IMS Registration & IMS Sessions

Interoperability Test Description		
Identifier:	TD_VxLTE_RMI_DTC_03	
Objective:	To demonstrate UE initiated network detachment (IP-CAN session termination) for a roaming UE that is registered to IMS and also has active IMS sessions.	
Summary:	On removal of all bearers, PCRF will notify IMS P-CSCF that Rx session should be aborted. IMS will take action and terminate all ongoing SIP sessions and the IMS registration.	
Configuration:	CF_VxLTE_RMI_B	
SUT:	IMS A, IMS B and EPC B	
Interfaces:	Gm, Mw, Cx, Rx, Gx, S6a, Ic	
References:	Gm, Mw	ETSI TS 124 229 [2], clause 5.2.5.1 and clause 5.2.8.1.2 and clause 5.4.1.5 and clauses 6.2 and 6.3
	Ic	ETSI TS 124 229 [2], clause 5.4.3.2 (item 1 in 7th numbered list) and clause 5.10.2.1 and clause 5.10.3.1 and clause 5.10.4.2
	Rx	ETSI TS 129 214 [6], clause 4.4.6.1
	Gx	ETSI TS 129 212 [7], clause 4.5.7
	Cx	ETSI TS 129 228 [4], clauses 6.1.1.1, 6.1.2.1 and A.4.3 ETSI TS 129 229 [5], clauses 6.1.1, 6.1.2, 6.1.3 and 6.1.4
	S9	ETSI TS 129 215 [9], clauses 4.5.1.2, 4.5.3.3 and 4.5.3.6
Pre-test conditions:	• Roaming UE A previously attached to EPC with a single attachment. • Roaming UE A previously registered to IMS. • Roaming UE A previously established SIP session with UE B.	
Test Sequence:	**Step**	
	1	UE initiates IP-CAN session termination.
	2	EPC triggers removal of all affected bearers.
	3	Verify that EPC aborts affected Rx sessions with IMS.
	4	Verify that IMS performs P-CSCF-initiated call release on affected SIP sessions and admin IMS De-registration.
	5	Verify that media is no longer exchanged after these procedures.
	6	Verify that media between UE and other endpoint can no longer be exchanged and is filtered out by EPC.
	7	Verify that the Rx messages are sent over S9 between the visited and home PCRFs.
	8	Verify that the S9 session is terminated.

Interoperability Test Description		
Conformance criteria of test sequence step:	1	Gx TP_GX_PGW_CCR_02 (CCR - Event 2) S9 TP_S9_PCRF_CCR_02 (CCR - Event 3) S9 TP_S9_PCRF_CCA_02 (CCA - Event 4) Gx TP_GX_PCRF_CCA_05 (CCA - Event 5)
	2, 3	MwPS TP_MW_PCSCF_BYE_07 (Events 9, 16) Ic TP_IC_IBCF_BYE_03 (Events 10,15) S9 TP_S9_PCRF_ASR_01 (ASR - Event 7) Rx TP_RX_PCSCF_ASR_01 (ASR - Event 8) S9 TP_S9_PCRF_ASA_01 (ASA - Events 17,19) S9 TP_S9_PCRF_STR_01 (STR - Events 18,20) S9 TP_S9_PCRF_STA_02 (STA - Events 21,22)
	4-8	S9 TP_S9_PCRF_ASR_01 (ASR - Event 23) Rx TP_RX_PCSCF_ASR_01 (ASR - Event 24) MwPS TP_MW_PCSCF_REGISTER_13 (Events 25, 36) Ic TP_IC_IBCF_REGISTER_05 (Events 26, 35) Cx TP_CX_HSS_UAA_04 (UAR,UAA - Events 28, 29) Cx TP_CX_HSS_SAA_02 (SAR,SAA - Events 31, 32) S9 TP_S9_PCRF_ASA_01 (ASA - Events 37, 39) S9 TP_S9_PCRF_STR_01 (STR - Events 38, 40) S9 TP_S9_PCRF_STA_02 (STA - Events 41, 42)

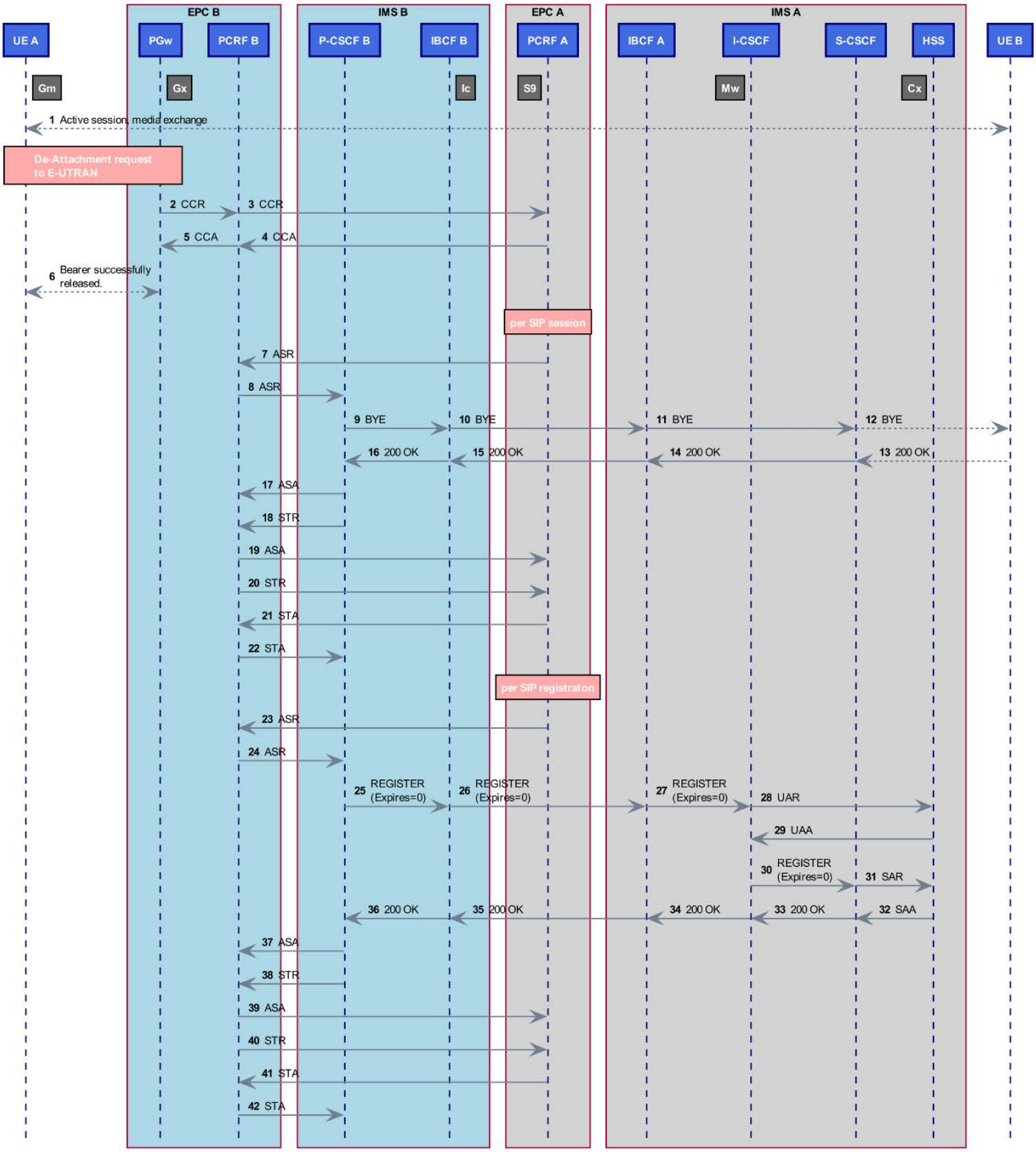


Figure 49: UE Initiated Network Detachment - IMS Registered & IMS sessions (Roaming)

1) SIP session is established and User initiates detachment on UE-A.

2) The P-GW sends a CCR message to the visited PCRF to inform the PCRF that the default bearer is being released.

3) The visited PCRF invokes the home PCRF.

4) The home PCRF responds with a CCA.

5) The visited-PCRF responds with a CCA.

6) The MME responds to the UE, confirming that the IP-CAN has been successfully released. User is informed that the default bearer has been successfully released.

7) Home PCRF sends ASR to the P-CSCF (via the visited PCRF) for session bearer.
8) Visited PCRF passes ASR thru to the P-CSCF.
9) Visited P-CSCF B initiates the SIP session release with a BYE to visited IBCF B.
10) Visited IBCF B sends BYE to home IBCF A.
11) Home IBCF A sends BYE to S-CSCF.
12) IMS A forwards the BYE to UE B.
13) UE A sends 200 OK (BYE) towards S-CSCF A.
14) S-CSCF A sends 200 OK (BYE) to IBCF A.
15) IBCF A forwards 200 OK (BYE) to visited IBCF B.
16) Visited IBCF B sends 200 OK (BYE) to P-CSCF B.
17) P-CSCF responds with ASA.
18) IMS P-CSCF sends STR to abort the Rx session.
19) ASA message is passed onto the home PCRF.
20) Visited PCRF passes the STR message to the home PCRF.
21) Home PCRF responds with STA.
22) Visited PCRF passes the response to the P-CSCF.
23) Home PCRF sends ASR to the P-CSCF (via the visited PCRF) for default bearer.
24) Visited PCRF passes ASR thru to the P-CSCF.
25) P-CSCF sends the REGISTER (Expires=0) to visited IBCF B.
26) Visited IBCF B sends REGISTER (Expires=0) to home IBCF A.
27) Home IBCF A sends REGISTER (Expires=0) to I-CSCF.
28) I-CSCF sends UAR to HSS.
29) HSS responds with UAA.
30) I-CSCF forwards the REGISTER to S-CSCF.
31) S-CSCF sends SAR to HSS.
32) HSS responds with SAA.
33) S-CSCF send 200 response (REGISTER) to I-CSCF.
34) I-CSCF forwards 200 response (REGISTER) to home IBCF A.
35) Home IBCF A sends 200 response (REGISTER) to visited IBCF B.
36) Visited IBCF B sends 200 response (REGISTER) to visited P-CSCF. The IMS de-registration is successful.
37) Visited P-CSCF responds with ASA.
38) Visited P-CSCF sends STR to abort the Rx session.
39) Visited PCRF passes the ASA message to the home PCRF.
40) Visited PCRF passes the STR message to the home PCRF.
41) Home PCRF responds with STA.

42) Visited PCRF passes the response to the P-CSCF.

6.5.4 HSS Initiated Network Detachment (no IMS Registration)

Interoperability Test Description		
Identifier:	TD_VxLTE_RMI_DTC_04	
Objective:	To demonstrate HSS initiated network detachment (IP-CAN session termination) for a roaming UE that has not yet registered to IMS.	
Summary:	On complete network detachment, the EPC removes all relevant bearers.	
Configuration:	CF_VxLTE_RMI_B	
SUT:	IMS A, IMS B and EPC B	
Interfaces:	Gx, S6a, S9	
References:	Gx	ETSI TS 129 212 [7], clause 4.5.7
	S6a	ETSI TS 129 272 [8], clause 5.2.1.2
	S9	ETSI TS 129 215 [9], clauses 4.5.1.2 and 4.5.3.3
Pre-test conditions:	• Roaming UE A previously attached to EPC with a single attachment	
Test Sequence:	**Step**	
	1	HSS triggers n/w initiated network detachment, whilst UE is not registered at IMS.
	2	Verify that EPC removes the affected bearer.
	3	Verify that EPC P-GW informs the V-PCRF of the loss of the bearer.
	4	Verify that V-PCRF terminates the S9 session with the H-PCRF.
	5	Verify that EPC MME informs the UE of the detachment.
Conformance criteria of test sequence step:	1	S6a TP_S6A_HSS_CLR_01 (CLR - Event 1)
	2-4	Gx TP_GX_PGW_CCR_02 (CCR - Event 3) S9 TP_S9_PCRF_CCR_02 (CCR - Event 4) S9 TP_S9_PCRF_CCA_02 (CCA - Event 6) Gx TP_GX_PCRF_CCA_05 (CCA - Event 7)
	5	S6a TP_S6A_MME_CLA_01 (CLA - Event 8)

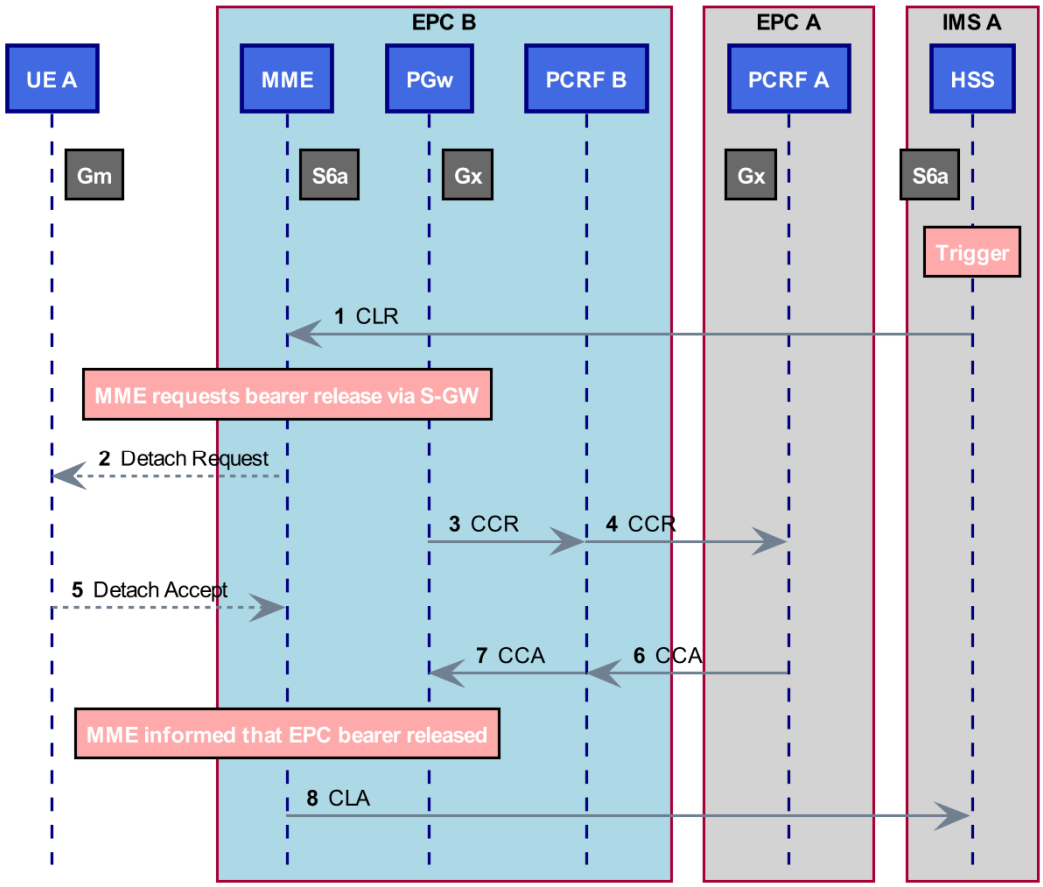


Figure 50: HSS Initiated Network Detachment - not IMS Registered (Roaming)

1) HSS initiates detachment on UE-A (e.g. by withdrawing subscription from the UE). HSS sends a CLR message to the EPC MME.

2) The UE is requested to Detach. The EPC MME initiates the release of the EPC bearer via the EPC S-GW.

3) The P-GW sends a CCR message to the visited PCRF B.

4) Visited PCRF informs the home PCRF that the default bearer is being released. The visited PCRF invokes the home PCRF.

5) The UE responds to the MME UE, confirming the Detach request.

6) The home PCRF responds with CCA to the visited PCRF.

7) The visited PCRF responds with a CCA to the P-GW.

8) The MME responds with a CLA to the HSS.

The flows for the cases where the UE is IMS registered or IMS registered with active IMS sessions at the point of HSS initiated detachment may be derived from figures 45 and 46 respectively with appropriate messages being triggered at the PCRF on receipt of the DIAMETER CCR message.

6.5.5 MME Purge UserData

This test description is identical to clause 5.5.5. The only difference is that the MME resides in the visited network and the HSS resides in the home network. The S6a reference point therefore crosses the n/w boundary between the visited and home networks.

7 Test Descriptions (Roaming S8HR)

7.1 Network Attachment (S8HR)

7.1.1 UE Initial Network Attachment and Establishment of the Default Bearer (S8HR)

Interoperability Test Description		
Identifier:	TD_VxLTE_RMI_ATT_02	
Objective:	To perform UE initial attachment to the network and establish a default bearer.	
Summary:	On successful initial network attachment, the UE should discover the P-CSCF IP address. The EPC will create the Default Bearers which will allow communication only between the UE and the P-CSCF.	
Configuration:	CF_VxLTE_RMI_S8HR	
SUT:	IMS A and EPC A	
Interfaces:	Gx, S6a	
References:		ETSI TS 124 229 [2], clauses 9.2.1 and L.2.2.1
	S6a	ETSI TS 129 272 [8], clause 5.2.1.1
Pre-test conditions:	• Network attachment credential provisioned in UE A, HSS/SPR and PCRF. • HSS/SPR and UE A provisioned with selectable APN configurations for IPv4, IPv6 or IPv4&IPv6 PDN types. • P-CSCF address provisioned in the PCRF for the purpose of delivery to UE on attachment. • Default Bearer PCRF policies set to allow UE A - P-CSCF communication. • Default EPC Gating Policy set to "Deny". • UE A not attached to network and EPC.	
Test Sequence:	**Step**	
	1	UE A starts initial network attachment to visited EPC B
	2	Verify that the message sequence is correct.
	3	Verify that EPC establishes Default Bearer for allowing UE A - P-CSCF communication, by starting at UE A an IMS registration
	4	Verify that UE A attached successfully and received the following information: • suitable IPv4 and/or IPv6 address(es) • DNS configuration information P-CSCF IP address or FQDN
	5	Verify that arbitrary IP packets from UE A to arbitrary node, other than the P-CSCF, are filtered-out by EPC and not visible on PO_SGi
	6	Verify that arbitrary IP packets from another node (e.g. UE B sent over PO_SGi) to UE A, are filtered-out by EPC and not visible on PO_UE A
Conformance criteria of test sequence step:	2	S6a TP_S6A_MME_ULR_01 (ULR - Event 2) S6a TP_S6A_HSS_ULA_01 (ULA - Event 3)

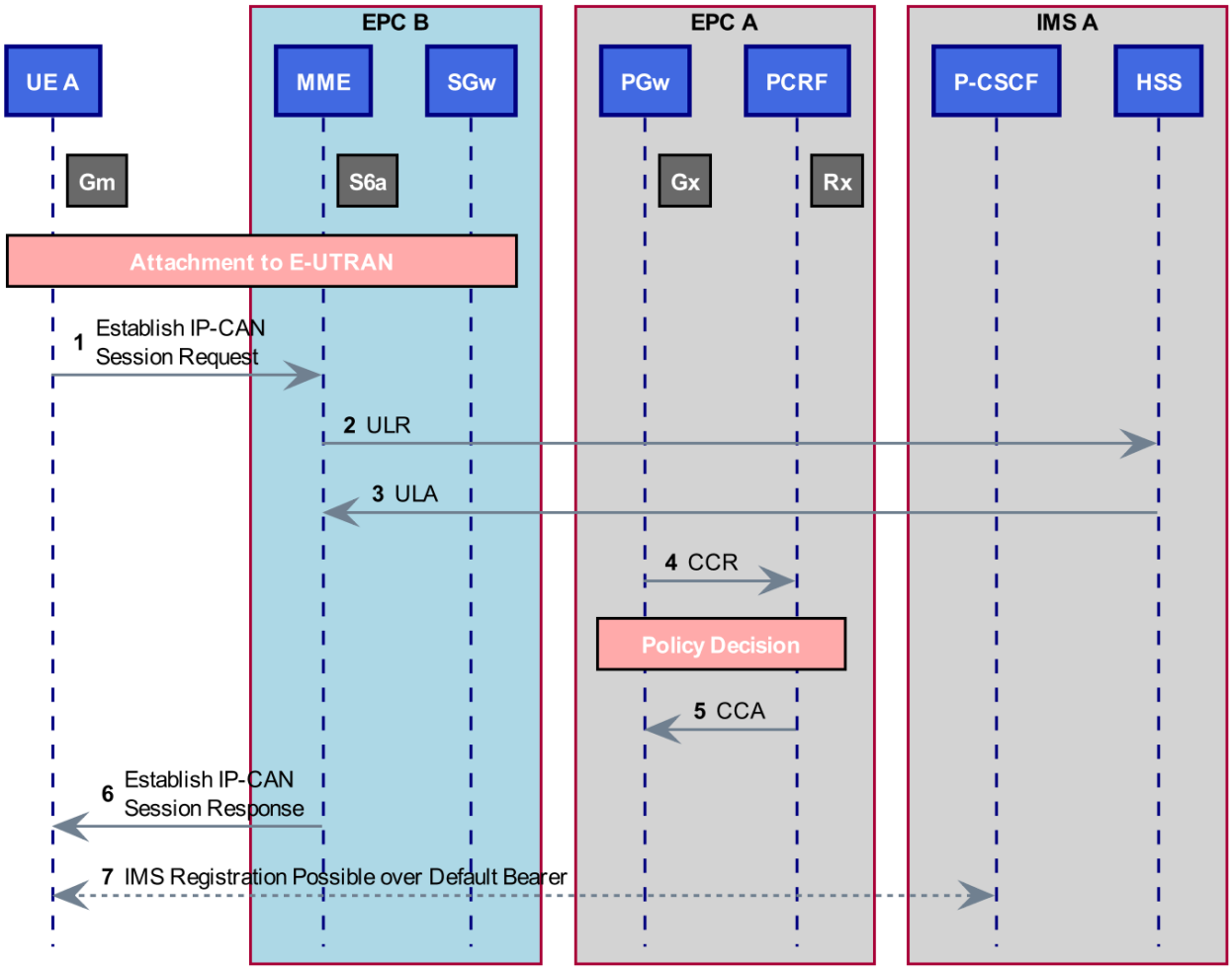


Figure 51: Initial network attachment

1) The UE-A requests IP-CAN session establishment to the EPC B (MME).

2) The visited MME sends a ULR message to the home HSS/SPR.

3) The home HSS responds with ULA.

4) The home P-GW sends a CCR message to the home PCRF to request the default bearer. The PCRF checks if the user is entitled to set up the requested bearer.

5) The home PCRF responds with a CCA.

6) The visited MME responds to the UE A, confirming that the IP-CAN has been successfully set up.

7) User is informed that the default bearer has been successfully set up.

7.2 Other functionality (S8HR)

Since interfaces Uu, S1AP and S8 are not in the scope of the present document the test descriptions for registration, session operation, deregistration described in clause 5 for CF_VxLTE_INT can be reused for configuration CF_VxLTE_RMI_S8HR. The PIXIT values need to be set according to this configuration during the execution.

Annex A (informative): Message Sequence Charts (MSC)

A.1 The MSC files

The MSCs have been produced using the PlantUML tool with recommended ETSI styles.

The PlantUML text files and the derived Portable Network Graphics files (.png) of the MSCs related to the test descriptions are contained in archive ts_10365302v010101p0.zip which accompanies the present document.

History

Document history		
V1.1.1	August 2020	Publication