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IMS Network Testing (INT);
IMS & EPC Interoperability test descriptions (3GPP Release 10)

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Foreword

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

Introduction

The IP Multimedia core network Subsystem (IMS) is a key component in the ETSI NGN architecture. Each IMS consists of multiple functional entities and interfaces. The Evolved Packet Core (EPC) is a key architectural entity between the E-UTRAN and legacy 2G/3G systems and an IP Application Function like IMS.

The present document defines the inter-system interoperability test descriptions for standardized IMS - EPC interfacing.

Test Purposes (TP) defined in the present document have been developed based on the requirements stated in the 3GPP IMS and EPC Release 10 specification and uses Diameter version 1 [i.1] as the main signalling protocol.

1 Scope

The present document provides a set of interoperability use cases to be tested in order to validate an interconnection between IMS and EPC subsystems. For each use case there are conformance criteria and Test Descriptions (TD) detailed.

The target of the present document is to provide the boiler-plate for verifying interoperability between the IMS and EPC subsystems based on the exemplary scenarios network attachment, IMS registration and IMS session management, IMS de-registration and network detachment. Each scenario is covered for both single n/w and roaming.

2 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 http://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.

2.1 Normative references

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

[1] ETSI TS 123 228: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); LTE; IP Multimedia Subsystem (IMS); Stage 2 (3GPP TS 23.228 Release 10)".

[2] ETSI TS 124 229: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); LTE; IP multimedia call control protocol based on Session Initiation Protocol (SIP) and Session Description Protocol (SDP); Stage 3 (3GPP TS 24.229 Release 10)".

[3] ETSI TS 123 401: "LTE; General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access (3GPP TS 23.401 Release 10)".

[4] ETSI TS 123 402: "Universal Mobile Telecommunications System (UMTS); LTE; Architecture enhancements for non-3GPP accesses (3GPP TS 23.402 Release 10)".

[5] ETSI TS 129 214: "Universal Mobile Telecommunications System (UMTS); LTE; Policy and charging control over Rx reference point (3GPP TS 29.214 Release 10)".

[6] ETSI TS 129 212: "Universal Mobile Telecommunications System (UMTS); LTE; Policy and charging control over Gx reference point (3GPP TS 29.212 Release 10)".

[7] ETSI TR 121 905: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); LTE; Vocabulary for 3GPP Specifications (3GPP TR 21.905)".

[8] ETSI TS 129 272: "Universal Mobile Telecommunications System (UMTS); LTE; Evolved Packet System (EPS); Mobility Management Entity (MME) and Serving GPRS Support Node (SGSN) related interfaces based on DIAMTER protocol (3GPP TS 29.272 Release 10)".

[9] ETSI TS 129 215: "Universal Mobile Telecommunications System (UMTS); LTE; Policy and Charging Control (PCC) over S9 reference point; Stage (3GPP TS 29.215 Release 10)".

2.2 Informative references

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] IETF RFC 3588: "Diameter Base Protocol"; P. Calhoun et all, September 2003.

[i.2] ETSI TS 186 011-1 (V4.1.1): "IMS Network Testing (INT); IMS NNI Interoperability Test Specifications; Part 1: Test Purposes for IMS NNI Interoperability".

[i.3] ETSI TS 186 011-2 (V4.1.1): "IMS Network Testing (INT); IMS NNI Interoperability Test Specifications; Part 2: Test Descriptions for IMS NNI Interoperability".

[i.4] ETSI TS 123 008: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); LTE; Organization of subscriber data (3GPP TS 23.008 Release 10)".

[i.5] ETSI TS 123 203: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); LTE; Policy and charging control architecture (3GPP TS 23.203 Release 10)".

[i.6] ETSI TS 129 213: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); LTE; Policy and charging control signalling flows and QOS parameter mapping (3GPP TS 29.215 Release 10)".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in TS 123 203 [i.5], TS 124 229 [2], TS 123 401 [3], TS 123 402 [4], TS 129 214 [5] and the following apply:

authorised QoS: maximum QoS that is authorised for a service data flow

NOTE: In case of an aggregation of multiple service data flows within one IP-CAN bearer (e.g. for GPRS a PDP context), the combination of the "Authorised QoS" information of the individual service data flows is the "Authorised QoS" for the IP-CAN bearer. It contains the QoS class identifier and the data rate.

binding: association between a service data flow and the IP-CAN bearer (for GPRS the PDP context) transporting that service data flow

binding mechanism: method for creating, modifying and deleting bindings

default bearer: EPS bearer which is first established for a new PDN connection and remains established throughout the lifetime of the PDN connection

dynamic PCC Rule: PCC rule for which the definition is provided into the PCEF via the Gx reference point

event report: notification, possibly containing additional information, of an event which occurs that corresponds with an event trigger

NOTE: Also, an event report is a report from the PCRF to the AF concerning transmission resources or requesting additional information.

event trigger: rule specifying the event reporting behaviour of a PCEF or BBERF

NOTE: Also, a trigger for credit management events.

gating control: process of blocking or allowing packets, belonging to a service data flow, to pass through to the desired endpoint

initial registration: registration procedure for a public user identity initiated by the UE in the absence of any valid registration

IP-CAN bearer: IP transmission path of defined capacity, delay and bit error rate, etc.

NOTE: See TR 121 905 [7] for the definition of bearer.

IP-CAN session: association between a UE and an IP network

NOTE: The association is identified by one IPv4 and/or an IPv6 prefix together with UE identity information, if available, and a PDN represented by a PDN ID (e.g. an APN). An IP-CAN session incorporates one or more IP-CAN bearers. Support for multiple IP-CAN bearers per IP-CAN session is IP-CAN specific. An IP-CAN session exists as long as UE IP addresses/prefix are established and announced to the IP network.

PDN connection: association between a UE represented by one IPv4 address and/or one IPv6 prefix and a PDN represented by an APN

policy control: process whereby the PCRF indicates to the PCEF how to control the IP-CAN bearer. Policy control includes QoS control and/or gating control

QoS class identifier (QCI): scalar that is used as a reference to a specific packet forwarding behaviour (e.g. packet loss rate, packet delay budget) to be provided to a SDF. A standardized set of QCI values (and associated flow characteristics) is defined in TS 123 203 [i.5].

NOTE: This may be implemented in the access network by the QCI referencing node specific parameters that control packet forwarding treatment (e.g. scheduling weights, admission thresholds, queue management thresholds, link layer protocol configuration, etc.), that have been pre-configured by the operator at a specific node(s) (e.g. eNodeB).

QoS rule: set of information enabling the detection of a service data flow and defining its associated QoS parameters

resource reservation: mechanism for reserving bearer resources that is required for certain access technologies

service information: set of information conveyed from the AF to the PCRF over the Rx interface to be used as a basis for PCC decisions at the PCRF, including information about the AF session (e.g. application identifier, type of media, bandwidth, IP address and port number)

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in TS 124 229 [2], TS 123 401 [3], TS 123 402 [4], TS 123 203 [i.5] and the following apply:

ACK	SIP (Acknowledge) Message Type
AF	Application Function
ANDSF	Access Network Discovery and Selection Function
AN-GW	Access Network Gateway
APN	Access Point Name
AVP	Attribute-Value Pair
BBERF	Bearer Binding and Event Reporting Function
BGCF	Breakout Gateway Control Function
CS	Circuit Switched
CSCF	Call Session Control Function
DEA	Diameter Edge Agent
DHCP	Dynamic Host Configuration Protocol
DNS	Domain Name System
DRA	Diameter Routing Agent
EPC	Evolved Packet Core
ePDG	Evolved Packet Data Gateway
EPS	Evolved Packet System
FQDN	Fully Qualified Domain Name
GBR	Guaranteed Bitrate
GPRS	General Packet Radio Service
GTP	GPRS Tunneling Protocol

GW	Gateway
H-PCRF	Home (Network) PCRF
HSS	Home Subscriber Server
IBCF	Interconnection Border Control Function
I-CSCF	Interrogating CSCF
IMPU	IP Multimedia Public Identity
IMS	IP Multimedia Subsystem
IMS-AGW	IMS Access Gateway
IOP	Interoperability
IP	Internet Protocol
IP-CAN	IP-Connectivity Access Network
IPv4	Internet Protocol version 4
IPv6	Internet Protocol version 6
ISIM	IM Subscriber Identity Module
MGCF	Media Gateway Control Function
MGW	Media Gateway
MME	Mobility Management Entity
NGN	Next Generation Network
NNI	Network to Network Interface
OK/ACK	SIP Message Types
PCC	Policy and Charging Control
PCEF	Policy and Charging Enforcement Function
PCRF	Policy and Charging Rules Function
P-CSCF	Proxy CSCF
PDN	Packet Data Network
PDP	Packet Data Protocol
P-GW	PDN Gateway
PMIP	Proxy Mobile IP
PO	Point of Observation
PO_UE	Point of Observation on UE
PSTN	Public Switched Telephone Network
QCI	QoS Class Identifier
QoS	Quality of Service
RAN	Radio Access Network
RAT	Radio Access Technology
RTP	Real Time Protocol
S-CSCF	Serving CSCF
SDF	Service Data Flow
SDP	Session Description Protocol
S-GW	Serving Gateway
SIP	Session Initiation Protocol
SPR	Subscription Profile Repository
SUT	System - Under Test
TD	Test Description
TLS	Transport Layer Security
TP	Test Purpose
TrGW	Transition Gateway
UA	User Agent
UDR	User Data Request
UE	User Equipment
UE_A	User Equipment A
UE_B	User Equipment B
UNI	User-Network Interface
URI	Uniform Resource Identifier
USIM	Universal Subscriber Identity
UTRAN	UMTS Terrestrial Radio Access Network
V-PCRF	Visited (Network) PCRF

4 Overview of the EPC and IMS Architecture, in the scope of LTE/SAE

The IP Multimedia Subsystem defined in TS 123 228 [1] and TS 124 229 [2] describes the control and service delivery architecture standardized by 3GPP. It was initially started in 3GPP Release 5 as an all-IP core network for providing IP services in the context of the mobile domain evolution. Over the subsequent releases, various other standardization bodies have adopted the same principles and core network architecture for providing IP services, each complementing with requirements and specifics for their respective access network type of interest. Starting with 3GPP Release 8 onwards, the efforts converged into the Common-IMS specifications.

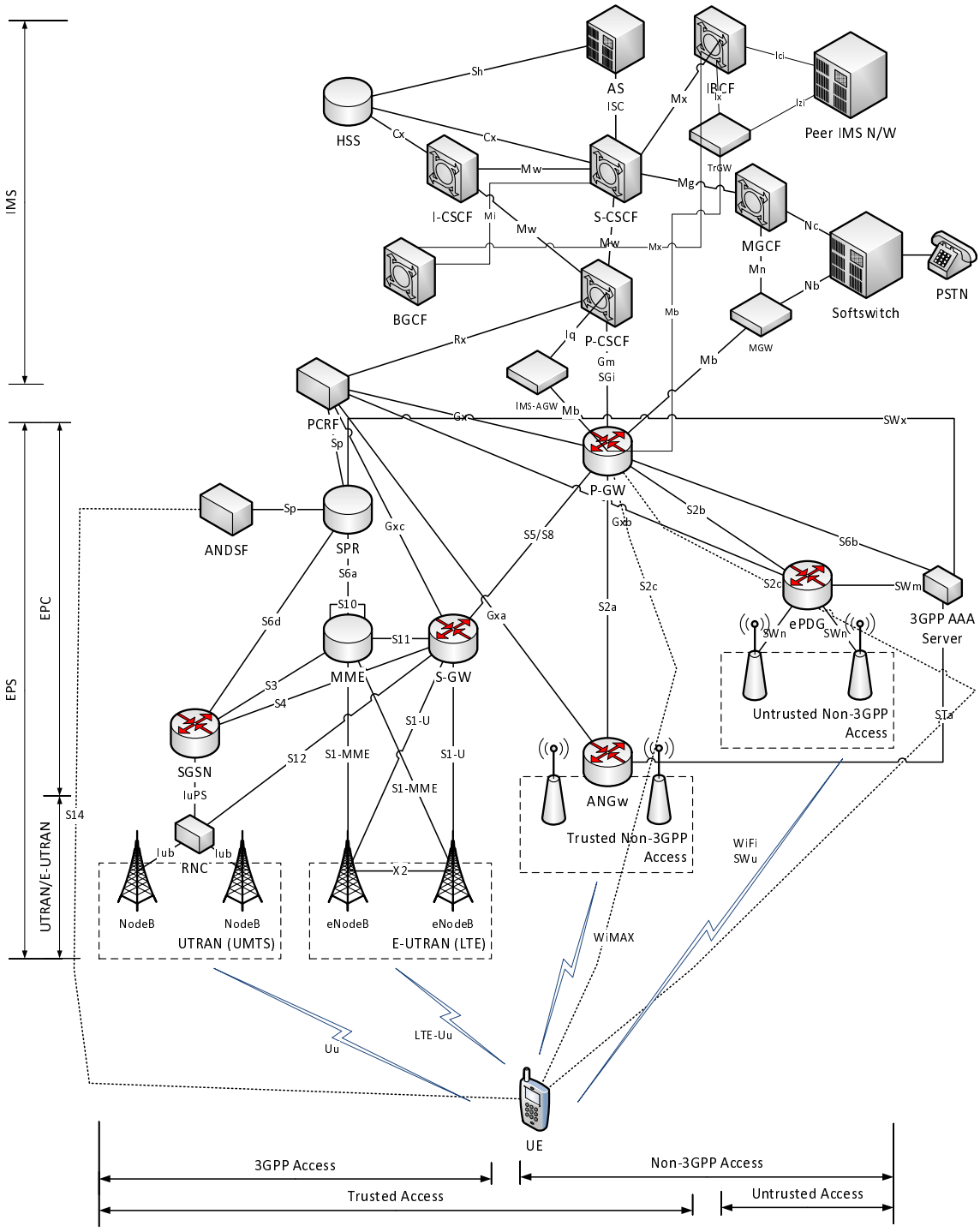


Figure 1: The EPC and IMS Core Network Architectures

At its core, IMS comprises of a set of specialized Call Session Control Functions (CSCF), which route and process SIP signalling between the IMS User Endpoints (UE), the IMS Application Servers (AS) and a set of user plane Gateways (MGW, TrGW) interfacing with the CS Network/Public Switched Telephony Network (PSTN) or peer IMS networks. The subscriber data is stored in a central database, the Home Subscriber Server (HSS). The HSS also provides Authentication, Authorization and Accounting services and uses the Diameter protocol.

The main target of the IMS architecture is to provide service control for an extensible set of applications. It features an open-ended model, where a set of operations are defined as basic building blocks (e.g. authentication and registration, session set-up/tear-down, messaging, etc.). These building blocks can later be re-used and re-combined by ASs in order to realize a future-proof Service Delivery Platform. This model is set to replace the currently obsolete silo-model approach for services of the legacy systems.

As IMS was adopted for the non-mobile access, the underlying network and attachment architectures and procedures started to diverge such that various types of fixed network could be supported. This prompted a split between the strict IMS standardization and that of the underlying Access Network.

The LTE path started an evolution of both the Radio Access Network (E-UTRAN) and its supporting GPRS Core Network architecture (Evolved Packet Core TS 123 401 [3], into a consolidated Evolved Packet System, as part of the System Architecture Evolution. Additionally to the 3GPP RAN, comes the all-IP Network plus integration with less reliable yet more cost efficient Access Network solutions (non-3GPP Access TS 123 402 [4]).

The main targets of the EPC architecture are to provide a flexible and efficient IP-connectivity layer, capable of handling Inter-System Handovers, Policy and Charging Control as well as security for transparent IP services. The approach is more generalized than with IMS which requires SIP signalling for services. EPC is capable of supporting not only an IMS architecture on top, but also has a potential for generic Over-The-Top (OTT) services.

The PCC architecture is defined in TS 123 203 ([i.5]) and defines a generic functional architecture to enable policy rules to be passed from an AF to a PCEF via a PCRF. In the context of the IMS and EPC architectures, the AF function is provided by the IMS P-CSCF whilst the PCEF function is provided by the EPC P-GW function. The PCRF is a stand-alone function that sits in the signalling path between the IMS and EPC layers.

The EPC and IMS architectures are not meant to compete or replace each other. They are built as to complement each other in an efficient manner, which abstracts services in the EPC as IP data flows, while providing transparent handling of both horizontal and vertical hand over's without complex IMS signalling.

The EPC architectural nodes can be grouped, based on functionality, as following:

- Core Network Mobility - a 2-layer gateway model allowing vertical hand overs; uses GTP for legacy and PMIP for non-3GPP access.
- Policy and Charging Enforcement - split into Policy and Charging enforcement functions (PCEF, part of the P-GW) and access network specific functions (BBERF).
- Access Network Discovery and Selection Function - provides AN discovery and Inter-System Mobility policies directly to the mobile devices, helping in establishing the operator policies for AN selection and use.
- Subscription Profiles Repository - accessible from the (E-)UTRAN, PCC and ANDSF components, such that network attachments are secured with authentication and authorization procedures, while also providing per-subscriber customized service levels.

For EPC to support the IMS services requirements and for IMS to fully take advantage of the EPC provided IP connectivity, the inter-architecture interfacing is of critical importance. Unlike in the individual IMS or EPC cases, it is foreseen that in real life deployments the multi-vendor setups from different IMS and EPC providers will be much more common. The present document aims at providing a set of test purposes and descriptions for testing the base inter-operability between the IMS and EPC systems, for the most common scenarios.

4.1 Scope of the IMS-EPC Interoperability

The interoperability in scope for testing here covers all the interactions on the border interfaces between the IMS and the EPC systems. It has to be noted that this is a bi-directional resource negotiation, event propagation and IP transport interaction point.

The present document covers both single network (non-roaming) and multi-domain (roaming) situations. These are illustrated in figures 2 and 3.

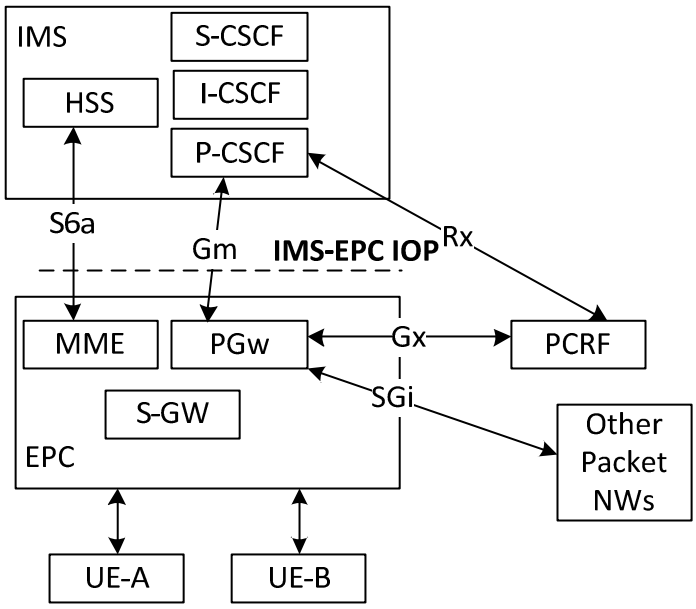


Figure 2: IMS-EPC Interoperability (single network)

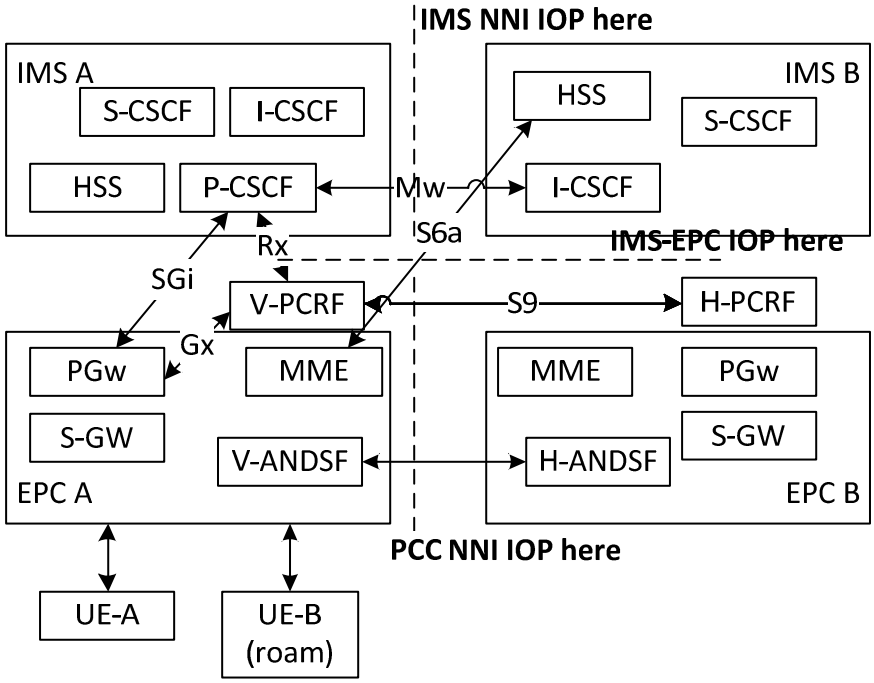


Figure 3: IMS-EPC Interoperability (roaming case)

4.1.1 Reference Points in Scope

The SGi interface transports the User plane data from the UEs towards IMS as well as other Application Functions. This a generic reference point, for the transport of the IP User Plane data belonging to different more specific reference points, like Gm for SIP signalling or Mb for RTP media. These transported reference points though are end-to-end, such that the EPC system tunnels the IP packets through GTP and PMIP specific procedures, while the IMS processes the data itself, whether it is signalling or media.

The Rx interface uses the DIAMETER protocol [i.1] to push from IMS to PCRF the communication bearer establishment requirements, as derived by the P-CSCF from the SIP and SDP signalling that passes through. In turn, the PCRF invokes the P-GW over the Gx interface in order to establish well-ruled communication paths in the Evolved Packet Core and the E-UTRAN systems. The Gx interface is also based on DIAMETER [i.1]. The EPC Policy and Charging Control concepts encompass Gating, QoS and Charging Rules which constitute the operator's (per subscriber) dynamic policies.

The Rx and Gx interfaces are also used as a feedback path for events and notifications pertaining to the status of the network attachments and communication bearers, to be delivered from the EPC system to IMS.

The S6a interface enables the transfer of subscription and authentication data for authenticating/authorizing user access. The protocol used on the S6a interface is also DIAMETER [i.1]. It should be noted that in the above figures, it is assumed that the SPR function has been co-located with the HSS. It is also recognized that the IMS and EPC, in many situations would not share a common subscriber database and when performing IOP tests between IMS and EPC from different vendors, the following situations are possible:

a) two separate HSS entities, common data initially duplicated and later synchronized between them;

b) single HSS, as part of the IMS system, which will export SPR type interfaces as Sp, S6a/d, SWx, etc. towards the EPC system;

c) single SPR, as part of the EPC system, which will export HSS type interfaces as Cx and Sh towards the IMS system.

To simplify the architecture and provide maximum coverage of interfaces, it is assumed that case b) will be the only one considered in the present document.

It is further noted that in 3GPP Release 11 (TS 123 203 [i.5]), a similar approach has been taken with the introduction of a Universal Data Repository (UDR), which would constitute the common back-end between the HSS/UPSF/SPR, etc. data retrieval components.

The S9 interface is applicable only to the roaming case and 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.

It should be noted that interactions between elements within the EPC and IMS within a single network are out of scope for the present document and are not shown.

When considering the multi-domain situation, besides the IMS-EPC intra-domain interactions, IMS NNI is addressed in TS 186 011-1 [i.2] and TS 186 011-2 [i.3], although the respective specification abstracts from the Access Network situation.

5 Test Pre-requisites

5.1 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. After testing all the use cases, the IMS system should be re-configured and the execution repeated.

5.2 Test Configurations and Points of Observation

There are two separate configurations defined dependent on whether the tests are related to a single network (non-roaming) or roaming case. The configurations are shown in figures 4 and 5. In each case, the Points of Observation are also identified.

The IMS-EPC IOP tests employ SIP and Diameter protocol signalling, as well as transparent media (e.g. RTP).

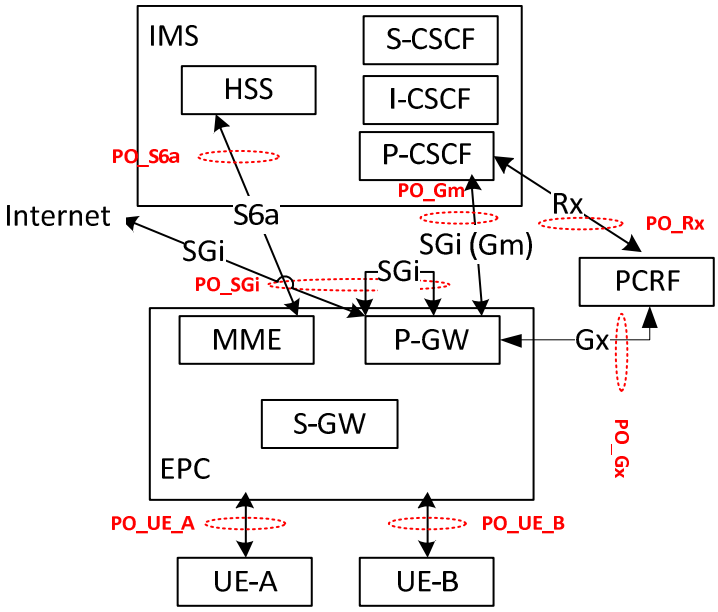


Figure 4: Configuration CF_IMSEPC (Single Network)

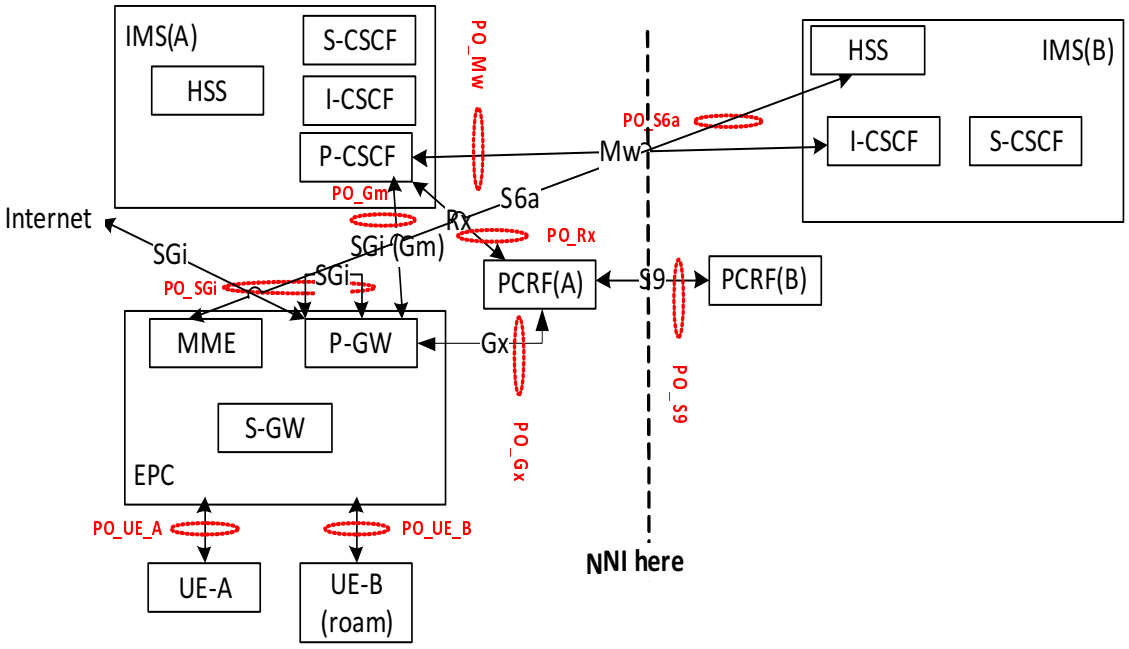


Figure 5: Configuration CF_IMSEPC_Roam (Roaming)

User Plane data as SIP and media is to be transported transparently between the UE and the P-CSCF respectively. The Point of Observation (PO) for SIP signalling will be the Gm interface and Mw interface (roaming case only), which for observability reasons will not be secured. The PO for media happens at 2 points:

- the SGi interface between the P-GW and a generic IP router, positioned between IMS and EPC; all traffic, including direct UE to UE traffic, will be redirected and proxied through this IP router;
- the UE device's interface towards EPC.

The Rx Diameter interface is to be observed and as such not secured with encryption between the IMS and PCRF systems.

The Gx interface is to be observed between the PCRF and P-GW in the EPC.

The S6a interface is to be observed between the MME in the EPC and the HSS (SPR) in the IMS.

The S9 interface is to be observed between the H-PCRF and V-PCRF (roaming case only).

None of the observed interfaces need be secured.

In addition, for all of the DIAMETER based interfaces (Gx, Rx, S6a and S9), basic Diameter connectivity is also a pre-requisite for the tests, such that the required nodes should be correctly configured to establish and maintain (Capabilities-Exchange, Diameter-Watchdogs) stateful connectivity, as well as both declaring support for the relevant Diameter interfaces which will be successfully routed and processed. Finally, Diameter connectivity between the relevant nodes may also be realised via a DRA/DEA which would reduce the required number of connections. The use of a DRA/DEA is optional.

5.3 Test Infrastructure

This 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.

5.3.1 HSS/SPR

Subscriber data (TS 123 008 [i.4]) 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.

5.3.2 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 to provide. 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.

5.3.3 PCRF

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 (TS 123 203 [i.5]).

The PCRF interfaces with the AF (P-CSCF in our 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.

5.3.4 P-GW (EPC)

The P-GW (Packet Data Network Gateway/PDN Gateway) provides connectivity between the UE and external packet data networks. It provides the entry and exit point 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. It is possible that the P-GW function may be co-located with the S-GW in a single network element.

5.3.5 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 interfaces with the home HSS for roaming UEs.

5.3.6 User Endpoints

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

The Test Descriptions have been developed such that during execution, only one client device has to be observed. The counterpart UE in calls for example can be placed either as a full EPC and IMS client, or only as IMS client, or even as a stand-alone SIP UA. In all cases the main requirement is that IP and SIP traffic would be observable for test validation. For this purpose, the Test Description refers to PO_SGi interface.

5.4 Reference Points and Protocols

5.4.1 The SGi reference point (IP)

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.

5.4.1.1 The Gm reference point (SIP)

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.

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

As the policy signalling interface, the Rx interface will be monitored for correct signalling as derived from the specific test described 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-events and not the Rx interface data.

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

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.

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

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.

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

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.

5.5 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 10 but (given its scope), Release 9 implementations should still be able to perform most of the tests without major difficulties.

6 Test Descriptions Overview

The test descriptions are documented in clauses 7 and 8.

Clause 7 represents test descriptions in the single network (non-roaming) case and clause 8 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.

7 Test Descriptions (Single Network)

7.1 Network Attachment & IMS Registration - Default Bearer Operations

7.1.1 Initial Network Attachment and Establishment of the Default Bearer

Interoperability Test Description		
Identifier:	**TD_IMSEPC_Network_Attachment**	
Purpose:	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.	
Config.:	CF_IMSEPC	
SUT:	IMS, PCRF and EPC	
Ref.:	TS 124 229 [2], clause 9.2.1 (Connecting to the IP-CAN and P-CSCF discovery). TS 124 229 [2], clause L.2.2.1 (EPS bearer context activation and P-CSCF discovery). TS 129 212 [6], clause 4.5.1-1) (PCC procedures over Gx reference point/Request for PCC Rules). TS 129 212 [6], clause 4a.5.1-1) (PCC procedures over Gx reference point/Gateway control and QoS Rules Request). TS 129 272 [8], clause 5.2.1.1 (Update Location procedure over S6a reference point).	
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

Interoperability Test Description		
Conformance Criteria:	**Check**	

	1	TP_EPC_7001_01
		Ensure that{
		when { MME is invoked with an IP_CAN session establishment request}
		then { a DIAMETER ULR message is generated
		(containing the IMSI in the User-Name AVP
		containing the ULR-Flags AVP
		containing the Visited-PLMN-Id AVP
		containing the RAT-Type AVP
		)
		}

	2	TP_EPC_7001_02
		Ensure that{
		when { HSS is invoked with a ULR}
		then { a DIAMETER ULA message is generated (
		containing the Result-Code AVP
		indicating DIAMETER_SUCCESS(2001)
		containing the Subscription-Data AVP
		if the received ULR flags do not indicate "skip subscriber data"
		)
		}

	3	TP_EPC_7001_03 Ensure that{ when { P-GW is invoked with a create session request} then { a DIAMETER CCR message is generated (containing CC_Request_Type AVP set to "INITIAL_REQUEST" containing the IMSI in the Subscription_Id AVP containing the IP_CAN_Type AVP containing the RAT-Type AVP containing the P-GW Id in the Called_Station_Id AVP containing the PDN-Connection-Id AVP containing the Framed_IP_Address AVP or Framed_IP6_IP_Address AVP containing Bearer-Usage AVP set to "IMS_SIGNALLING" containing QoS-Information AVP made up of APN-Aggregate-Max-Requested-Bandwidth-UL AVP APN-Aggregate-Max-Requested-Bandwidth-DL AVP Bearer-Identifier AVP containing Default-EPS-Bearer-QoS AVP made up of QoS-Class-Identifier AVP set to "5" Allocation-Retention-Priority AVP made up of Priority-Level AVP Pre-emption-Capablity AVP Pre-emption-Vulnerability AVP) }
	4	TP_EPC_7001_04 Ensure that{ when { PCRF is invoked with a CCR} then { a DIAMETER CCA message is generated (containing the Result-Code AVP indicating DIAMETER_SUCCESS(2001) containing QoS-Information AVP made up of APN-Aggregate-Max-Requested-Bandwidth-UL AVP APN-Aggregate-Max-Requested-Bandwidth-DL AVP Bearer-Identifier AVP containing Default-EPS-Bearer-QoS AVP made up of QoS-Class-Identifier AVP set to "5" Allocation-Retention-Priority AVP made up of Priority-Level AVP Pre-emption-Capablity AVP Pre-emption-Vulnerability AVP) }
	5	TP_EPC_6001_01 ensure that { when { UE_A completes initial network_attachment to EPC } then { receives IP_configuration_data (containing IPv4_address of UE_A or

Interoperability Test Description		
		containing IPv6_address of UE_A or containing (IPv4_address and IPv6_address) of UE_A) containing DNS_information containing P-CSCF_information (indicating the P-CSCF-IP_address or indicating the P-CSCF-FQDN_address) } }

	6	TP_EPC_6003_01
		ensure that {
		when { UE_A sends IP_packets to UE_B }
		then { EPC filters the IP_packets }
		then { the IP_packets not visible on PO_SGi }
		when { UE_B sends IP_packets to UE_A }
		then { EPC filters the IP_packets }
		then { the IP_packets not visible on PO_SGi }
		}

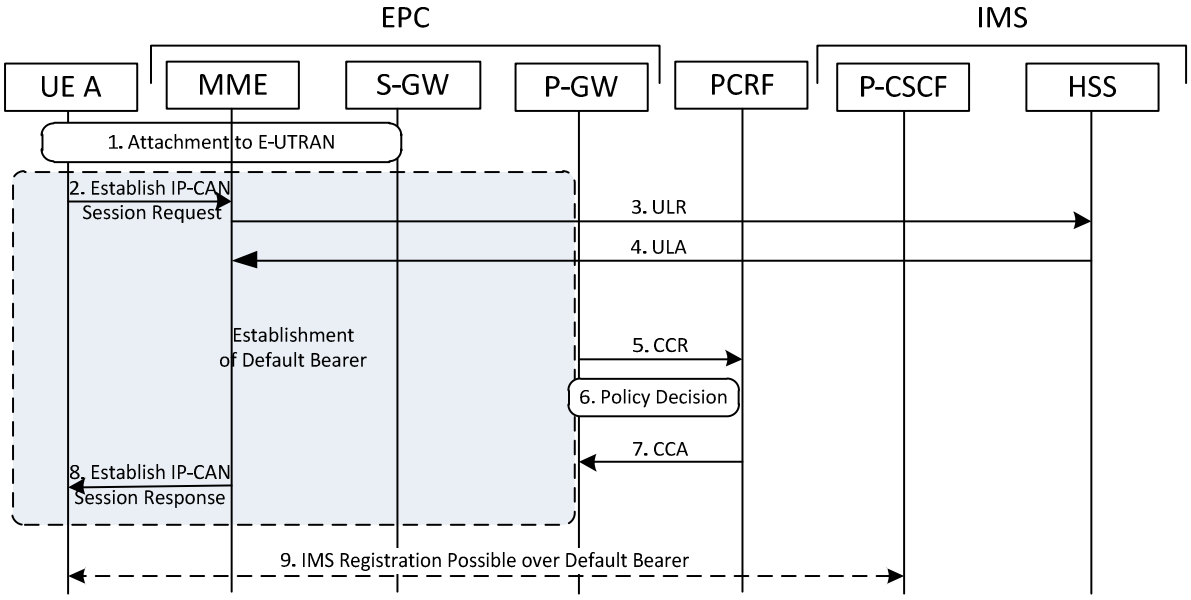


Figure 6: Initial Network Attachment

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

1) The default bearer is established with the following parameters (see TS 123 203 [i.5]) 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

7.1.2 IMS Initial Registration - Successful

Interoperability Test Description		
Identifier:	**TD_IMSEPC_Registration_Initial_Successful**	
Purpose:	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.	
Config.:	CF_IMSEPC	
SUT:	IMS, PCRF and EPC	
Ref.:	TS 124 229 [2], clause 5.4.1.2 (Initial registration and user-initiated re-registration). TS 129 214 [5], clause 4.4.5a (Provisioning of AF Signalling Flow Information). TS 129 214 [5], clause A.8 (Provision of Signalling Flow Information at P-CSCF). TS 129 214 [5], annex B (Flow identifiers: Format definition and examples). TS 129 212 [6], clause 4.5.2 (Provision of PCC rules) and clause 4.5.3 (Provision of Event Triggers).	
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:	**Check**	

	1	TP_EPC_6012_01
		ensure that {
		when { IMS_P-CSCF receives 2xx_Response on REGISTER from IMS_S-CSCF }
		then { UE_A receives 2xx_Response }
		}

	2	TP_EPC_6013_01 ensure that { when { IMS_P-CSCF receives 2xx_Response on REGISTER from IMS_S-CSCF } then { IMS_P-CSCF sends AA-Request to PCRF containing framed IPv4_Address AVP (indicating IPv4_Address of UE_A or containing framed IPv6_Address AVP indicating IPv6_Address of UE_A) containing a Specific-Action AVP indicating INDICATION_OF_LOSS_OF_BEARER containing one or more Media-Component-Description_AVP (containing Media-Component-Number_AVP indicating value 0 containing Media-Sub-Comonent AVP (containing Flow-Description_AVP (

Interoperability Test Description		
		indicating permit_in_ip from (UE_A-IP_address and UE_A_port_number) to (P-CSCF-IP_address and P-CSCF_port_number) or indicating permit_in_udp from (UE_A-IP_address and UE_A_port_number) to (P-CSCF-IP_address and P-CSCF_port_number) or indicating permit_in_tcp from (UE_A-IP_address and UE_A_port_number) to (P-CSCF-IP_address and P-CSCF_port_number)) and containing Flow-Description_AVP (indicating permit_out_ip from (P-CSCF-IP_address P-CSCF_port_number) to UE_A-IP_address or indicating permit_out_udp from (P-CSCF-IP_address P-CSCF_port_number) to UE_A-IP_address or indicating permit_out_tcp from (P-CSCF-IP_address P-CSCF_port_number) to UE_A-IP_address) and containing Flow-Usage_AVP indicating AF_SIGNALING(0) containing Flow-Status_AVP indicating ENABLED(2) containing AF-Signalling-Protocol_AVP indicating SIP(1)) } }

	3	TP_EPC_6014_01
		ensure that {
		when { PCRF receives AA-Request from IMS_P-CSCF }
		then { PCRF sends AA-Answer to IMS_P-CSCF
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001) and
		containing Acceptable-Service-Info_AVP (
		containing one or more Media-Component-Description_AVP(
		containing Media-Component-Number_AVP
		indicating 0 and
		containing Media-Sub-Component AVP (
		containing Flow-Description_AVP (
		indicating permit_in_ip from (UE_A-IP_address and UE_A_port_number) to (P-CSCF-IP_address and P-CSCF_port_number) or
		indicating permit_in_udp from (UE_A-IP_address and UE_A_port_number) to (P-CSCF-IP_address and P-CSCF_port_number) or
		indicating permit_in_tcp from (UE_A-IP_address and UE_A_port_number) to (P-CSCF-IP_address and P-CSCF_port_number)
		) and
		containing Flow-Description_AVP (
		indicating permit_out_ip from (P-CSCF-IP_address P-CSCF_port_number) to UE_A-IP_address or
		indicating permit_out_udp from (P-CSCF-IP_address P-CSCF_port_number) to UE_A-IP_address or
		indicating permit_out_tcp from (P-CSCF-IP_address P-CSCF_port_number) to UE_A-IP_address
		) and
		containing Flow-Usage_AVP
		indicating AF_SIGNALING(0) and
		containing Flow-Status_AVP
		indicating ENABLED(2) and
		containing AF-Signalling-Protocol_AVP
		indicating SIP(1)
		)
		) and
		containing IP-CAN_AVP
		indicating Current_IP_CAN_Type of UE_A and
		containing RAT-Type_AVP
		indicating Current_RAT_Type of UE_A
		}
		}

	4	TP_EPC_7001_05
		ensure that PCRF invokes the EPC P-GW with a RAR {
		containing a Charging-Rule-Install AVP
		containing a Charging-Rule-Definition AVP
		containing a Charging-Rule-Name AVP
		containing a Flows AVP
		containing containing Media-Component-Number AVP
		indicating value 0
		containing Flow-Status_AVP
		indicating ENABLED(2)
		}

Interoperability Test Description		

	5	TP_EPC_7001_06
		ensure that {
		when { P-GW receives RA-Request from PCRF }
		then { P-GW sends RA-Answer to PCRF
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001)
		}
		}

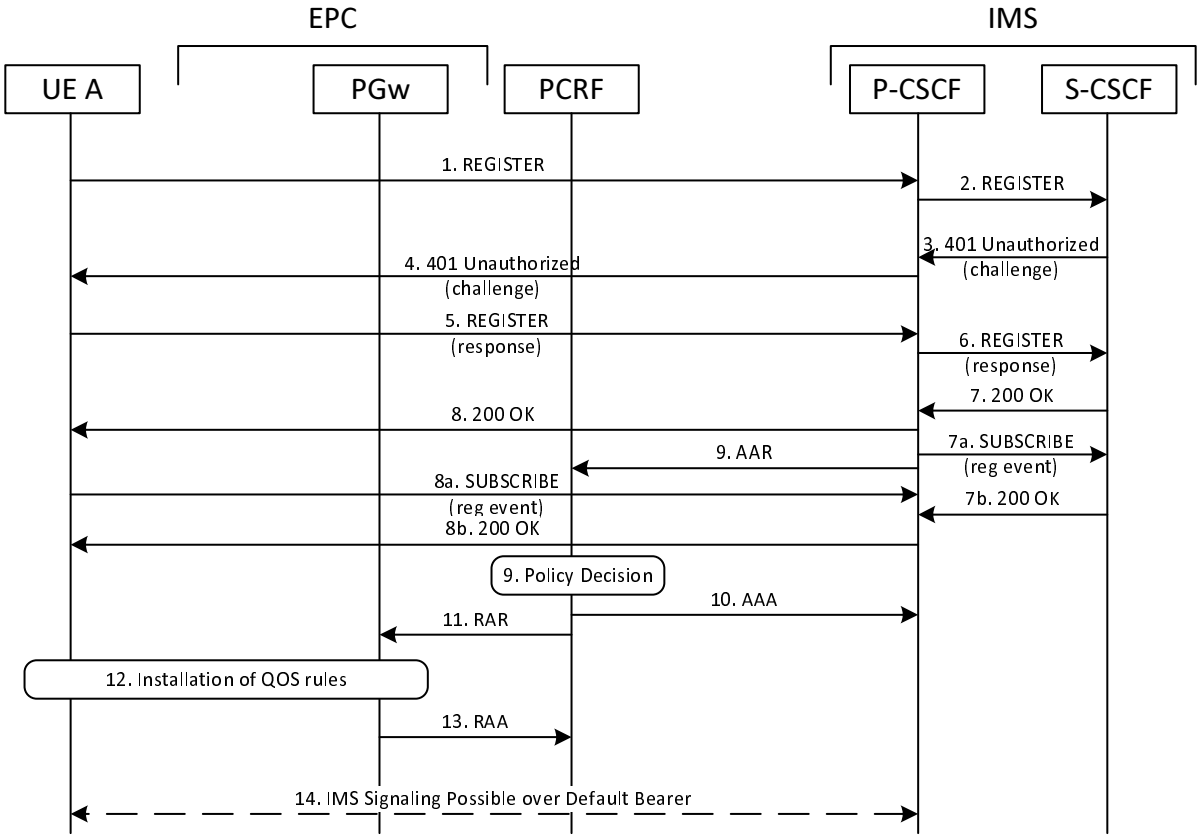


Figure 7: IMS Initial Registration (success)

Step	Direction						Message	Comment
	USER	UEA	EPC	PCRF	IMS			
1		→						User initiates IMS Registration.
2					→		SIP REGISTER	The UE-A requests IMS Registration.
3			←				SIP 401 Response	IMS rejects the REGISTER and issues a challenge.
4					→		SIP REGISTER	The REGISTER is re-sent with an Authorization header.
5			←				SIP 200 OK	The IMS registration is successful.
6		←						User is informed that the IMS registration is successful.
7					←		DIAMETER AAR	The P-CSCF initiates session binding to the default bearer.
7a, 7b								The P-CSCF subscribes to the registration event package to be notified of a de-registration.
8					→		DIAMETER AAA	The PCRF responds to the P-CSCF.
8a, 8b								The UE subscribes to the registration event package to be notified of a de-registration.
9				←			DIAMETER RAR	The PCRF pushes a flow description to the P-GW to modify the default bearer.
10				→			DIAMETER RAA	The P-GW in the EPC responds to the PCRF.
11								The default bearer has been successfully modified and bi-directional IMS signalling is possible.

NOTE 1: In the Flow-Description AVP, instead of protocol "ip", alternative values as "udp" or "tcp" can be used. These are more specific, but might require the use of multiple Media-Sub-Component AVP.

NOTE 2: The Flow-Number AVP is derived according to the respective rules in TS 129 214 [5], annex B.

7.1.3 IMS Initial Registration - Failure

Interoperability Test Description		
Identifier:	**TD_IMSEPC_Registration_Initial_Failed**	
Purpose:	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.	
Config.:	CF_IMSEPC	
SUT:	IMS, PCRF and EPC	
Ref.:	TS 124 229 [2], clause 5.4.1.2 (Initial registration and user-initiated re-registration).	
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.	
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.

Interoperability Test Description		
Conformance Criteria:	**Check**	

	1	TP_EPC_6016_01
		ensure that {
		when { IMS_P-CSCF receives 4xx_Response on REGISTER from IMS_S-CSCF }
		then { UE_A receives 4xx_Response from IMS_P-CSCF}
		}

	2	TP_EPC_6016_02
		ensure that {
		when { IMS_P-CSCF receives 4xx_Response on REGISTER from IMS_S-CSCF }
		then { IMS_P-CSCF not send AA-Request to PCRF }
		}

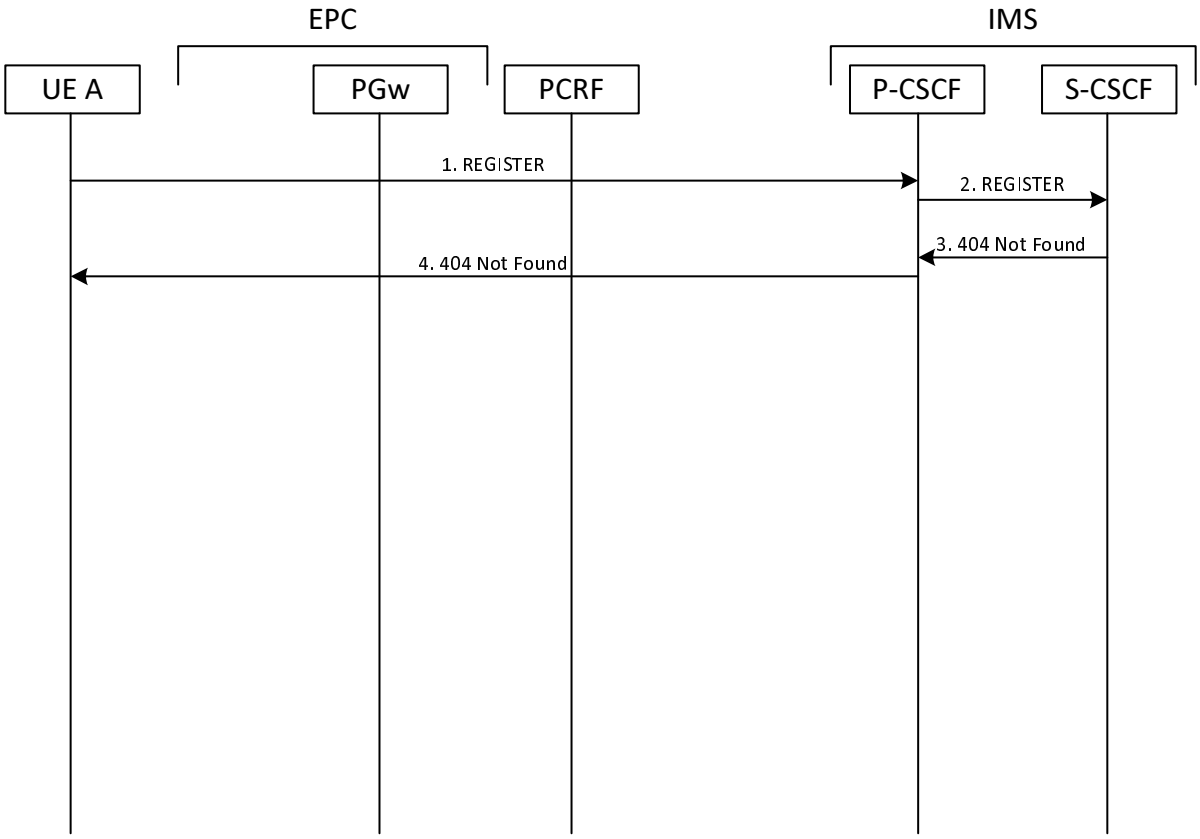


Figure 8: IMS Initial Registration (failure)

Step	Direction					Message	Comment
	USER	UEA	EPC	PCRF	IMS		
1		→					User initiates IMS Registration
2					→	SIP REGISTER	The UE-A requests IMS Registration
3			←			SIP 404 Response	IMS rejects the REGISTER and responds 404 (Not Found)

7.2 SIP Session and Dedicated Bearer Operations

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. 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:

- SDP offer in INVITE and SDP answer in 200 OK;
- SDP offer in INVITE and SDP answer in 183 Progress;
- SDP offer in INVITE and SDP offer in 180 Ringing;
- SDP offer in 200 OK and SDP answer in ACK;
- 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.

7.2.1 SIP Session Establishment

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 TS 123 203 [i.5]) 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 [i.6].

7.2.1.1 Originating Leg

Interoperability Test Description		
Identifier:	**TD_IMSEPC_Session_Establishment_Originating_1**	
Purpose:	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 PRFR 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).	
Config.:	CF_IMSEPC	
SUT:	IMS, PCRF and EPC	
Ref.:	TS 124 229 [2], clause 5.2.7.2 (Initial INVITE/Originating Case). TS 129 214 [5], clause 4.4.1 (Initial Provisioning of Session Information). TS 129 214 [5], clause A.1 (Provision of Service Information at the P-CSCF). TS 129 214 [5], clause A.2 (Enabling of IP Flows). TS 129 214 [5], annex B (Flow identifiers: Format definition and examples). TS 129 212 [6], clause 4.5.2 (Provision of PCC rules).	
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 an IMS signalling bearer. • UE_B 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.
	7	Verify that media between UE_A and UE_B is transported with appropriate PCC characteristics.
Conformance Criteria:	**Check**	

	1	`TP_EPC_6003_02`
		`ensure that {`
		`  when { UE_A sends media to UE_B }`
		`  then { EPC filters the IP_packets }`
		`  then { the IP_packets not visible on PO_SGi }`
		`  when { UE_B sends media to UE_A }`
		`  then { EPC filters the IP_packets }`
		`  then { the IP_packets not visible on PO_SGi }`
		`}`

Interoperability Test Description		

	2	TP_EPC_7002_01
		ensure that {
		when { IMS_P-CSCF receives INVITE from UEA with SDP offer }
		then { IMS_P-CSCF sends AA-Request to PCRF
		(containing Framed-IP-Address_AVP
		indicating IPv4_address of UE_A or
		containing Framed-IPv6-Address_AVP
		indicating IPv6_address of UE_A) and
		containing one or more Media-Component-Description_AVP (
		containing Media-Component-Number_AVP
		indicating values_derived from SDP
		containing Media-Type indicating a value derived from
		the SDP offer
		containing a Flow-Status AVP set to DISABLED(3)
		containing Max-Requested-Bandwidth-DL AVP indicating a
		value derived from the SDP offer
		containing RR-Bandwidth AVP mapped from SDP offer
		containing a Codec-Data AVP derived from the SDP offer
		containing one or more Media-Subcomponent-Description_AVP
		containing Flow-Number AVP
		containing Flow-Description AVP indicating values derived
		from the SDP
		)
		}
		}

	3	TP_EPC_7002_02
		ensure that when
		{ PCRF receives AA-Request from IMS P-CSCF }
		then PCRF invokes the EPC P-GW with a RAR {
		containing a Charging-Rule-Install AVP
		containing a Charging-Rule-Definition AVP
		containing a Charging-Rule-Name AVP
		containing a Flow-Information AVP
		containing Flow-Description AVP
		containing a Flow-Status AVP set as received from PCRF
		containing a Flows AVP
		containing containing Media-Component-Number AVP
		as received from PCRF
		containing QOS-Information AVP
		containing QOS-Class-Identifier AVP set to QCI_1 (1)
		for voice or QCI_2(2) for video
		containing Max-Requested-Bandwidth-UL AVP
		containing Max-Requested-Bandwidth-DL AVP
		containing Guaranteed-Bitrate-UL AVP
		containing Guaranteed-Bitrate-DL AVP
		containing Allocation-Retention-Priority AVP
		}

	4	TP_EPC_7002_03
		ensure that {
		when { P-GW receives RA-Request from PCRF }
		then { P-GW sends RA-Answer to PCRF
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001)
		}
		}

	5	TP_EPC_7002_04 ensure that when { PCRF receives RA-Answer from EPC P-GW } then { PCRF sends AA-Answer to IMS P-CSCF (containing containing Result-Code_AVP indicating DIAMETER_SUCCESS(2001) and containing Acceptable-Service-Info_AVP (containing one or more Media-Component-Description_AVP indicating values_derived from AA-Request) } }

	6	TP_EPC_7002_05
		Ensure that {
		when { IMS_P-CSCF receives AAA_response from PCRF
		then {INVITE is forwarded to the IMS S_CSCF and onto UE-B}
		}

Interoperability Test Description		

	7	TP_EPC_7002_06
		ensure that {
		when { IMS_P-CSCF receives 180_SDP_response on INVITE from IMS_S-CSCF }
		then { IMS_P-CSCF sends AA-Request to PCRF
		(containing Framed-IP-Address_AVP
		indicating IPv4_address of UE_A or
		containing Framed-IPv6-Address_AVP
		indicating IPv6_address of UE_A) and
		containing one or more Media-Component-Description_AVP (
		containing Media-Component-Number_AVP
		indicating values_derived from SDP
		containing Media-Type indicating a value derived from the SDP offer/answer
		containing a Flow-Status AVP set to ENABLED-DOWNLINK(1)
		containing Max-Requested-Bandwidth-DL AVP indicating a value derived from the SDP offer
		containing Max-Requested-Bandwidth-UL AVP indicating a value derived from the SDP answer
		containing RR-Bandwidth AVP mapped from SDP offer
		containing RS-Bandwidth AVP mapped from SDP answer
		containing a Codec-Data AVP derived from the SDP offer/answer
		containing one or more Media-Subcomponent-Description_AVP
		containing Flow-Number AVP
		containing Flow-Description AVP indicating values derived from the SDP/answer
		
		)
		}
		}

	8	TP_EPC_7002_02
		ensure that {
		when { PCRF receives AA-Request from IMS_P-CSCF }
		then {PCRF invokes the EPC P-GW with a RAR }
		containing a Charging-Rule-Install AVP
		containing a Charging-Rule-Definition AVP
		containing a Charging-Rule-Name AVP
		containing a Flow-Information AVP
		containing Flow-Description AVP
		containing a Flow-Status AVP set as received from PCRF
		containing a Flows AVP
		containing containing Media-Component-Number AVP
		as received from PCRF
		containing QOS-Information AVP
		containing QOS-Class-Identifier AVP set to QCI_1 (1) for voice or QCI_2(2) for video
		containing Max-Requested-Bandwidth-UL AVP
		containing Max-Requested-Bandwidth-DL AVP
		containing Guaranteed-Bitrate-UL AVP
		containing Guaranteed-Bitrate-DL AVP
		containing Allocation-Retention-Priority AVP
		}

	9	TP_EPC_7002_03
		ensure that {
		when { EPC P-GW receives RA-Request from PCRF }
		then { P-GW sends RA-Answer to PCRF
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001)
		}
		}

	10	TP_EPC_7002_04
		ensure that {
		when { PCRF receives RA-Answer from EPC P-GW }
		then { PCRF sends AA-Answer to IMS_P-CSCF
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001) and
		containing Acceptable-Service-Info_AVP (
		containing one or more Media-Component-Description_AVP
		indicating values_derived from AA-Request
		)
		}
		}

Interoperability Test Description		

	11	TP_EPC_7002_07
		ensure that {
		when { IMS_P-CSCF receives AA-Answer from PCRF }
		then { IMS_P-CSCF sends 180_SDP_Response_ on INVITE to UE_A }
		}

	12	TP_EPC_7002_08
		ensure that {
		when { IMS_P-CSCF receives 200 OK_response_SDP on INVITE from IMS_S-CSCF }
		then { IMS_P-CSCF sends AA-Request to PCRF
		(containing Framed-IP-Address_AVP
		indicating IPv4_address of UE_A or
		containing Framed-IPv6-Address_AVP
		indicating IPv6_address of UE_A) and
		containing one or more Media-Component-Description_AVP (
		containing Media-Component-Number_AVP
		indicating values_derived from SDP
		containing Media-Type indicating a value derived from the SDP offer/answer
		containing a Flow-Status AVP set to ENABLED(2)
		containing Max-Requested-Bandwidth-DL AVP indicating a value derived from the SDP offer
		containing Max-Requested-Bandwidth-UL AVP indicating a value derived from the SDP answer
		containing RR-Bandwidth AVP mapped from SDP offer
		containing RS-Bandwidth AVP mapped from SDP answer
		containing a Codec-Data AVP derived from the SDP offer/answer
		containing one or more Media-Subcomponent-Description_AVP
		containing Flow-Number AVP
		containing Flow-Description AVP indicating values derived from the SDP/answer
		}
		}

	13	TP_EPC_7002_02
		ensure that {
		when { PCRF receives AA-Request from IMS_P-CSCF }
		then {PCRF invokes the EPC P-GW with a RAR }
		containing a Charging-Rule-Install AVP
		containing a Charging-Rule-Definition AVP
		containing a Charging-Rule-Name AVP
		containing a Flow-Information AVP
		containing Flow-Description AVP
		containing a Flow-Status AVP set as received from PCRF
		containing a Flows AVP
		containing containing Media-Component-Number AVP
		as received from PCRF
		containing QOS-Information AVP
		containing QOS-Class-Identifier AVP set to QCI_1 (1) for voice or QCI_2(2) for video
		containing Max-Requested-Bandwidth-UL AVP
		containing Max-Requested-Bandwidth-DL AVP
		containing Guaranteed-Bitrate-UL AVP
		containing Guaranteed-Bitrate-DL AVP
		containing Allocation-Retention-Priority AVP
		}

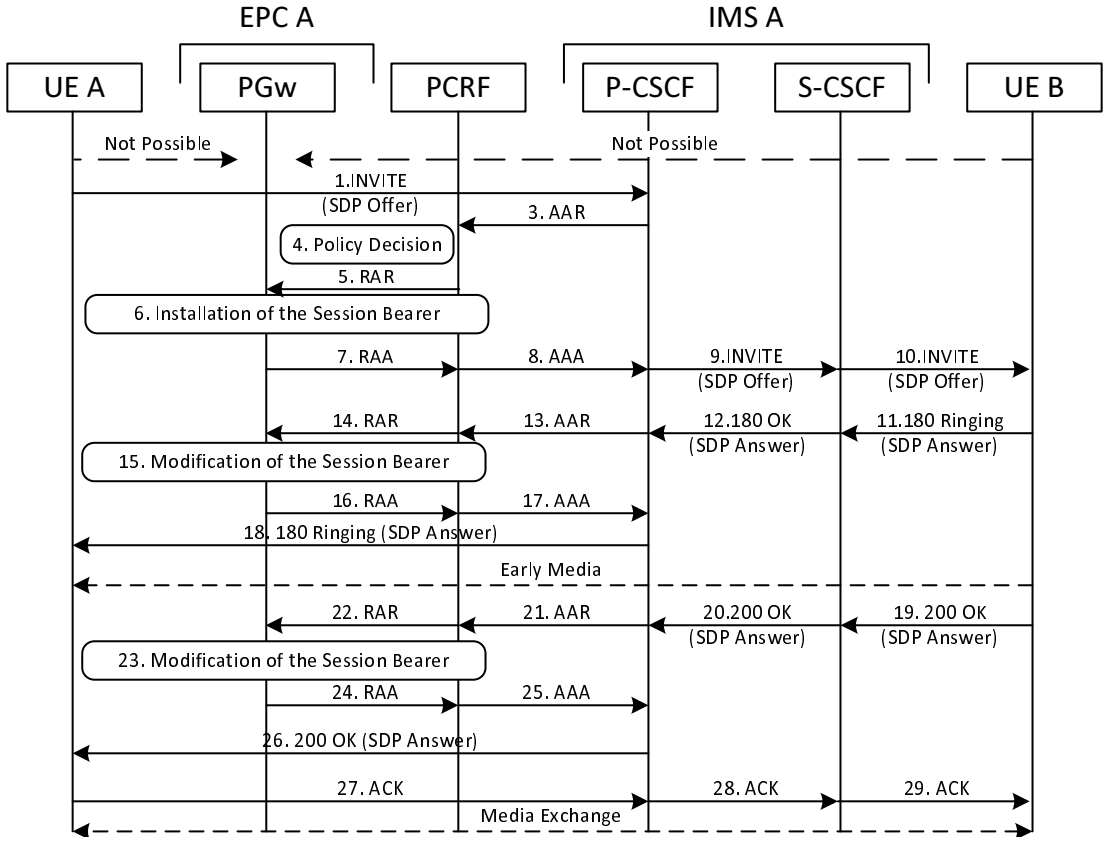
	14	TP_EPC_7002_03
		ensure that {
		when { P-GW receives RA-Request from PCRF }
		then { P-GW sends RA-Answer to PCRF
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001)
		}
		}

	15	TP_EPC_7002_04
		ensure that {
		when { PCRF receives RA-Answer from EPC P-GW }
		then { PCRF sends AA-Answer to IMS_P-CSCF
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001) and
		containing Acceptable-Service-Info_AVP (
		containing one or more Media-Component-Description_AVP
		indicating values_derived from AA-Request
		)
		}
		}

Interoperability Test Description		

	16	TP_EPC_7002_09
		ensure that {
		when { IMS_P-CSCF receives AA-Answer from PCRF }
		then { IMS_P-CSCF sends 200_OK_Response_SDP on INVITE to UE_A }
		}

	17	TP_EPC_6030_01
		ensure that {
		when { UE_A sends media to UE_B }
		then { EPC uses_correct_bearers for the service_data_flows }
		then { UE_B receives media }
		when { UE_B sends media to UE_A }
		then { EPC uses_correct_bearers for the service_data_flows }
		then { UE_A receives media }
		}



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

Step	Direction						Message	Comment
	UEA		EPC	PCRF	IMS	UEB		
1		→	→	→			SIP INVITE (SDP)	UEA initiates the SIP session with an NVITE containing the SDP offer.
2				←			DIAMETER AAR	The IMS P-CSCF invokes the PCRF.
3			←				DIAMETER RAR	PCRF sends RAR to EPC P-GW.
4			→				DIAMETER RAA	EPC P-GW responds.
5				→			DIAMETER AAA	PCRF responds to IMS P-CSCF.
6					→		SIP INVITE (SDP)	IMS forwards the INVITE to UEB.
7					←		SIP 180 (SDP)	The UE responds with the 180 with SDP answer.
8				←			DIAMETER AAR	The IMS P-CSCF invokes the PCRF to modify the bearer.
9			←				DIAMETER RAR	PCRF sends RAR to EPC P-GW.
10			→				DIAMETER RAA	EPC P-GW responds.
11				→			DIAMETER AAA	PCRF responds to IMS P-CSCF.
12		←					SIP 180 (SDP)	P-CSCF forwards the SIP 180 (SDP) to UEA.
7							SIP 200 OK (SDP)	The UE responds with the SIP 200 OK (SDP).
8				←	←		DIAMETER AAR	The IMS P-CSCF invokes the PCRF to complete the bearer set up.
9			←				DIAMETER RAR	PCRF sends RAR to EPC P-GW.
10			→				DIAMETER RAA	EPC P-GW responds.
11				→			DIAMETER AAA	PCRF responds to IMS P-CSCF.
12		←					SIP 200 OK (SDP)	P-CSCF forwards the SIP 200 OK (SDP) to UEA.
13					→		SIP ACK	The UEA sends ACK to 200 OK (INVITE).
14						→	SIP ACK	The ACK is sent to UEB.
15								The dedicated bearer(s) is/are set up. Media can flow between the UEs.

7.2.1.2 Terminating Leg

Interoperability Test Description		
Identifier:	**TD_IMSEPC_Session_Establishment_Terminating_1**	
Purpose:	To demonstrate the establishment of dedicated bearers at the terminating 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 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).	
Config.:	CF_IMSEPC	
SUT:	IMS, PCRF and EPC	
Ref.:	TS 124 229 [2], clause 5.2.7.3 (Initial INVITE/Terminating Case). TS 129 214 [5], clause 4.4.1 (Initial Provisioning of Session Information). TS 129 214 [5], clause A.1 (Provision of Service Information at the P-CSCF). TS 129 214 [5], clause A.2 (Enabling of IP Flows). TS 129 214 [5], annex B (Flow identifiers: Format definition and examples). TS 129 212 [6], clause 4.5.2 (Provision of PCC rules).	
Pre-test conditions:	• UE_B previously attached to EPC. • EPC established a Default Bearer allowing UE_B - P-CSCF IP communication. • UE_B previously registered to IMS. • EPC established an IMS 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.

Interoperability Test Description		
	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 IMS requested media description was found acceptable by EPC.
	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:	**Check**	

	1	TP_EPC_6003_03
		ensure that {
		when { UE_B sends media to UE_A }
		then { EPC filters the IP_packets }
		then { the IP_packets not visible on PO_SGi }
		when { UE_A sends media to UE_B }
		then { EPC filters the IP_packets }
		then { the IP_packets not visible on PO_SGi }
		}

	2	TP_EPC_7002_10
		ensure that {
		when { IMS_P-CSCF receives INVITE from IMS S-CSCF with SDP offer
		}
		then { IMS_P-CSCF sends AA-Request to PCRF
		(containing Framed-IP-Address_AVP
		indicating IPv4_address of UE_A or
		containing Framed-IPv6-Address_AVP
		indicating IPv6_address of UE_A) and
		containing one or more Media-Component-Description_AVP (
		containing Media-Component-Number_AVP
		indicating values_derived from SDP
		containing Media-Type indicating a value derived from
		the SDP offer
		containing a Flow-Status AVP set to DISABLED(3)
		containing Max-Requested-Bandwidth-UL AVP indicating a
		value derived from the SDP offer
		containing RS-Bandwidth AVP mapped from SDP offer
		containing a Codec-Data AVP derived from the SDP offer
		containing one or more Media-Subcomponent-Description_AVP
		containing Flow-Number AVP
		containing Flow-Description AVP indicating values derived
		from the SDP
		)
		}
		}

	3	TP_EPC_7002_02
		ensure that when
		{ PCRF receives AA-Request from IMS P-CSCF }
		then PCRF invokes the EPC P-GW with a RAR {
		containing a Charging-Rule-Install AVP
		containing a Charging-Rule-Definition AVP
		containing a Charging-Rule-Name AVP
		containing a Flow-Information AVP
		containing Flow-Description AVP
		containing a Flow-Status AVP set as received from PCRF
		containing a Flows AVP
		containing containing Media-Component-Number AVP
		as received from PCRF
		containing QOS-Information AVP
		containing QOS-Class-Identifier AVP set to QCI_1 (1)
		for voice or QCI_2(2) for video
		containing Max-Requested-Bandwidth-UL AVP
		containing Max-Requested-Bandwidth-DL AVP
		containing Guaranteed-Bitrate-UL AVP
		containing Guaranteed-Bitrate-DL AVP
		containing Allocation-Retention-Priority AVP
		
		}

Interoperability Test Description		

	4	TP_EPC_7002_03
		ensure that {
		when { P-GW receives RA-Request from PCRF }
		then { P-GW sends RA-Answer to PCRF
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001)
		}
		}

	5	TP_EPC_7002_04 ensure that when { PCRF receives RA-Answer from EPC P-GW } then { PCRF sends AA-Answer to IMS P-CSCF (containing containing Result-Code_AVP indicating DIAMETER_SUCCESS(2001) and containing Acceptable-Service-Info_AVP (containing one or more Media-Component-Description_AVP indicating values_derived from AA-Request) } }

	6	TP_EPC_7002_11
		Ensure that {
		when { IMS_P-CSCF receives AAA_response from PCRF
		then {INVITE is forwarded to the UE B }
		}

	7	TP_EPC_7002_12
		ensure that {
		when { IMS_P-CSCF receives 180_SDP_response on INVITE from UEB }
		then { IMS_P-CSCF sends AA-Request to PCRF
		(containing Framed-IP-Address_AVP
		indicating IPv4_address of UE_A or
		containing Framed-IPv6-Address_AVP
		indicating IPv6_address of UE_A) and
		containing one or more Media-Component-Description_AVP (
		containing Media-Component-Number_AVP
		indicating values_derived from SDP
		containing Media-Type indicating a value derived from
		the SDP offer/answer
		containing a Flow-Status AVP set to ENABLED-UPLINK(0)
		containing Max-Requested-Bandwidth-DL AVP indicating a
		value derived from the SDP offer
		containing Max-Requested-Bandwidth-UL AVP indicating a
		value derived from the SDP answer
		containing RR-Bandwidth AVP mapped from SDP offer
		containing RS-Bandwidth AVP mapped from SDP answer
		containing a Codec-Data AVP derived from the SDP
		offer/answer
		containing one or more Media-Subcomponent-Description_AVP
		containing Flow-Number AVP
		containing Flow-Description AVP indicating values derived
		from the SDP/answer
		}
		}

	8	TP_EPC_7002_02
		ensure that {
		when { EPC_PCRF receives AA-Request from IMS_P-CSCF }
		then {PCRF invokes the EPC P-GW with a RAR }
		containing a Charging-Rule-Install AVP
		containing a Charging-Rule-Definition AVP
		containing a Charging-Rule-Name AVP
		containing a Flow-Information AVP
		containing Flow-Description AVP
		containing a Flow-Status AVP set as received from PCRF
		containing a Flows AVP
		containing containing Media-Component-Number AVP
		as received from PCRF
		containing QOS-Information AVP
		containing QOS-Class-Identifier AVP set to QCI_1 (1)
		for voice or QCI_2(2) for video
		containing Max-Requested-Bandwidth-UL AVP
		containing Max-Requested-Bandwidth-DL AVP
		containing Guaranteed-Bitrate-UL AVP
		containing Guaranteed-Bitrate-DL AVP
		containing Allocation-Retention-Priority AVP
		}

Interoperability Test Description		

	9	TP_EPC_7002_03
		ensure that {
		when { P-GW receives RA-Request from PCRF }
		then { P-GW sends RA-Answer to PCRF
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001)
		}
		}

	10	TP_EPC_7002_04
		ensure that {
		when { PCRF receives RA-Answer from EPC P-GW }
		then { PCRF sends AA-Answer to IMS_P-CSCF
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001) and
		containing Acceptable-Service-Info_AVP (
		containing one or more Media-Component-Description_AVP
		indicating values_derived from AA-Request
		)
		}
		}

	11	TP_EPC_7002_13
		ensure that {
		when { IMS_P-CSCF receives AA-Answer from PCRF }
		then { IMS_P-CSCF sends 180_SDP_Response on INVITE to S-CSCF }
		}

	12	TP_EPC_7002_14
		ensure that {
		when { IMS_P-CSCF receives 2xx_response on INVITE from UEB }
		then { IMS_P-CSCF sends AA-Request to PCRF
		(containing Framed-IP-Address_AVP
		indicating IPv4_address of UE_A or
		containing Framed-IPv6-Address_AVP
		indicating IPv6_address of UE_A) and
		containing one or more Media-Component-Description_AVP (
		containing Media-Component-Number_AVP
		indicating values_derived from SDP
		containing Media-Type indicating a value derived from
		the SDP offer/answer
		containing a Flow-Status AVP set to ENABLED (2)
		containing Max-Requested-Bandwidth-DL AVP indicating a
		value derived from the SDP offer
		containing Max-Requested-Bandwidth-UL AVP indicating a
		value derived from the SDP answer
		containing RR-Bandwidth AVP mapped from SDP offer
		containing RS-Bandwidth AVP mapped from SDP answer
		containing a Codec-Data AVP derived from the SDP
		offer/answer
		containing one or more Media-Subcomponent-Description_AVP
		containing Flow-Number AVP
		containing Flow-Description AVP indicating values derived
		from the SDP/answer
		}
		}

	13	TP_EPC_7002_02
		ensure that {
		when { EPC_PCRF receives AA-Request from IMS_P-CSCF }
		then {PCRF invokes the EPC P-GW with a RAR }
		containing a Charging-Rule-Install AVP
		containing a Charging-Rule-Definition AVP
		containing a Charging-Rule-Name AVP
		containing a Flow-Information AVP
		containing Flow-Description AVP
		containing a Flow-Status AVP set as received from PCRF
		containing a Flows AVP
		containing containing Media-Component-Number AVP
		as received from PCRF
		containing QOS-Information AVP
		containing QOS-Class-Identifier AVP set to QCI_1 (1)
		for voice or QCI_2(2) for video
		containing Max-Requested-Bandwidth-UL AVP
		containing Max-Requested-Bandwidth-DL AVP
		containing Guaranteed-Bitrate-UL AVP
		containing Guaranteed-Bitrate-DL AVP
		containing Allocation-Retention-Priority AVP
		}

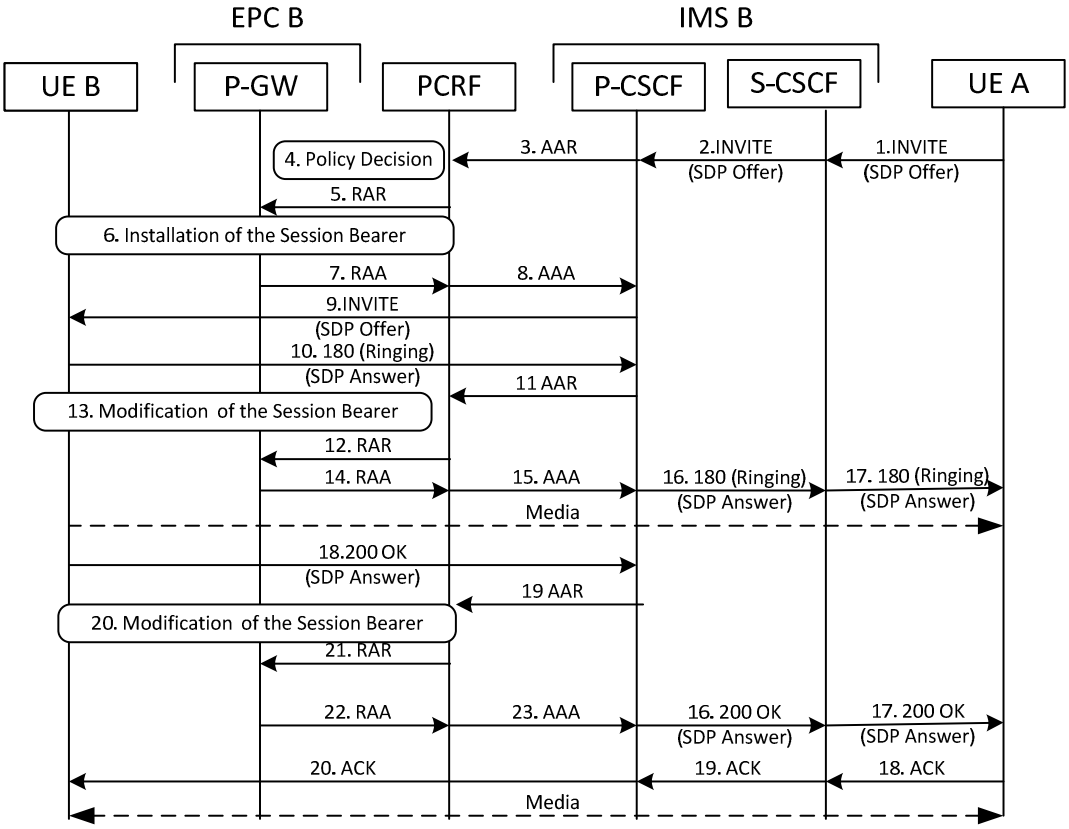
Interoperability Test Description		

	14	TP_EPC_7002_03
		ensure that {
		when { P-GW receives RA-Request from PCRF }
		then { P-GW sends RA-Answer to PCRF
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001)
		}
		}

	15	TP_EPC_7002_04
		ensure that {
		when { PCRF receives RA-Answer from EPC P-GW }
		then { PCRF sends AA-Answer to IMS_P-CSCF
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001) and
		containing Acceptable-Service-Info_AVP (
		containing one or more Media-Component-Description_AVP
		indicating values_derived from AA-Request
		)
		}
		}

	16	TP_EPC_6029_01
		ensure that {
		when { IMS_P-CSCF receives AA-Answer from PCRF }
		then { IMS_P-CSCF sends 2xx_Response on INVITE to S-CSCF }
		}

	17	TP_EPC_6030_01
		ensure that {
		when { UE_A sends media to UE_B }
		then { EPC uses_correct_bearers for the service_data_flows }
		then { UE_B receives media }
		when { UE_B sends media to UE_A }
		then { EPC uses_correct_bearers for the service_data_flows }
		then { UE_A receives media }
		}



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

Step	Direction						Message	Comment
	UEA		EPC	PCRF	IMS	UEB		
1		→		→			SIP INVITE (SDP)	UEA initiates the SIP session with an INVITE containing the SDP offer.
2							DIAMETER AAR	The IMS P-CSCF invokes the PCRF.
3			←	←			DIAMETER RAR	PCRF sends RAR to EPC P-GW.
4			→				DIAMETER RAA	EPC P-GW responds.
5				→			DIAMETER AAA	PCRF responds to IMS P-CSCF.
6					→		SIP INVITE (SDP)	P-CSCF forwards the INVITE to UEB.
7					←		SIP 180 (SDP)	The UE responds with the 180 (Ringing) with SDP answer.
8				←			DIAMETER AAR	The IMS P-CSCF invokes the PCRF to modify the bearer.
9			←				DIAMETER RAR	PCRF sends RAR to EPC P-GW.
10			→				DIAMETER RAA	EPC P-GW responds.
11				→			DIAMETER AAA	PCRF responds to IMS P-CSCF.
12		←					SIP 180 (SDP)	P-CSCF forwards the SIP 180 (SDP) to S-CSCF and onto UEA.
13							SIP 200 OK (SDP)	The UE responds with the 200 OK SDP answer.
14				←	←		DIAMETER AAR	The IMS P-CSCF invokes the PCRF to complete the bearer set up.
15			←				DIAMETER RAR	PCRF sends RAR to EPC P-GW.
16			→				DIAMETER RAA	EPC P-GW responds.
17				→			DIAMETER AAA	PCRF responds to IMS P-CSCF.
18		←					SIP 200 OK (SDP)	P-CSCF forwards the SIP 200 OK (SDP) to S-CSCF and onto UEA.
19					→		SIP ACK	The UEA sends ACK to 200 OK (INVITE).
20						→	SIP ACK	The ACK is sent to UEB.
21								The dedicated bearer(s) is/are set up. Media can flow between the UEs.

7.2.2 SIP Session Modification

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.).

7.2.2.1 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_IMSEPC_Session_Modification_Originating_1**	
Purpose	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.	
Config.:	CF_IMSEPC	
SUT:	IMS, PCRF and EPC	
Ref.:	TS 124 229 [2], clause 5.2.9.1 (Subsequent requests/UE-originating Case). TS 129 214 [5], clause 4.4.2 (Modification of Session Bearers). TS 129 214 [5], clause A.1 (Provision of Service Information at the P-CSCF). TS 129 214 [5], clause A.2 (Enabling of IP Flows). TS 129 214 [5], annex B (Flow identifiers: Format definition and examples). TS 129 212 [6], clause 4.5.2 (Provision of PCC rules).	
Pre-test conditions:	• UE_A and UE_B previously attached to EPC. • 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.	
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.
Conformance Criteria:	**Check**	

	1	`TP_EPC_6030_02`
		`ensure that {`
		`  when { UE_A sends audio_media to UE_B }`
		`  then { EPC uses_correct_bearers for the service_data_flows }`
		`  then { UE_B receives media }`
		`  when { UE_B sends audio_media to UE_A }`
		`  then { EPC uses_correct_bearers for the service_data_flows }`
		`  then { UE_A receives the media }`
		`  when { UE_A sends video_media to UE_B }`
		`  then { EPC uses_correct_bearers for the service_data_flows }`
		`  then { UE_B receives the media }`
		`  when { UE_B sends video_media to UE_A }`
		`  then { EPC uses_correct_bearers for the service_data_flows }`
		`  then { UE_A receives the media }`
		`}`

Interoperability Test Description		

	2	TP_EPC_7002_15
		ensure that {
		when { IMS_P-CSCF receives 2xx_response on INVITE from IMS_S-CSCF
		}
		then { IMS_P-CSCF sends AA-Request to EPC_PCRF
		(containing Framed-IP-Address_AVP
		indicating IPv4_address of UE_A or
		containing Framed-IPv6-Address_AVP
		indicating IPv6_address of UE_A) and
		containing one or more Media-Component-Description_AVP (
		containing Media-Component-Number_AVP
		indicating values_derived from SDP
		containing Media-Type indicating a value derived from
		the SDP offer/answer
		containing a Flow-Status AVP set to ENABLED-UPLINK(0)
		containing Max-Requested-Bandwidth-DL AVP indicating a
		value derived from the SDP offer
		containing Max-Requested-Bandwidth-UL AVP indicating a
		value derived from the SDP answer
		containing RR-Bandwidth AVP mapped from SDP offer
		containing RS-Bandwidth AVP mapped from SDP answer
		containing a Codec-Data AVP derived from the SDP
		offer/answer
		containing one or more Media-Subcomponent-Description_AVP
		containing Flow-Number AVP
		containing Flow-Description AVP indicating values derived
		from the SDP/answer
		}
		}

	3	TP_EPC_7002_02
		ensure that {
		when { EPC_PCRF receives AA-Request from IMS_P-CSCF }
		then {PCRF invokes the EPC P-GW with a RAR }
		containing a Charging-Rule-Install AVP
		containing a Charging-Rule-Definition AVP
		containing a Charging-Rule-Name AVP
		containing a Flow-Information AVP
		containing Flow-Description AVP
		containing a Flow-Status AVP set as received from PCRF
		containing a Flows AVP
		containing containing Media-Component-Number AVP
		as received from PCRF
		containing QOS-Information AVP
		containing QOS-Class-Identifier AVP set to QCI_1 (1)
		for voice or QCI_2(2) for video
		containing Max-Requested-Bandwidth-UL AVP
		containing Max-Requested-Bandwidth-DL AVP
		containing Guaranteed-Bitrate-UL AVP
		containing Guaranteed-Bitrate-DL AVP
		containing Allocation-Retention-Priority AVP
		
		}

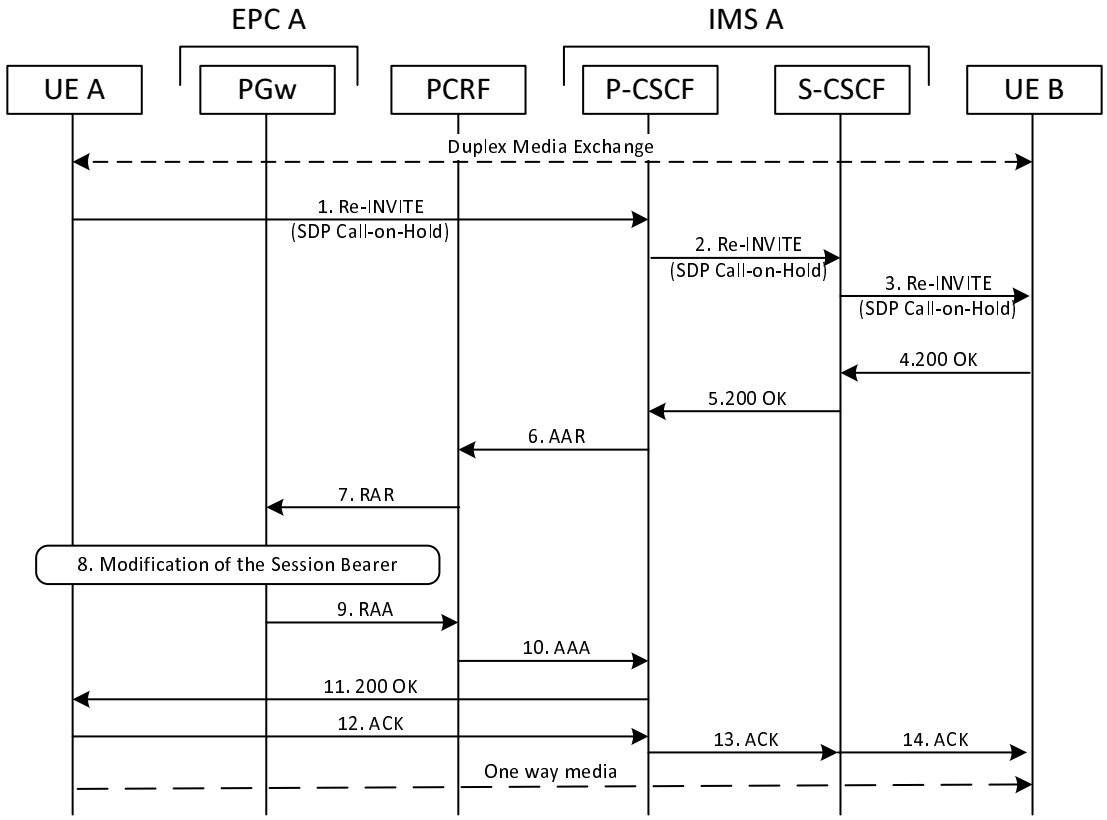
	4	TP_EPC_7002_03
		ensure that {
		when { P-GW receives RA-Request from PCRF }
		then { P-GW sends RA-Answer to PCRF
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001)
		}
		}

	5	TP_EPC_7002_04
		ensure that {
		when { EPC_PCRF receives RA-Answer from EPC P-GW }
		then { EPC_PCRF sends AA-Answer to IMS_P-CSCF
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001) and
		containing Acceptable-Service-Info_AVP (
		containing one or more Media-Component-Description_AVP
		indicating values_derived from AA-Request
		)
		}
		}

Interoperability Test Description		

	6	TP_EPC_7002_09
		ensure that {
		when { IMS_P-CSCF receives AA-Answer from PCRF }
		then { IMS_P-CSCF sends 2xx_Response on INVITE to UE_A }
		}

	7	TP_EPC_6031_01
		ensure that {
		when { UE_A sends audio_media to UE_B }
		then { EPC allows the IP_packets }
		then { the IP_packets are visible on PO_SGi }
		when { UE_B sends audio_media to UE_A }
		then { EPC filters the IP_packets }
		then { the IP_packets not visible on PO_SGi }
		when { UE_A sends video_media to UE_B }
		then { EPC uses_correct_bearers for the service_data_flows }
		then { UE_B receives media }
		when { UE_B sends video_media to UE_A }
		then { EPC filters the IP_packets }
		then { the IP_packets not visible on PO_SGi
		}
		}



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

Step	Direction						Message	Comment
	UEA		EPC	PCRF	IMS	UEB		
1		→		→			SIP INVITE (SDP)	UEA initiates the SIP session with a re-I NVITE containing the new SDP offer. In this case, the SPD will differ in a media attribute line(s) set to "sendonly" indicating the existing media stream(s) are being placed on hold.
2					→		SIP INVITE (SDP)	IMS forwards the INVITE to UEB.
3					←		SIP 200 OK (SDP)	The UE responds with the SDP answer. The SDP answer will differ in a media attribute line(s) set to "recvonly" indicating the existing media stream(s) are being placed on hold.
4				←			DIAMETER AAR	The IMS P-CSCF invokes the PCRF to modify the bearer(s) to reflect the new offer/answer exchange.
5			←				DIAMETER RAR	PCRF sends RAR to EPC P-GW.
6			→				DIAMETER RAA	EPC P-GW responds.
7				→			DIAMETER AAA	PCRF responds to IMS P-CSCF.
8		←					SIP 200 OK (SDP)	P-CSCF forwards the SIP 200 OK (SDP) to UEA.
9					→		SIP ACK	The UEA sends ACK to 200 OK (INVITE).
10						→	SIP ACK	The ACK is sent to UEB.
11								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.

7.2.2.2 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_IMSEPC_Session_Modification_Terminating_1**
Purpose:	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.
Config.:	CF_IMSEPC
SUT:	IMS, PCRF and EPC
Ref.:	TS 124 229 [2], clause 5.2.9.2 (Subsequent requests/UE-terminating Case). TS 129 214 [5], clause 4.4.2 (Modification of Session Bearers). TS 129 214 [5], clause A.1 (Provision of Service Information at the P-CSCF). TS 129 214 [5], clause A.2 (Enabling of IP Flows). TS 129 214 [5], annex B (Flow identifiers: Format definition and examples). TS 129 212 [6], clause 4.5.2 (Provision of PCC rules).
Pre-test conditions:	• 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 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:	**Check**	

	1	TP_EPC_6030_02
		ensure that {
		when { UE_A sends audio_media to UE_B }
		then { EPC uses_correct_bearers for the service_data_flows }
		then { UE_B receives media }
		when { UE_B sends audio_media to UE_A }
		then { EPC uses_correct_bearers for the service_data_flows }
		then { UE_A receives the media }
		when { UE_A sends video_media to UE_B }
		then { EPC uses_correct_bearers for the service_data_flows }
		then { UE_B receives the media }
		when { UE_B sends video_media to UE_A }
		then { EPC uses_correct_bearers for the service_data_flows }
		then { UE_A receives the media }
		}

	2	TP_EPC_7002_16
		ensure that {
		when { IMS_P-CSCF receives 2xx_response on INVITE from UE-B }
		then { IMS_P-CSCF sends AA-Request to EPC_PCRF
		(containing Framed-IP-Address_AVP
		indicating IPv4_address of UE_A or
		containing Framed-IPv6-Address_AVP
		indicating IPv6_address of UE_A) and
		containing one or more Media-Component-Description_AVP (
		containing Media-Component-Number_AVP
		indicating values_derived from SDP
		containing Media-Type indicating a value derived from
		the SDP offer/answer
		containing a Flow-Status AVP set to ENABLED-DOWNLINK(1)
		containing Max-Requested-Bandwidth-DL AVP indicating a
		value derived from the SDP offer
		containing Max-Requested-Bandwidth-UL AVP indicating a
		value derived from the SDP answer
		containing RR-Bandwidth AVP mapped from SDP offer
		containing RS-Bandwidth AVP mapped from SDP answer
		containing a Codec-Data AVP derived from the SDP
		offer/answer
		containing one or more Media-Subcomponent-Description_AVP
		containing Flow-Number AVP
		containing Flow-Description AVP indicating values derived
		from the SDP/answer
		}
		}

	3	TP_EPC_7002_02 ensure that { when { EPC_PCRF receives AA-Request from IMS_P-CSCF } then {PCRF invokes the EPC P-GW with a RAR } containing a Charging-Rule-Install AVP containing a Charging-Rule-Definition AVP containing a Charging-Rule-Name AVP containing a Flow-Information AVP containing Flow-Description AVP containing a Flow-Status AVP set as received from PCRF containing a Flows AVP containing containing Media-Component-Number AVP as received from PCRF containing QOS-Information AVP

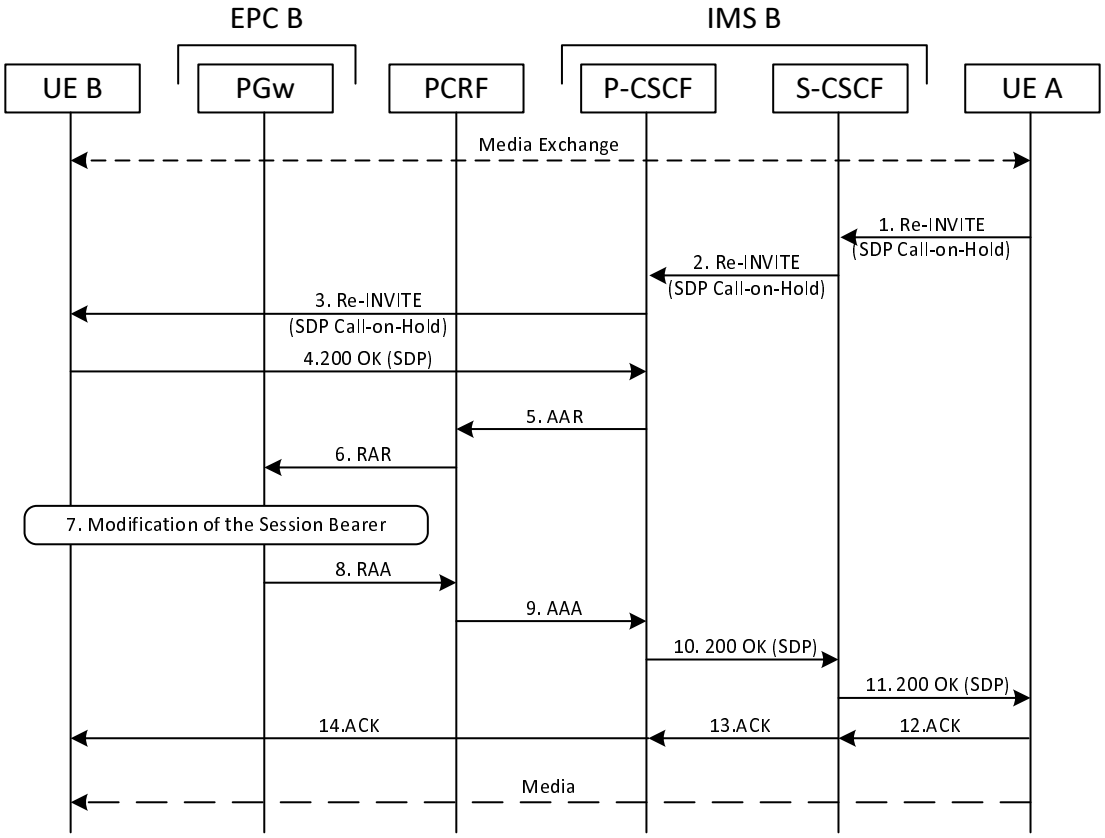
Interoperability Test Description		
		containing QOS-Class-Identifier AVP set to QCI_1 (1) for voice or QCI_2(2) for video containing Max-Requested-Bandwidth-UL AVP containing Max-Requested-Bandwidth-DL AVP containing Guaranteed-Bitrate-UL AVP containing Guaranteed-Bitrate-DL AVP containing Allocation-Retention-Priority AVP }

	4	TP_EPC_7002_03
		ensure that {
		when { P-GW receives RA-Request from PCRF }
		then { P-GW sends RA-Answer to PCRF
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001)
		}
		}

	5	TP_EPC_7002_04
		ensure that {
		when { EPC_PCRF receives RA-Answer from EPC P-GW }
		then { EPC_PCRF sends AA-Answer to IMS_P-CSCF
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001) and
		containing Acceptable-Service-Info_AVP (
		containing one or more Media-Component-Description_AVP
		indicating values_derived from AA-Request
		)
		}
		}

	6	TP_EPC_6029_01
		ensure that {
		when { IMS_P-CSCF receives AA-Answer from PCRF }
		then { IMS_P-CSCF sends 2xx_Response on INVITE to S-CSCF }
		}

	7	TP_EPC_6031_01
		ensure that {
		when { UE_A sends audio_media to UE_B }
		then { EPC allows the IP_packets }
		then { the IP_packets are visible on PO_SGi }
		when { UE_B sends audio_media to UE_A }
		then { EPC filters the IP_packets }
		then { the IP_packets not visible on PO_SGi }
		when { UE_A sends video_media to UE_B }
		then { EPC uses_correct_bearers for the service_data_flows }
		then { UE_B receives media }
		when { UE_B sends video_media to UE_A }
		then { EPC filters the IP_packets }
		then { the IP_packets not visible on PO_SGi
		}
		}



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

Step	Direction					Message	Comment
	UEA	EPC	PCRF	IMS	UEB		
1		→	→			SIP INVITE (SDP)	UEA initiates the SIP session with a re-I NVITE containing the new SDP offer. In this case, the SPD will differ in a media attribute line(s) set to "sendonly" indicating the existing media stream(s) are being placed on hold.
2				→		SIP INVITE (SDP)	IMS forwards the INVITE to UEB.
3				←		SIP 200 OK (SDP)	The UE responds with the SDP answer. The SDP answer will differ in a media attribute line(s) set to "recvonly" indicating the existing media stream(s) are being placed on hold.
4			←			DIAMETER AAR	The IMS P-CSCF invokes the PCRF to modify the bearer(s) to reflect the new offer/answer exchange.
5		←				DIAMETER RAR	PCRF sends RAR to EPC P-GW.
6		→				DIAMETER RAA	EPC P-GW responds.
7			→			DIAMETER AAA	PCRF responds to IMS P-CSCF.
8	←					SIP 200 OK (SDP)	P-CSCF forwards the SIP 200 OK (SDP) to UEA.
9				→		SIP ACK	The UEA sends ACK to 200 OK (INVITE).
10					→	SIP ACK	The ACK is sent to UEB.
11							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.

7.2.3 SIP Session Release

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.

7.2.3.1 UE Initiated Session Release

Interoperability Test Description		
Identifier:	**TD_IMSEPC_Session_Release_UE_Initiated**	
Purpose:	To demonstrate IMS session termination (UE initiated) and the tear down of related dedicated bearers.	
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.	
Config.:	CF_IMSEPC	
SUT:	IMS, PCRF and EPC	
Ref.:	TS 124 229 [2], clause 5.2.8.2 (Call release initiated by any other entity). TS 129 214 [5], clause 4.4.4 (AF Session Termination). TS 129 212 [6], clause 4.5.2 (Provision of PCC rules).	
Pre-test conditions:	• UE_A and UE_B previously attached to EPC. • EPC 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 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.
Conformance Criteria:	**Check**	

	1	TP_EPC_6030_01
		ensure that {
		when { UE_A sends media to UE_B }
		then { EPC uses_correct_bearers for the service_data_flows }
		then { UE_B receives media }
		when { UE_B sends media to UE_A }
		then { EPC uses_correct_bearers for the service_data_flows }
		then { UE_A receives media }
		}

Interoperability Test Description		

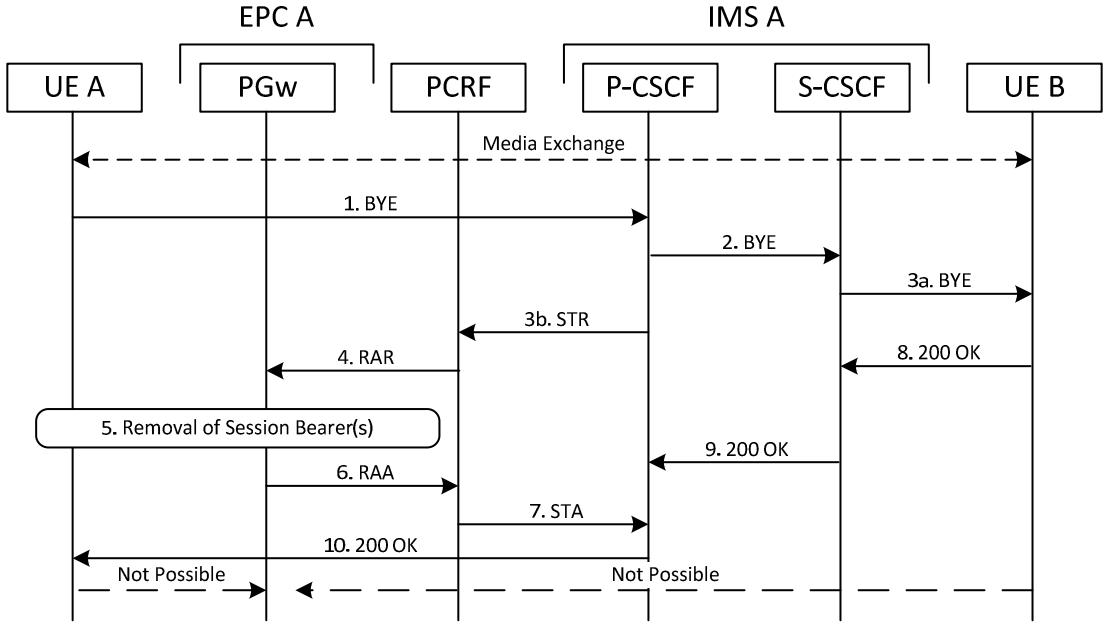
	2	TP_EPC_6034_01
		ensure that {
		when { IMS_P-CSCF receives SIP BYE from UE_A }
		then { IMS_P-CSCF sends Session-Termination-Request to PCRF
		containing Session-Id_AVP
		indicating session for SIP_session
		}
		}

	3	TP_EPC_7002_17
		ensure that {
		when { PCRF receives ST-Request from IMS_P-CSCF }
		then {PCRF invokes the EPC P-GW with a RAR }
		containing a Charging-Rule-Remove AVP
		containing a Charging-Rule-Name AVP
		}

	4	TP_EPC_7002_18
		ensure that {
		when { P-GW receives RA-Request from PCRF }
		then { P-GW sends RA-Answer to PCRF
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001)
		}
		}

	5	TP_EPC_7002_19
		ensure that {
		when { PCRF receives RA-Answer from EPC P-GW}
		then { PCRF sends Session-Termination-Answer to IMS_P-CSCF
		containing Session-Id_AVP
		indicating session for IMS_signalling session
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001)
		}
		}

	6	TP_EPC_6003_02
		ensure that {
		when { UE_A sends media to UE_B }
		then { EPC filters the IP_packets }
		then { the IP_packets not visible on PO_SGi }
		when { UE_B sends media to UE_A }
		then { EPC filters the IP_packets }
		then { the IP_packets not visible on PO_SGi }
		}



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

Figure 13: SIP Session Tear-down - UE initiated release

Step	Direction					Message	Comment
	UEA	EPC	PCRF	IMS	UEB		
1		→		→		SIP BYE	UEA initiates the SIP session release by sending a BYE message.
2					→	SIP BYE	IMS forwards the BYE to UEB.
3				←		DIAMETER STR	The IMS P-CSCF invokes the PCRF to terminate the Rx session.
4			←			DIAMETER RAR	PCRF sends RAR to EPC P-GW.
5			→			DIAMETER RAA	EPC P-GW responds.
6				→		DIAMETER STA	PCRF responds to IMS P-CSCF.
7					←	SIP 200 OK	The UE sends 200 OK to the BYE.
8		←				SIP 200 OK	P-CSCF forwards the SIP 200 OK to UEA.
9							The dedicated bearer(s) has/have been released.

7.2.3.2 Network Initiated Session Release

Interoperability Test Description		
Identifier:	**TD_IMSEPC_Session_Release_Network_Initiated**	
Purpose:	To demonstrate IMS session termination (network initiated) and the tear down of related dedicated bearers.	
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.	
Config.:	CF_IMSEPC	
SUT:	IMS, PCRF and EPC	
Ref.:	TS 124 229 [2], clause 5.2.8.2 (Call release initiated by any other entity). TS 129 214 [5], clause 4.4.4 (AF Session Termination). TS 129 212 [6], clause 4.5.2 (Provision of PCC rules).	
Pre-test conditions:	• UE_A and UE_B previously attached to EPC. • EPC 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 negotiated media stream types after call establishment.
	2	UE_B receives a Call-Release (BYE) operation, ending the session.
	3	Verify that P-CSCF terminates the Rx session, triggering the removal of all session related bearers.
	4	Verify that EPC removes all session related bearers.
	5	Verify that the media between UE_A and UE_B can no longer be exchanged and is filtered out by EPC.
Conformance Criteria:	**Check**	

	1	`TP_EPC_6030_01`
		`ensure that {`
		`  when { UE_A sends media to UE_B }`
		`  then { EPC uses_correct_bearers for the service_data_flows }`
		`  then { UE_B receives media }`
		`  when { UE_B sends media to UE_A }`
		`  then { EPC uses_correct_bearers for the service_data_flows }`
		`  then { UE_A receives media }`
		`}`

	2	`TP_EPC_7002_20`
		`ensure that {`
		`  when { IMS_P-CSCF receives SIP BYE message  from S-CSCF }`
		`  then { IMS_P-CSCF sends Session-Termination-Request to PCRF`

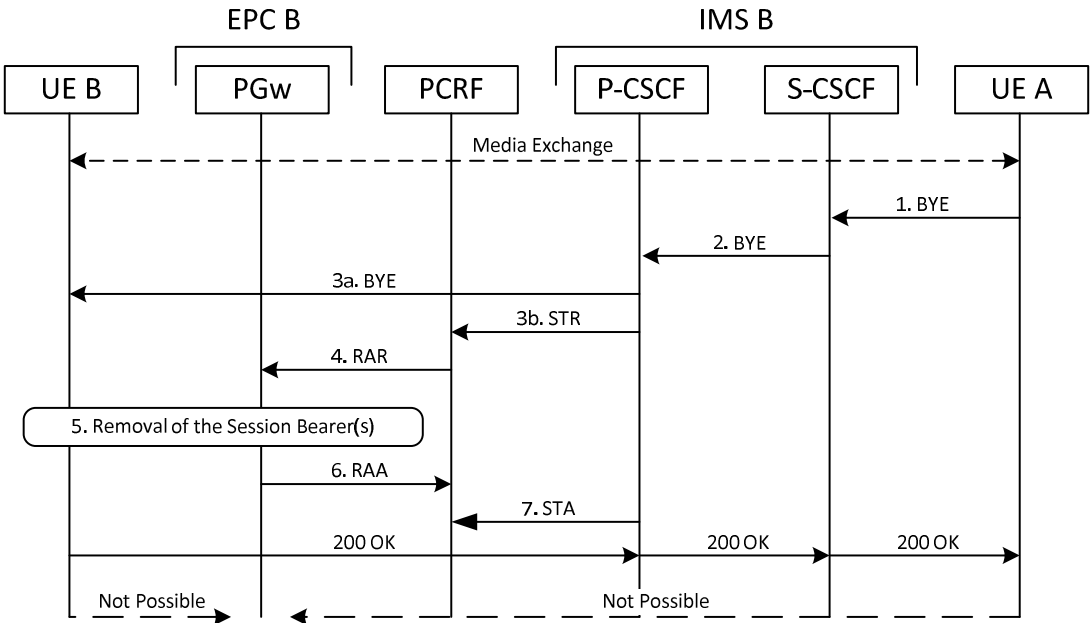
Interoperability Test Description		
		containing Session-Id_AVP indicating session for SIP_session } }

	3	TP_EPC_7002_17
		ensure that {
		when { PCRF receives ST-Request from IMS_P-CSCF }
		then {PCRF invokes the EPC P-GW with a RAR }
		containing a Charging-Rule-Remove AVP
		containing a Charging-Rule-Name AVP
		}

	4	TP_EPC_7002_18
		ensure that {
		when { P-GW receives RA-Request from PCRF }
		then { P-GW sends RA-Answer to PCRF
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001)
		}
		}

	5	TP_EPC_7002_19
		ensure that {
		when { PCRF receives RA-Answer from EPC P-GW }
		then { PCRF sends Session-Termination-Answer to IMS_P-CSCF
		containing Session-Id_AVP
		indicating session for IMS_signalling session
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001)
		}
		}

	6	TP_EPC_6003_02 ensure that { when { UE_A sends media to UE_B } then { EPC filters the IP_packets } then { the IP_packets not visible on PO_SGi } when { UE_B sends media to UE_A } then { EPC filters the IP_packets } then { the IP_packets not visible on PO_SGi }



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

Figure 14: SIP Session Tear-down - Network Initiated

Step	Direction						Message	Comment
	UEA		EPC	PCRF	IMS	UEB		
1		→					SIP BYE	UEA initiates the SIP session release by sending a BYE message.
2					→		SIP BYE	IMS forwards the BYE to UEB.
3				←			DIAMETER STR	The IMS P-CSCF invokes the PCRF to terminate the Rx session.
4			←				DIAMETER RAR	PCRF sends RAR to EPC P-GW.
5			→				DIAMETER RAA	EPC P-GW responds.
6				→			DIAMETER STA	PCRF responds to IMS P-CSCF.
7					←		SIP 200 OK	The UE sends 200 OK to the BYE.
8		←					SIP 200 OK	P-CSCF forwards the SIP 200 OK to S-CSCF and onto UE-A.
9								The dedicated bearer(s) has/have been released.

7.2.4 SIP Session Abort/Reject

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.

7.2.4.1 SIP Session Abort - Originating Leg

Interoperability Test Description		
Identifier:	**TD_IMSEPC_Session_Abort_Originating**	
Purpose:	To demonstrate SIP session abort (originating side) and the related interactions with PCRF and EPC.	
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.	
Config.:	CF_IMSEPC	
SUT:	IMS, PCRF and EPC	
Ref.:	TS 124 229 [2], clause 5.2.7.2 (Initial INVITE/Originating Case). TS 129 214 [5], clause 4.4.4 (AF Session Termination). TS 129 212 [6], clause 4.5.2 (Provision of PCC rules).	
Pre-test conditions:	• UE_A & UE_B previously attached to EPC. • 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. • EPC 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.

Interoperability Test Description		
	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.
Conformance Criteria:	**Check**	
	1-11	As checks 1-11 of clause 7.2.1.1 (SIP Session Establishment, originating leg)

	12	TP_EPC_6032_01
		ensure that {
		when { UE_A sends media to UE_B }
		then { EPC filters the IP_packets }
		then { the IP_packets not visible on PO_SGi }
		when { UE_B sends early_media to UE_A }
		then { EPC uses_correct_bearers for service_data_flows }
		then { UE_A receives media }
		}

	13	TP_EPC_6034_02
		ensure that {
		when { IMS_P-CSCF receives CANCEL from UE_A }
		then { IMS_P-CSCF sends Session-Termination-Request to PCRF
		containing Session-Id_AVP
		indicating session for SIP_session
		}
		}

	14	TP_EPC_7002_17
		ensure that {
		when { PCRF receives ST-Request from IMS_P-CSCF }
		then {PCRF invokes the EPC P-GW with a RAR }
		containing a Charging-Rule-Remove AVP
		containing a Charging-Rule-Name AVP
		}

	15	TP_EPC_7002_18
		ensure that {
		when { P-GW receives RA-Request from PCRF }
		then { P-GW sends RA-Answer to PCRF
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001)
		}
		}

	16	TP_EPC_7002_19
		ensure that {
		when { PCRF receives RA-Answer from EPC P-GW }
		then { PCRF sends Session-Termination-Answer to IMS_P-CSCF
		containing Session-Id_AVP
		indicating session for IMS_signalling session
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001)
		}
		}

	16	TP_EPC_6003_02
		ensure that {
		when { UE_A sends media to UE_B }
		then { EPC filters the IP_packets }
		then { the IP_packets not visible on PO_SGi }
		when { UE_B sends media to UE_A }
		then { EPC filters the IP_packets }
		then { the IP_packets not visible on PO_SGi }
		}

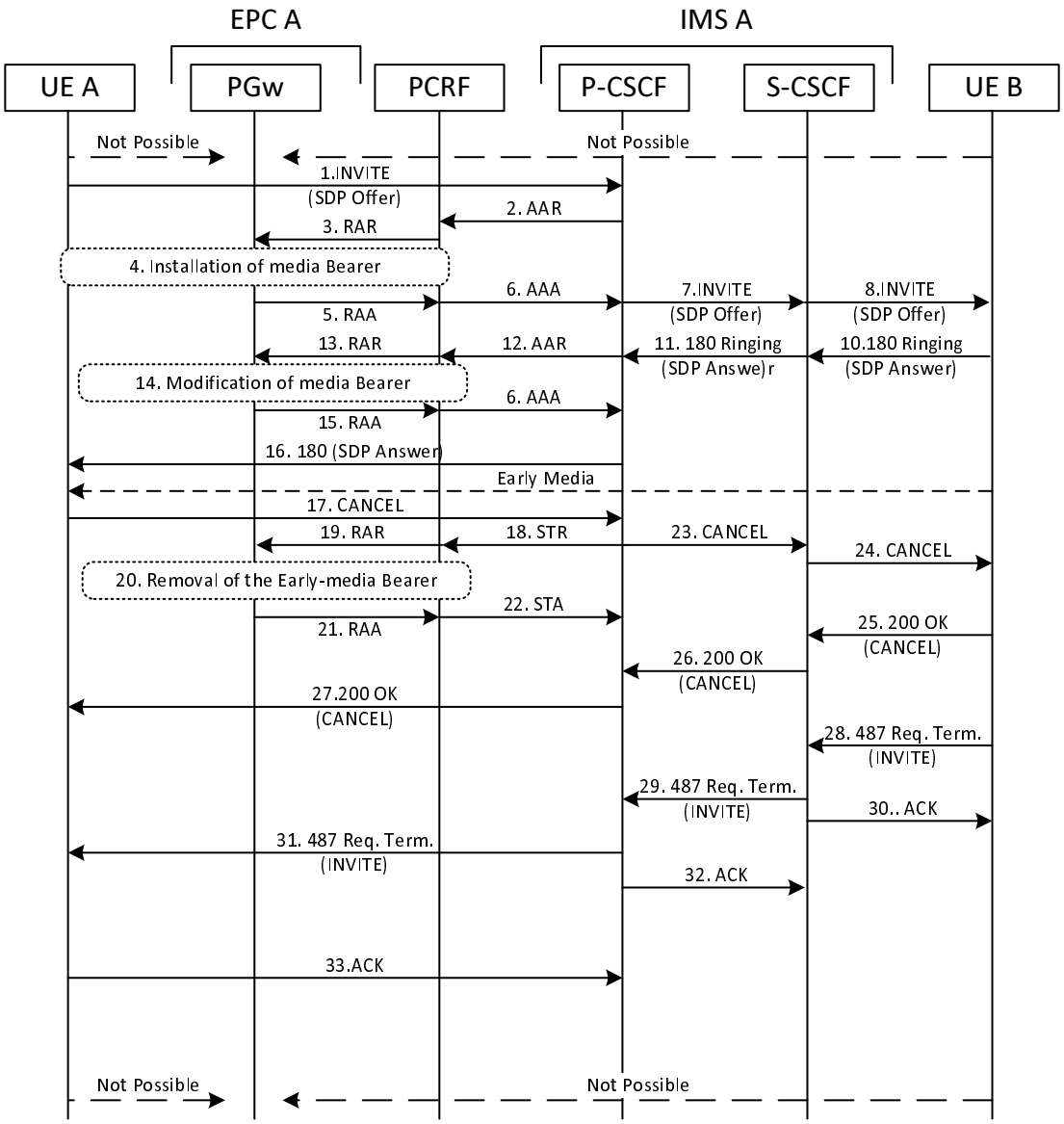


Figure 15: SIP Session Abort - Originating Leg

Step	Direction						Message	Comment
	UEA		EPC	PCRF	IMS	UEB		
1		→	→	→			SIP INVITE (SDP)	UEA initiates the SIP session with an NVITE containing the SDP offer.
2				→			DIAMETER AAR	The IMS P-CSCF invokes the PCRF.
3			←	←			DIAMETER RAR	PCRF sends RAR to EPC P-GW.
4			→				DIAMETER RAA	EPC P-GW responds.
5				→			DIAMETER AAA	PCRF responds to IMS P-CSCF.
6					→		SIP INVITE (SDP)	IMS forwards the INVITE to UEB.
7					←		SIP 180 OK (SDP)	UE-B responds with a 180(ringing) response with SDP and notification of early media.
8				←			DIAMETER AAR	The IMS P-CSCF invokes the PCRF to modify the media bearer.
9			←				DIAMETER RAR	PCRF sends RAR to EPC P-GW.
10			→				DIAMETER RAA	EPC P-GW responds.
11				→			DIAMETER AAA	PCRF responds to IMS P-CSCF.
12		←					SIP 180 (SDP)	The 180 is passed onto UE-A.
13								Early media is flowing from UE-B to UE-A.
14		→	→	→			SIP CANCEL	UEA aborts the session.
15					→		SIP CANCEL	IMS forwards the CANCEL to UEB.
16				←			DIAMETER STR	The IMS P-CSCF invokes the PCRF to release the media bearer.
17			←				DIAMETER RAR	PCRF sends RAR to EPC P-GW.
18			→				DIAMETER RAA	EPC P-GW responds.
19				→			DIAMETER STA	PCRF responds to IMS P-CSCF.
20					←		SIP 200 OK (CANCEL)	UE-B responds 200 OK.
21		←	←	←			SIP 200 OK (CANCEL)	P-CSCF forwards the SIP 200 OK (CANCEL) to UEA.
22					←		SIP 487 (INV)	UE-B responds 487 (Request Terminated).
23		←	←	←			SIP 487 (INV)	P-CSCF forwards the SIP 487 to UEA.
24				→			SIP ACK	The UEA sends ACK to 487 (INVITE).
25					→		SIP ACK	The ACK is sent to UEB.
26								The dedicated bearer(s) is/are released. No media flow is possible.

7.2.4.2 SIP Session Abort - Terminating Leg

Interoperability Test Description	
Identifier:	**TD_IMSEPC_Session_Abort_Terminating**
Purpose:	To demonstrate SIP session abort (originating side) and the related interactions with PCRF and EPC.
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.
Config.:	CF_IMSEPC
SUT:	IMS, PCRF and EPC
Ref.:	TS 124 229 [2], clause 5.2.7.3 (Initial INVITE/Terminating Case). TS 129 214 [5], clause 4.4.4 (AF Session Termination). TS 129 212 [6], clause 4.5.2 (Provision of PCC rules).
Pre-test conditions:	• UE_A & UE_B previously attached to EPC. • 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. • EPC 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 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 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.
Conformance Criteria:	**Check**	
	1-11	As checks 1-11 of clause 7.2.1.2 (SIP Session Establishment, terminating leg)

	12	TP_EPC_6032_01
		ensure that {
		when { UE_A sends media to UE_B }
		then { EPC filters the IP_packets }
		then { the IP_packets not visible on PO_SGi }
		when { UE_B sends early_media to UE_A }
		then { EPC uses_correct_bearers for service_data_flows }
		then { UE_A receives media }
		}

	13	TP_EPC_6034_03
		ensure that {
		when { IMS_P-CSCF receives CANCEL from IMS_S-CSCF }
		then { IMS_P-CSCF sends Session-Termination-Request to PCRF
		containing Session-Id_AVP
		indicating session for SIP_session
		}
		}

	14	TP_EPC_7002_17
		ensure that {
		when { PCRF receives ST-Request from IMS_P-CSCF }
		then {PCRF invokes the EPC P-GW with a RAR }
		containing a Charging-Rule-Remove AVP
		containing a Charging-Rule-Name AVP
		}

	15	TP_EPC_7002_18
		ensure that {
		when { P-GW receives RA-Request from PCRF }
		then { P-GW sends RA-Answer to PCRF
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001)
		}
		}

	16	TP_EPC_7002_19
		ensure that {
		when { PCRF receives RA-Answer from EPC P-GW }
		then { PCRF sends Session-Termination-Answer to IMS_P-CSCF
		containing Session-Id_AVP
		indicating session for IMS_signalling session
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001)
		}
		}

	17	TP_EPC_6003_02
		ensure that {
		when { UE_A sends media to UE_B }
		then { EPC filters the IP_packets }
		then { the IP_packets not visible on PO_SGi }
		when { UE_B sends media to UE_A }
		then { EPC filters the IP_packets }
		then { the IP_packets not visible on PO_SGi }
		}

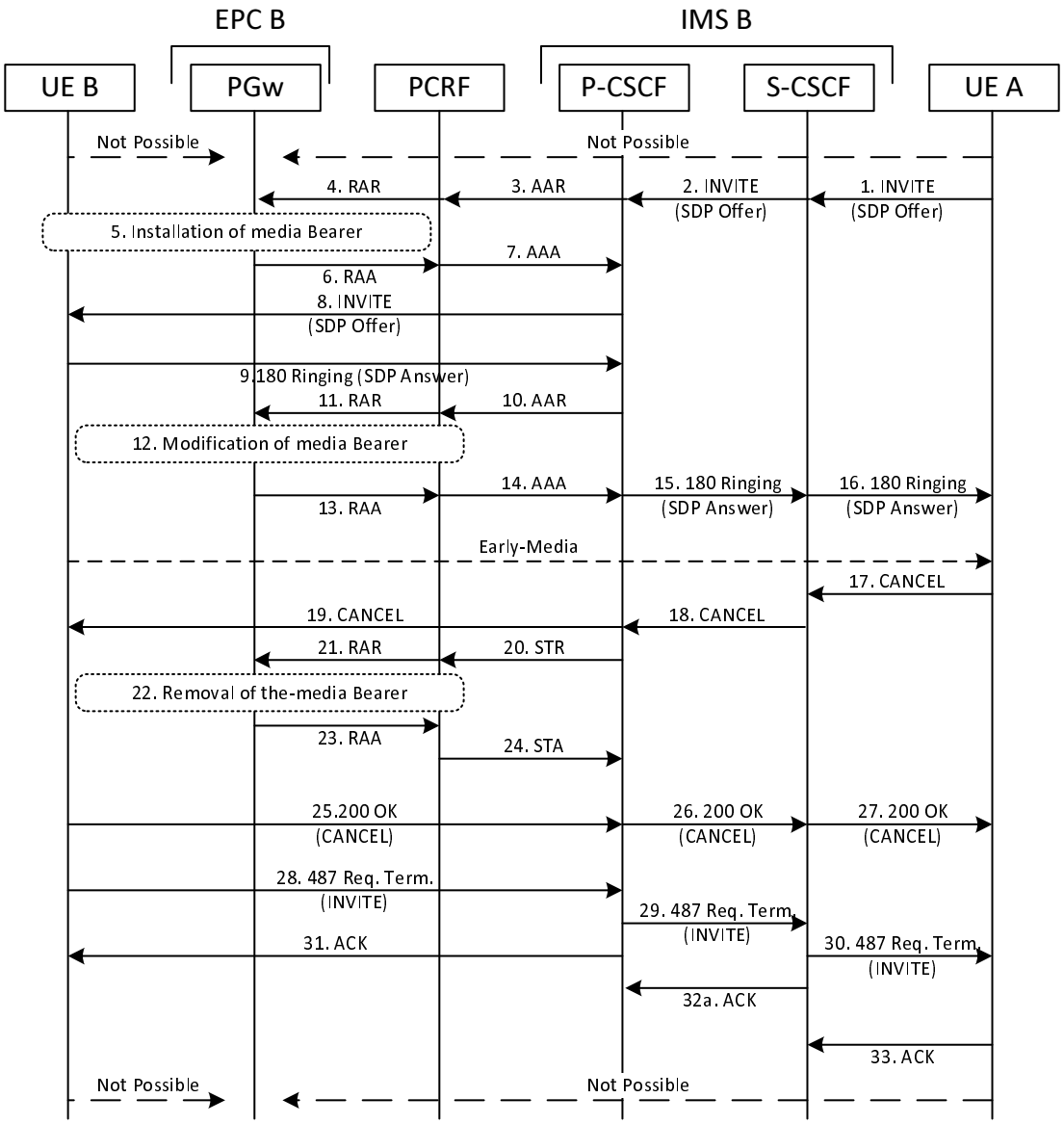


Figure 16: SIP Session Abort - Terminating Leg

Step	Direction						Message	Comment
	UEA		EPC	PCRF	IMS	UEB		
1		→	→	→			SIP INVITE (SDP)	UEA initiates the SIP session with an NVITE containing the SDP offer.
2				→			DIAMETER AAR	The IMS P-CSCF invokes the PCRF.
3			←	←			DIAMETER RAR	PCRF sends RAR to EPC P-GW.
4			→				DIAMETER RAA	EPC P-GW responds.
5				→			DIAMETER AAA	PCRF responds to IMS P-CSCF.
6					→		SIP INVITE (SDP)	IMS forwards the INVITE to UEB.
7					←		SIP 180 OK (SDP)	UE-B responds with a 180(ringing) response with SDP and notification of early media.
8				←			DIAMETER AAR	The IMS P-CSCF invokes the PCRF to modify the media bearer.
9			←				DIAMETER RAR	PCRF sends RAR to EPC P-GW.
10			→				DIAMETER RAA	EPC P-GW responds.
11				→			DIAMETER AAA	PCRF responds to IMS P-CSCF.
12		←					SIP 180 (SDP)	The 180 is passed onto UE-A.
13								Early media is flowing from UE-B to UE-A.
14		→	→	→			SIP CANCEL	UEA aborts the session.
15					→		SIP CANCEL	IMS forwards the CANCEL to UEB.
16				←			DIAMETER STR	The IMS P-CSCF invokes the PCRF to release the media bearer.
17			←				DIAMETER RAR	PCRF sends RAR to EPC P-GW.
18			→				DIAMETER RAA	EPC P-GW responds.
19				→			DIAMETER STA	PCRF responds to IMS P-CSCF.
20					←		SIP 200 OK (CANCEL)	UE-B responds 200 OK.
21		←	←	←			SIP 200 OK (CANCEL)	P-CSCF forwards the SIP 200 OK (CANCEL) to UEA.
22					←		SIP 487 (INV)	UE-B responds 487 (Request Terminated).
23		←	←	←			SIP 487 (INV)	P-CSCF forwards the SIP 487 to UEA.
24				→			SIP ACK	The UEA sends ACK to 487(INVITE).
25					→		SIP ACK	The ACK is sent to UEB.
26								The dedicated bearer(s) is/are released. No media flow is possible.

7.2.4.3 SIP Session Reject - Originating Leg

Interoperability Test Description	
Identifier:	**TD_IMSEPC_Session_Reject _Originating**
Purpose:	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.
Config.:	CF_IMSEPC
SUT:	IMS, PCRF and EPC
Ref.:	TS 124 229 [2], clause 5.2.7.2 (Initial INVITE/Originating Case). TS 129 214 [5], clause 4.4.4 (AF Session Termination). TS 129 212 [6], clause 4.5.2 (Provision of PCC rules).
Pre-test conditions:	• UE_A & UE_B previously attached to EPC. • 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. • EPC 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 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 terminates the Rx session, triggering the removal of all early media related bearers.
	6	Verify that EPC removes all early media related bearers.
	7	Verify that media between UE_B and UE_A cannot be exchanged and is filtered out by EPC.
Conformance Criteria:	**Check**	
	1-6	As checks 1-6 of clause 7.2.1.1 (SIP Session Establishment, originating leg)

	7	TP_EPC_7002_21
		ensure that {
		when { IMS_P-CSCF receives 486_response on INVITE from IMS-S-SCF
		}
		then { IMS_P-CSCF sends Session-Termination-Request to PCRF
		containing Session-Id_AVP
		indicating session for SIP_session
		}
		}

	8	TP_EPC_7002_17
		ensure that {
		when { PCRF receives ST-Request from IMS_P-CSCF }
		then {PCRF invokes the EPC P-GW with a RAR }
		containing a Charging-Rule-Remove AVP
		containing a Charging-Rule-Name AVP
		}

	9	TP_EPC_7002_18
		ensure that {
		when { P-GW receives RA-Request from PCRF }
		then { P-GW sends RA-Answer to PCRF
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001)
		}
		}

	10	TP_EPC_7002_19
		ensure that {
		when { PCRF receives RA-Request from PC P-GW }
		then { PCRF sends Session-Termination-Answer to IMS_P-CSCF
		containing Session-Id_AVP
		indicating session for IMS_signalling session
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001)
		}
		}

	11	TP_EPC_6003_02
		ensure that {
		when { UE_A sends media to UE_B }
		then { EPC filters the IP_packets }
		then { the IP_packets not visible on PO_SGi }
		when { UE_B sends media to UE_A }
		then { EPC filters the IP_packets }
		then { the IP_packets not visible on PO_SGi }
		}

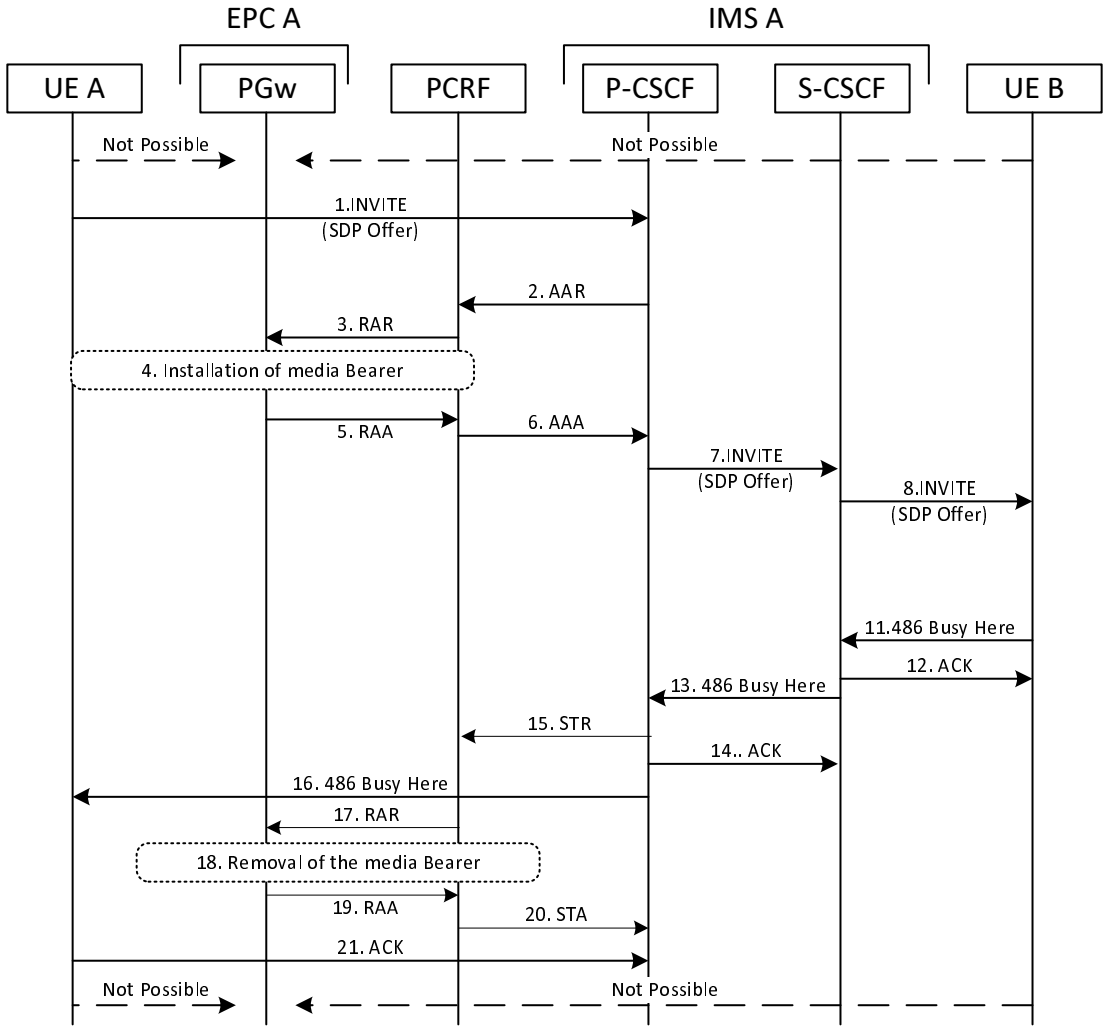


Figure 17: SIP Session Reject - Originating Leg

Step	Direction						Message	Comment
	UEA	EPC	PCRF	IMS	UEB			
1		→	→	→			SIP INVITE (SDP)	UEA initiates the SIP session with an NVITE containing the SDP offer.
2				←			DIAMETER AAR	The IMS P-CSCF invokes the PCRF.
3			←	←			DIAMETER RAR	PCRF sends RAR to EPC P-GW.
4			→				DIAMETER RAA	EPC P-GW responds.
5				→			DIAMETER AAA	PCRF responds to IMS P-CSCF.
6					→		SIP INVITE (SDP)	IMS forwards the INVITE to UEB.
7					←		SIP 486 (Busy)	UE-B responds with a 486 (busy) response.
16				←	←		DIAMETER STR	The IMS P-CSCF invokes the PCRF to release the media bearer.
17			←				DIAMETER RAR	PCRF sends RAR to EPC P-GW.
18			→				DIAMETER RAA	EPC P-GW responds.
19				→			DIAMETER STA	PCRF responds to IMS P-CSCF.
21		←					SIP 486 (Busy)	P-CSCF forwards the 486 (busy) response to UEA.
24				→			SIP ACK	The UEA sends ACK to 200 OK (INVITE).
25					→		SIP ACK	The ACK is sent to UEB.
26								The dedicated bearer(s) is/are released. No media flow is possible.

7.2.4.4 SIP Session Reject - Terminating Leg

Interoperability Test Description		
Identifier:	**TD_IMSEPC_Session_Reject _Terminating**	
Purpose:	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.	
Config.:	CF_IMSEPC	
SUT:	IMS, PCRF and EPC	
Ref.:	TS 124 229 [2], clause 5.2.7.3 (Initial INVITE/Terminating Case) TS 129 214 [5], clause 4.4.4 (AF Session Termination) TS 129 212 [6], clause 4.5.2 (Provision of PCC rules)	
Pre-test conditions:	• UE_B previously attached to EPC • EPC established a Default Bearer allowing UE_B - P-CSCF IP communication • UE_B previously registered to IMS • EPC established an IMS signalling bearer	
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 removes all early media related bearers.
	6	Verify that the media between UE_B and UE_A can no longer be exchanged and is filtered out by EPC.
Conformance Criteria:	**Check**	
	1-6	As checks 1-6 of clause 7.2.1.2 (SIP Session Establishment, terminating leg)

	7	TP_EPC_6034_04
		ensure that {
		when { IMS_P-CSCF receives 486_response on INVITE from UE_B }
		then { IMS_P-CSCF sends Session-Termination-Request to PCRF
		containing Session-Id_AVP
		indicating session for SIP_session
		}
		}

	8	TP_EPC_7002_17
		ensure that {
		when { PCRF receives ST-Request from IMS_P-CSCF }
		then {PCRF invokes the EPC P-GW with a RAR }
		containing a Charging-Rule-Remove AVP
		containing a Charging-Rule-Name AVP
		}

	9	TP_EPC_7002_18
		ensure that {
		when { P-GW receives RA-Request from PCRF }
		then { P-GW sends RA-Answer to PCRF
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001)
		}
		}

	10	TP_EPC_7002_19
		ensure that {
		when { PCRF receives RA-Answer from EPC P-GW }
		then { PCRF sends Session-Termination-Answer to IMS_P-CSCF
		containing Session-Id_AVP
		indicating session for IMS_signalling session
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001)
		}
		}

Interoperability Test Description		

	11	TP_EPC_6003_02
		ensure that {
		when { UE_A sends media to UE_B }
		then { EPC filters the IP_packets }
		then { the IP_packets not visible on PO_SGi }
		when { UE_B sends media to UE_A }
		then { EPC filters the IP_packets }
		then { the IP_packets not visible on PO_SGi }
		}

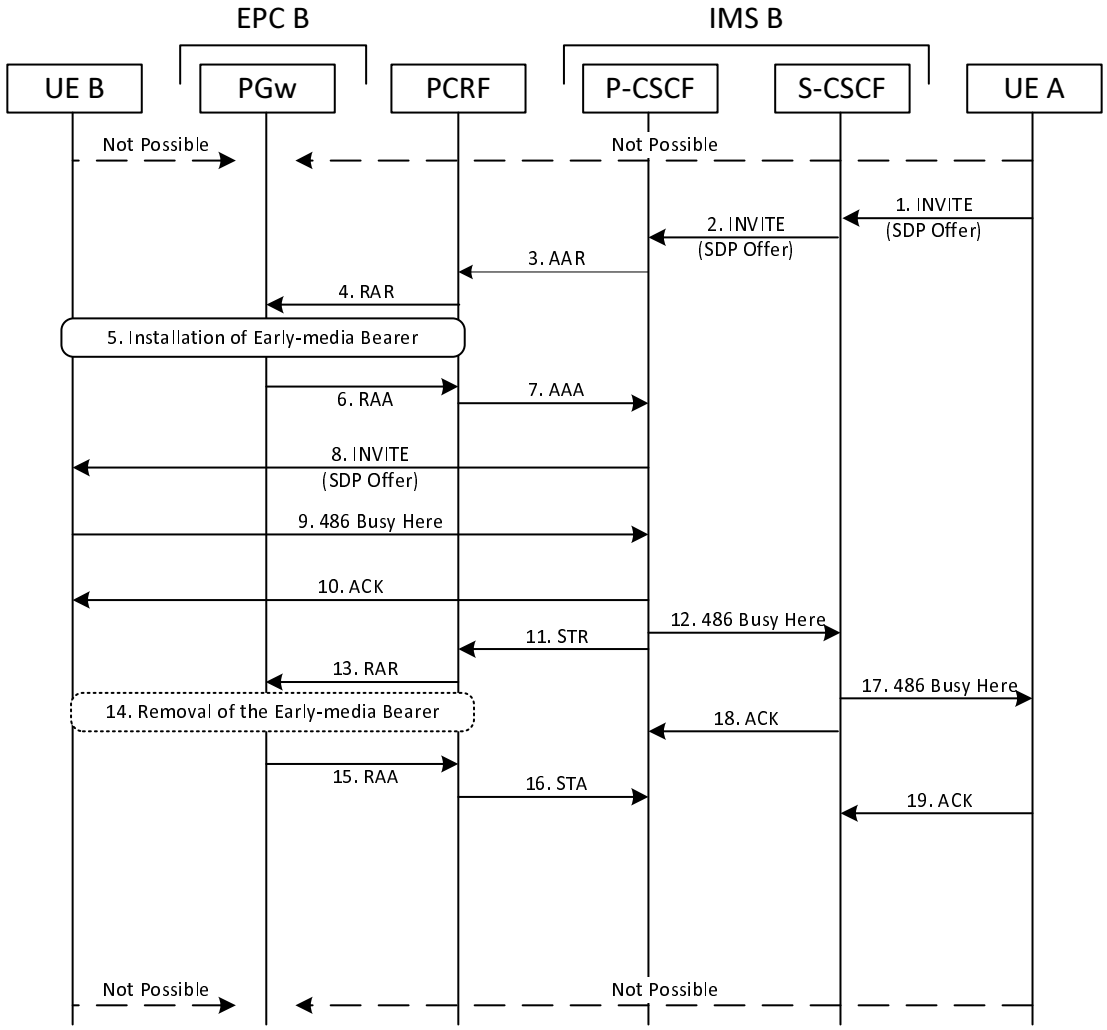


Figure 18: SIP Session Reject - Terminating Leg

Step	Direction						Message	Comment
	UEA		EPC	PCRF	IMS	UEB		
1		→					SIP INVITE (SDP)	UEA initiates the SIP session with an NVITE containing the SDP offer.
2							DIAMETER AAR	The IMS P-CSCF invokes the PCRF.
3			←	←			DIAMETER RAR	PCRF sends RAR to EPC P-GW.
4			→				DIAMETER RAA	EPC P-GW responds.
5				→			DIAMETER AAA	PCRF responds to IMS P-CSCF.
6					→		SIP INVITE (SDP)	IMS forwards the INVITE to UEB.
7							SIP 486 (Busy)	UE-B responds with a 486 (Busy) response
8				←	←		DIAMETER STR	The IMS P-CSCF invokes the PCRF to release the media bearer.
9			←				DIAMETER RAR	PCRF sends RAR to EPC P-GW.
10			→				DIAMETER RAA	EPC P-GW responds.
11				→			DIAMETER STA	PCRF responds to IMS P-CSCF.
12		←					SIP 486 (Busy)	The 486 (Busy) is passed onto UE-A via S-CSCF.
13							SIP ACK	The UEA sends ACK to 486 (Busy).
14					→		SIP ACK	The ACK is sent to UEB.
15								The dedicated bearer(s) is/are released. No media flow is possible.

7.3 IMS De-Registration

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.

7.3.1 IMS De-registration (no SIP session active)

Interoperability Test Description	
Identifier:	**TD_IMSEPC_DeRegistration_UE**
Purpose:	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.
Config.:	CF_IMSEPC
SUT:	IMS, PCRF and EPC
Ref.:	TS 124 229 [2], clause 5.4.1.4.1 (User-initiated de-registration/Normal cases). TS 129 214 [5], clause 4.4.5a (Provisioning of AF Signalling Flow Information). TS 129 214 [5], clause 4.4.4 (AF Session Termination). TS 129 214 [5], clause A.8 (Provision of Signalling Flow Information at P-CSCF). TS 129 212 [6], clause 4.5.2 (Provision of PCC rules).

Interoperability Test Description		
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:	**Check**	

	1	TP_EPC_7003_01
		ensure that {
		when { UE_A sends REGISTER for de-registration to IMS_P-CSCF }
		then { IMS_P-CSCF sends REGISTER to IMS_S-CSCF
		}
		}

	2	TP_EPC_6012_02
		ensure that {
		when { IMS_P-CSCF receives 2xx_Response on REGISTER from IMS_S-CSCF }
		then { IMS_P-CSCF sends 2xx_Response to UE_A }
		then { IMS_P-CSCF sends Session-Termination-Request to PCRF
		containing Session-Id_AVP
		indicating session for IMS_signalling session
		}
		}

	3	TP_EPC_7003_02
		ensure that {
		when { PCRF receives Session-Termination-Request from IMS_P-CSCF
		containing Session-Id_AVP
		indicating session for IMS_signalling session
		}
		then { PCRF sends Session-Termination-Answer to IMS_P-CSCF
		containing Session-Id_AVP
		indicating IMS_signalling value_received in Session-Termination-Request
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001)
		}
		
		}

	4	TP_EPC_7002_18 ensure that { PCRF sends RA-Request to EPC P-GW containing a Charging-Rule-Remove AVP containing a Charging-Rule-Name AVP }

	5	TP_EPC_7002_19
		ensure that {
		when { P-GW receives RA-Request from PCRF }
		then { P-GW sends RA-Answer to PCRF
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001)
		}
		}

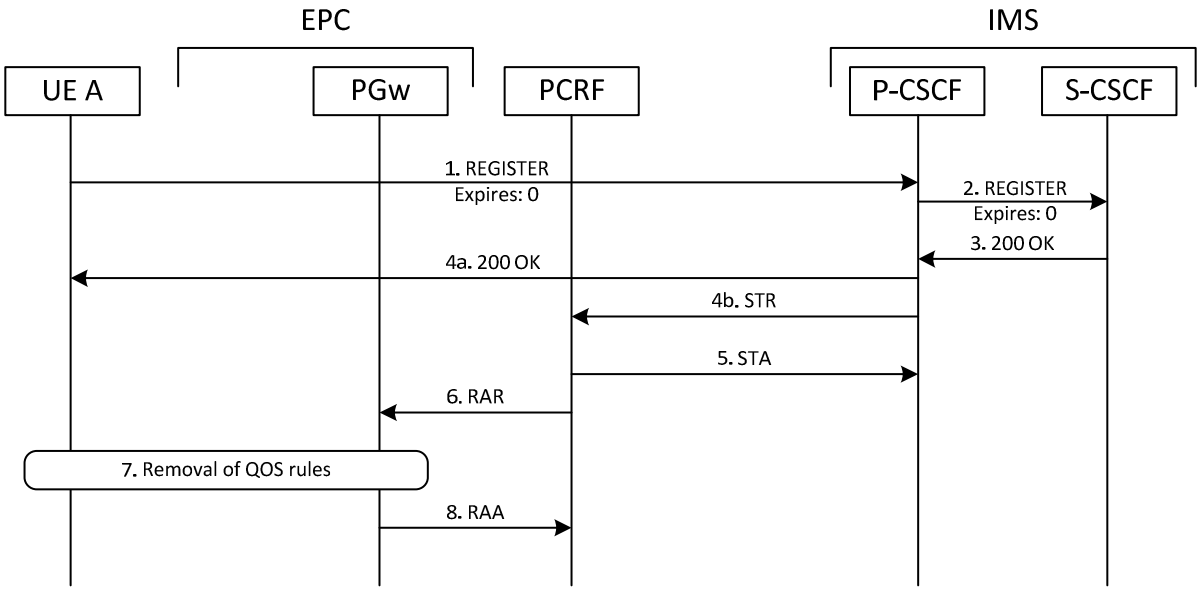


Figure 19: IMS De-registration

Step	Direction						Message	Comment
	USER	UEA	EPC	PCRF	IMS			
1		→						User initiates IMS De-Registration.
2					→		SIP REGISTER	The UE-A requests IMS De-Registration
3			←				SIP 200 OK Response	IMS de-registers the user and responds OK.
4		←						User is informed that the IMS registration is successful.
5				←			DIAMETER STR	The P-CSCF initiates removal of the session binding to the default bearer.
6				→			DIAMETER STA	The PCRF responds to the P-CSCF.
7			←				DIAMETER RAR	The PCRF removes the QOS rules at the P-GW to modify the default bearer.
8				→			DIAMETER RAA	The P-GW in the EPC responds to the PCRF.
9								The default bearer has been successfully modified.

7.3.2 IMS Administrative De-Registration (no SIP session active)

Interoperability Test Description	
Identifier:	**TD_IMSEPC_DeRegistration_Administrative**
Purpose:	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.
Config.:	CF_IMSEPC
SUT:	IMS, PCRF and EPC
Ref.:	TS 124 229 [2], clause 5.4.1.5 (Network-initiated de-registration). TS 129 214 [5], clause 4.4.5a (Provisioning of AF Signalling Flow Information). TS 129 214 [5], clause 4.4.4 (AF Session Termination). TS 129 214 [5], clause A.8 (Provision of Signalling Flow Information at P-CSCF). TS 129 212 [6], clause 4.5.2 (Provision of PCC rules).
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.

Interoperability Test Description		
	• 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:	**Check**	

	1	TP_EPC_6024_01
		ensure that {
		when { IMS_S-CSCF triggers_administrative_de-registration for UE_A }
		then { IMS_S-CSCF sends NOTIFY to IMS_P-CSCF
		containing Request_URI
		indicating IMS_P-CSCF contact_address for SUBSCRIBE dialog and
		containing Event_header
		indicating the reg_event_package and
		containing Message_Body
		indicating de-registration of all UE_A registered_public_identities
		}
		}

	2	TP_EPC_6025_01
		ensure that {
		when { IMS_P-CSCF receives NOTIFY for UE_A de-registration from IMS_S-CSCF }
		then { IMS_P-CSCF sends Session-Termination-Request to PCRF
		containing Session-Id_AVP
		indicating session for IMS_signalling session
		}
		}

	3	TP_EPC_7003_02
		ensure that {
		when { PCRF receives Session-Termination-Request from IMS_P-CSCF
		containing Session-Id_AVP
		indicating session for IMS_signalling session
		}
		then { PCRF sends Session-Termination-Answer to IMS_P-CSCF
		containing Session-Id_AVP
		indicating IMS_signalling value_received in Session-Termination-Request
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001)
		}
		}

	3	TP_EPC_7002_18 ensure that { EPC_PCRF sends RA-Request to EPC P-GW containing a Charging-Rule-Remove AVP containing a Charging-Rule-Name AVP }

	4	TP_EPC_7002_19
		ensure that {
		when { P-GW receives RA-Request from PCRF }
		then { P-GW sends RA-Answer to PCRF
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001)
		}
		}

	5	TP_EPC_6018_01
		ensure that {
		when { UE_A sends REGISTER to IMS_P-CSCF }
		then { IMS_P-CSCF receives REGISTER
		delivered over default bearer
		containing no Contact_header
		}
		then { IMS_P-CSCF sends Response to UE_A }
		}

Interoperability Test Description		

	6	TP_EPC_6019_01
		ensure that {
		when { IMS_P-CSCF sends Response on REGISTER to UE_A }
		then { UE_A receives Response on REGISTER from IMS_P-CSCF
		delivered over default bearer
		}
		}

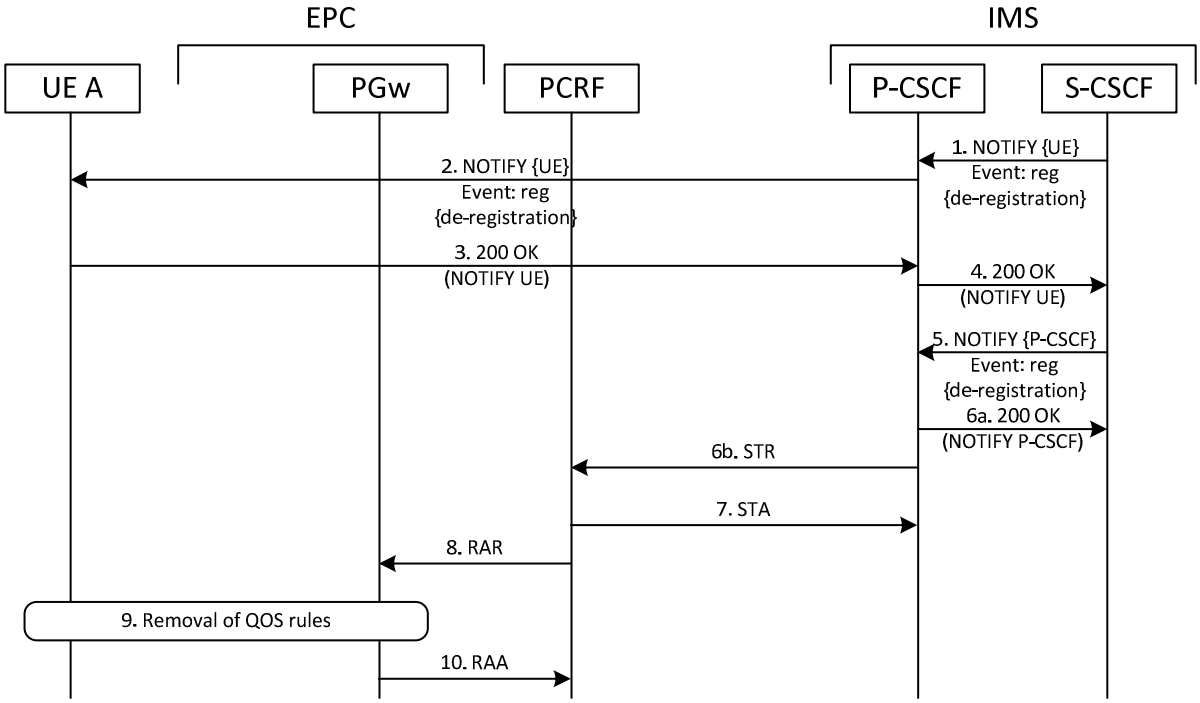


Figure 20: IMS Administrative De-Registration

Step	Direction						Message	Comment
	USER	UEA	EPC	PCRF	IMS			
1								IMS initiates admin. De-Registration
2			←				SIP NOTIFY	IMS informs the UE of the de-registration via a SIP Notify (UE previously subscribed to the reg-event package).
3							SIP 200 OK	UE responds OK.
4		←						User is informed that the UE is de-registered.
5					←		DIAMETER STR	The P-CSCF initiates removal of the session binding to the default bearer.
6					→		DIAMETER STA	The PCRF responds to the P-CSCF
7				←			DIAMETER RAR	The PCRF removes the QOS rules at the P-GW to modify the default bearer.
8				→			DIAMETER RAA	The P-GW in the EPC responds to the PCRF.
9								The default bearer has been successfully modified

7.3.3 IMS Registration Expiration (no SIP session active)

Interoperability Test Description		
Identifier:	**TD_IMSEPC_DeRegistration_Expiration**	
Purpose:	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.	
Config.:	CF_IMSEPC	
SUT:	IMS, PCRF and EPC	
Ref.:	TS 129 214 [5], clause 4.4.5a (Provisioning of AF Signalling Flow Information). TS 129 214 [5], clause 4.4.4 (AF Session Termination). TS 129 214 [5], clause A.8 (Provision of Signalling Flow Information at P-CSCF). TS 129 212 [6], clause 4.5.2 (Provision of PCC rules).	
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:	**Check**	

	1	TP_EPC_6026_01
		ensure that {
		when { IMS_P-CSCF triggers_registration_expiration for UE_A }
		then { IMS_P-CSCF sends Session-Termination-Request to PCRF
		containing Session-Id_AVP
		indicating session for IMS_signalling session
		}
		}

	2	TP_EPC_7003_02
		ensure that {
		when { PCRF receives Session-Termination-Request from IMS_P-CSCF
		containing Session-Id_AVP
		indicating session for IMS_signalling session
		}
		then { EPC_PCRF sends Session-Termination-Answer to IMS_P-CSCF
		containing Session-Id_AVP
		indicating IMS_signalling value_received in Session-Termination-Request
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001)
		}
		}

	3	TP_EPC_7002_18 ensure that { PCRF sends RA-Request to EPC P-GW containing a Charging-Rule-Remove AVP containing a Charging-Rule-Name AVP }

	4	TP_EPC_7002_19
		ensure that {
		when { P-GW receives RA-Request from PCRF }
		then { P-GW sends RA-Answer to PCRF
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001)
		}
		}

	5	TP_EPC_6018_01 ensure that { when { UE_A sends REGISTER to IMS_P-CSCF } then { IMS_P-CSCF receives REGISTER delivered over default bearer containing no Contact_header

Interoperability Test Description		
		} then { IMS_P-CSCF sends Response to UE_A } }

	6	TP_EPC_6019_01
		ensure that {
		when { IMS_P-CSCF sends Response on REGISTER to UE_A }
		then { UE_A receives Response on REGISTER from IMS_P-CSCF
		delivered over default bearer
		}
		}

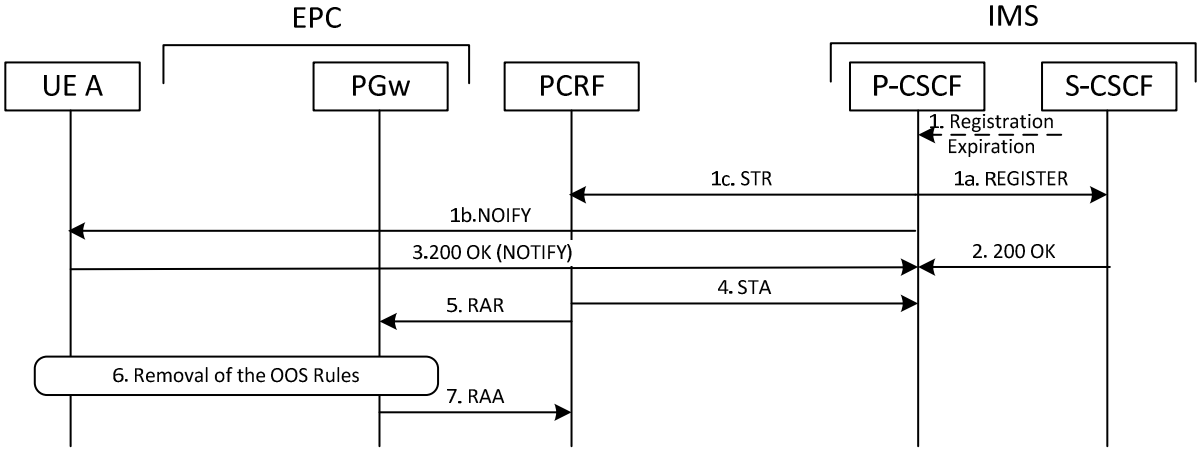


Figure 21: IMS Registration Expiration

Step	Direction						Message	Comment
	USER	UEA	EPC	PCRF	IMS			
1								IMS initiates De-Registration due to timer expiry.
2			←				SIP NOTIFY	IMS informs the UE of the de-registration via a SIP Notify (UE previously subscribed to the reg-event package).
3					→		SIP 200 OK	UE responds OK.
4		←						User is informed that the UE is de-registered.
5				←			DIAMETER STR	The P-CSCF initiates removal of the session binding to the default bearer.
6					→		DIAMETER STA	The PCRF responds to the P-CSCF.
7				←			DIAMETER RAR	The PCRF removes the QOS rules at the P-GW to modify the default bearer.
8				→			DIAMETER RAA	The P-GW in the EPC responds to the PCRF.
9								The default bearer has been successfully modified.

7.3.4 IMS De-registration with Active SIP Sessions

Interoperability Test Description	
Identifier:	**TD_IMSEPC_DeRegistration_UE_Active_Session**
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 exchange any longer 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.
Config.:	CF_IMSEPC
SUT:	IMS, PCRF and EPC

Interoperability Test Description		
Ref.:	TS 124 229 [2], clause 5.4.1.4.1 (User-initiated de-registration). TS 124 229 [2], clause 5.4.5.1 (S-CSCF-initiated call release). TS 129 214 [5], clause 4.4.5a (Provisioning of AF Signalling Flow Information). TS 129 214 [5], clause 4.4.4 (AF Session Termination). TS 129 214 [5], clause A.8 (Provision of Signalling Flow Information at P-CSCF). TS 129 212 [6], clause 4.5.2 (Provision of PCC rules).	
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.
Conformance Criteria:	**Check**	

	1	`TP_EPC_6020_01`
		`ensure that {`
		`  when { UE_A sends media to UE_B }`
		`  then { UE_B receives the media`
		`  delivered over SIP_Session media bearer`
		`  }`
		`  when { UE_B sends media to UE_A }`
		`  then { UE_A receives the media`
		`  delivered over SIP_Session media bearer`
		`  }`
		`}`

	2	`TP_EPC_6021_01`
		`ensure that {`
		`  when { UE_A sends REGISTER for de-registration to IMS_P-CSCF }`
		`  then { IMS_S-CSCF sends BYE to IMS_P-CSCF`
		`  containing Request_URI`
		`  including contact_address from Contact_header of UE_B and`
		`  containing To_header`
		`  including From_header or To_header from initial INVITE and`
		`  containing From_header`
		`  including From_header or To_header from initial INVITE and`
		`  containing Call-ID_header`
		`  indicating the initial INVITE_Call_Id_value and`
		`  containing CSeq_header`
		`  including an incremented Sequence_Number and`
		`  containing Route_header`
		`  including specific_routing_information`
		`  containing Reason_header`
		`  }`
		`}`

	3-7	`As checks 2-6 in clause 7.2.3.2 (N/W initiated Session Release)`
	8-11	`As checks 2-5 of clause 7.3.1 (IMS de-registration)`

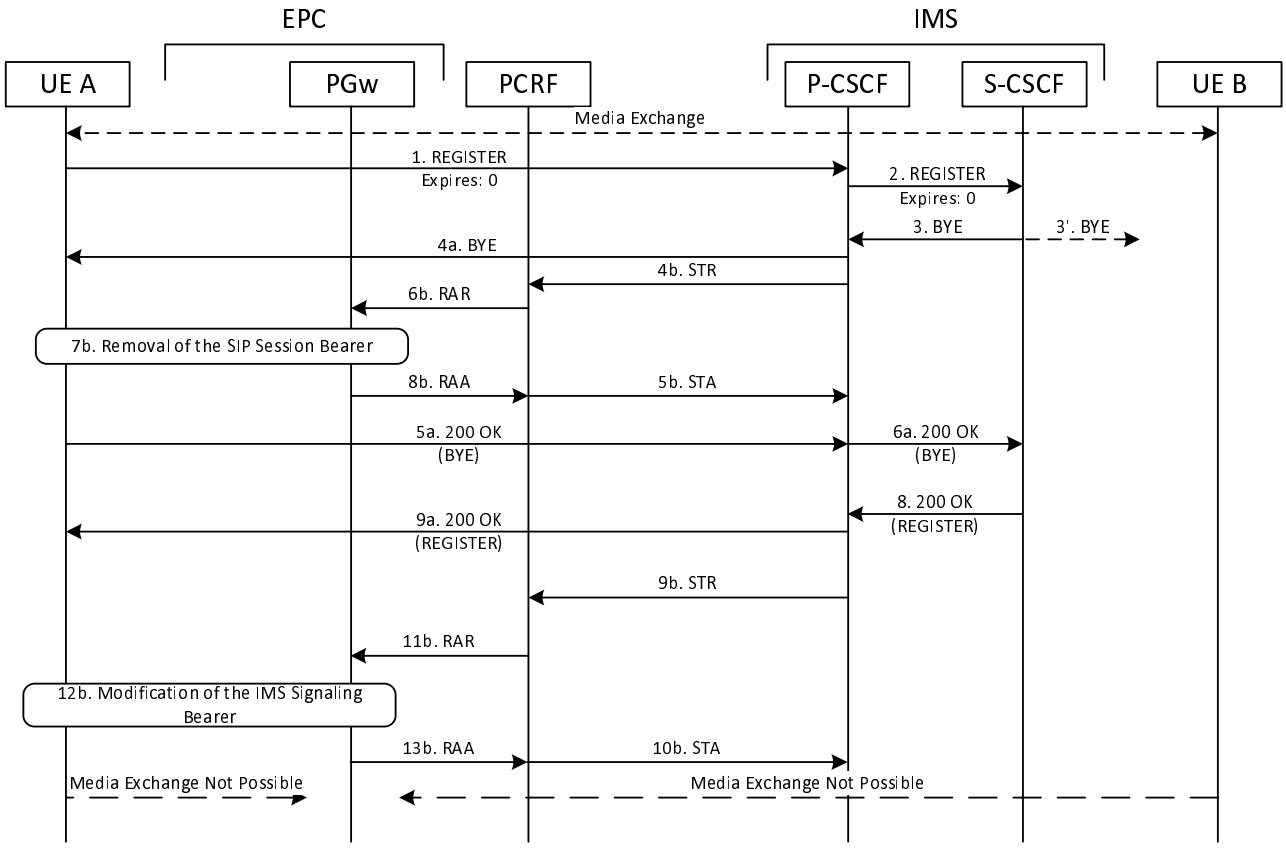


Figure 22: IMS UE De-registration with Active Session

Note that the Rx exchange need not wait for the Gx exchange to complete.

Step	Direction						Message	Comment
	USER		UEA	EPC	PCRF	IMS		
1								User initiates De-Registration.
2		→					SIP REGISTER	UE requests de-registration (exp=0).
3				→	→	→	SIP BYE	IMS releases the active SIP session.
3				←	←	←	SIP 200 OK	UE responds OK (to the BYE).
4								User is informed that the session is released.
5					←		DIAMETER STR	The P-CSCF initiates removal of the session bearer.
6					→		DIAMETER STA	The PCRF responds to the P-CSCF.
7				←			DIAMETER RAR	The PCRF releases the session bearer.
8				→			DIAMETER RAA	The P-GW in the EPC responds to the PCRF.
9								The session bearer has been released.
10					←		DIAMETER STR	The P-CSCF initiates removal of the session binding to the default bearer.
11					→		DIAMETER STA	The PCRF responds to the P-CSCF.
12				←			DIAMETER RAR	The PCRF removes the QOS rules at the P-GW to modify the default bearer.
13				→			DIAMETER RAA	The P-GW in the EPC responds to the PCRF.
14								The default bearer has been successfully modified.
15							SIP 200 OK	IMS responds OK (to REGISTER).
16		←	←					User is informed that the de-registration is complete.

7.4 Network Detachment

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.

7.4.1 UE Initiated Network Detachment (no IMS Registration)

Interoperability Test Description		
Identifier:	**TD_IMSEPC_UE_Network_Detachment**	
Purpose:	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_IMSEPC	
SUT:	PCRF and EPC	
Ref.:	TS 129 212 [6], clause 4.5.7 (Indication of IP-CAN session termination).	
Pre-test conditions:	• UE_A previously attached to EPC with a single attachment	
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:	**Check**	

	1	TP_EPC_7004_01
		ensure that {
		when { UE_A starts_complete_network_detachment from EPC }
		then { EPC removes_relevant_bearers } and
		
		when { P-GW is invoked with a delete session request}
		then { a DIAMETER CC-Request message is generated
		(
		containing CC_Request_Type AVP set to
		"TERMINATION_REQUEST"
		)
		}
		}

	2	TP_EPC_7004_02
		ensure that {
		when {PCRF receives the CC-Request message}
		then {a DIAMETER CC-Answer message is sent to P-GW
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001)
		}
		}
		}

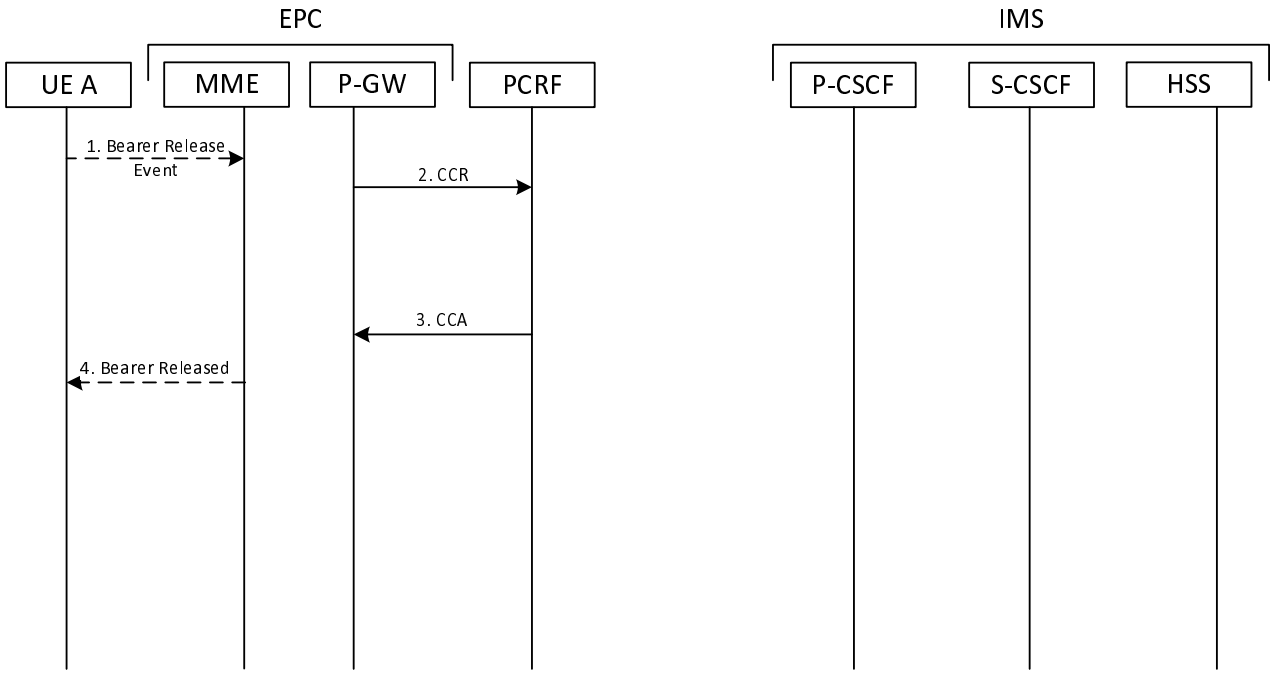


Figure 23: UE Initiated Network Detachment (not IMS Registered)

Step	Direction					Message	Comment
	USER	UEA	EPC	PCRF	IMS		
1		→					User initiates detachment on UE-A.
2			→				The UE-A requests IP-CAN session dis-establishment to the EPC (MME).
3				→		DIAMETER CCR	The P-GW sends a CCR message to the PCRF to inform the PCRF that the default bearer is being released.
4				←		DIAMETER CCA	The PCRF responds with a CCA.
5			←				The MME responds to the UE, confirming that the IP-CAN has been successfully released.
6		←					User is informed that the default bearer has been successfully released.

7.4.2 UE Initiated Network Detachment with Previously Established IMS Registration

Interoperability Test Description	
Identifier:	**TD_IMSEPC_UE_Network_Detachment_IMS_Registered**
Purpose:	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_IMSEPC
SUT:	IMS, PCRF and EPC
Ref.:	TS 129 214 [5], clause 4.4.6.1 (IP-CAN Session Termination). TS 129 212 [6], clause 4.5.7 (Indication of IP-CAN session termination).
Pre-test conditions:	• UE_A previously attached to EPC with a single attachment. • UE_A previously registered to IMS.

Interoperability Test Description		
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.
	3	Verify that PCRF informs IMS P-CSCF of the loss of the bearer.
	4	Verify that IMS performs P-CSCF-initiated administrative de-registration on.
	5	Verify that IMS P-CSCF terminates the Rx session with PCRF.
Conformance Criteria:	**Check**	

	1	TP_EPC_7004_01
		ensure that {
		when { UE_A starts_complete_network_detachment from EPC }
		then { EPC removes_relevant_bearers } and
		
		when { P-GW is invoked with a delete session request}
		then { a DIAMETER CC-Request message is generated
		(
		containing CC_Request_Type AVP set to
		"TERMINATION_REQUEST"
		)
		}
		}

	2	TP_EPC_7004_02
		ensure that {
		when {PCRF receives the CC-Request message}
		then {a DIAMETER CC-Answer message is sent to P-GW
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001)
		}
		}
		}

	3	TP_EPC_6005_01
		ensure that {
		when { PCRF triggers_termination of SIP_signalling session }
		then { PCRF sends Abort-Session-Request to IMS_P-CSCF
		containing Session-Id_AVP
		indicating session of SIP_session
		containing Abort-Cause_AVP
		indicating BEARER_RELEASED (0)
		}
		}

	4	TP_EPC_7004_03
		ensure that {
		when { IMS_P-CSCF receives Abort-Session-Request for SIP_session
		}
		then { IMS_P-CSCF sends Abort-Session-Answer to PCRF (
		containing Session-Id_AVP
		indicating value_received in Abort-Session-Request
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001)
		) and
		IMS_P-CSCF sends Session-Termination-Request to PCRF (
		containing Session-Id_AVP
		indicating value_received in Abort-Session-Request
		) and
		IMS_P-CSCF triggers_IMS_de-registration
		}
		}

	5	TP_EPC_6009_01
		ensure that {
		when { PCRF receives Session-Termination-Request from IMS_P-CSCF
		containing Session-Id_AVP
		indicating session for SIP_session
		}
		then { PCRF sends Session-Termination-Answer to IMS_P-CSCF
		containing Session-Id_AVP
		indicating SIP_session value_received in Session-Termination-Request
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001)}

	6	TP_EPC_6011_01 ensure that { when { IMS_P-CSCF triggers_administrative_de-registration } then { IMS_P-CSCF sends REGISTER to IMS_S-CSCF

Interoperability Test Description		
		containing Request_URI indicating stored_domain_URI for affected_IMPU of UE_A containing To_header indicating affected_IMPU --IP Multimedia Public Identity containing From_header indicating affected_IMPU containing Contact_header indicating Contact_header_value containing Authorization_header indicating an integrity-protected_parameter indicating yes containing Expires_header indicating 0 containing Reason_header indicating 503_service_unavailable } }

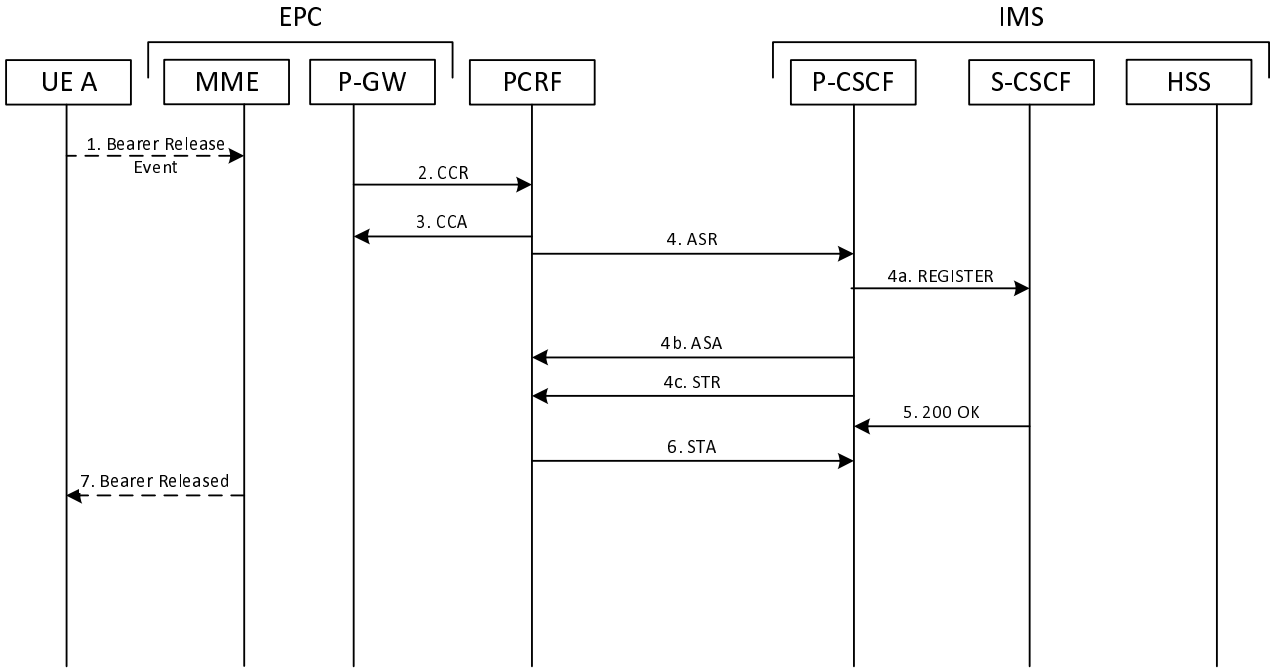


Figure 24: UE Initiated Network Detachment (IMS Registered)

Step	Direction						Message	Comment
	USER	UEA	EPC	PCRF	IMS			
1		→						User initiates detachment on UE-A.
2			→					The UE-A requests IP-CAN session dis-establishment to the EPC (MME).
3				→			DIAMETER CCR	The P-GW sends a CCR message to the PCRF to inform the PCRF that the default bearer is being released.
4				←			DIAMETER CCA	The PCRF responds with a CCA.
5					→		DIAMETER ASR	PCRF sends ASR to IMS P-CSCF.
6					←		DIAMETER ASA	IMS P-CSCF responds.
7					←		DIAMETER STR	IMS P-CSCF send s STR to abort the Rx session.
8					→		DIAMETER STA	PCRF responds.
9			←					The MME responds to the UE, confirming that the IP-CAN has been successfully released.
10		←						User is informed that the default bearer has been successfully released.

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

Interoperability Test Description		
Identifier:	**TD_IMSEPC_UE_Network_Detach_IMS_Session**	
Purpose:	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_IMSEPC	
SUT:	IMS, PCRF and EPC	
Ref.:	TS 124 229 [2], clause 5.2.8.1.2 (P-CSCF-initiated call release/Release of an existing session). TS 129 214 [5], clause 4.4.6.1 (IP-CAN Session Termination). TS 129 212 [6], clause 4.5.7 (Indication of IP-CAN session termination).	
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.
	2	Verify that EPC aborts affected Rx sessions with IMS.
	3	Verify that IMS performs P-CSCF-initiated call release on affected SIP sessions and admin IMS De-registration.
	4	Verify that media is no longer exchanged after these procedures.
	5	Verify that media between UE and other endpoint can no longer be exchanged and is filtered out by EPC.
Conformance Criteria:	**Check**	

	1	TP_EPC_7004_01
		ensure that {
		when { UE_A starts_complete_network_detachment from EPC }
		then { EPC removes_relevant_bearers } and
		
		when { P-GW is invoked with a delete session request}
		then { a DIAMETER CC-Request message is generated
		(
		containing CC_Request_Type AVP set to
		"TERMINATION_REQUEST"
		)
		}
		}

	2	TP_EPC_7004_02
		ensure that {
		when {PCRF receives the CC-Request message}
		then {a DIAMETER CC-Answer message is sent to P-GW
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001)
		}
		}
		}

	3	TP_EPC_6005_01
		ensure that {
		when { PCRF triggers_termination of SIP_session }
		then PCRF sends Abort-Session-Request to IMS_P-CSCF
		containing Session-Id_AVP
		indicating session of SIP_session
		containing Abort-Cause_AVP
		indicating BEARER_RELEASED (0)
		}
		}

	4	TP_EPC_6006_01
		ensure that {
		when { IMS_P-CSCF receives Abort-Session-Request for SIP_session
		}
		then { IMS_P-CSCF sends Abort-Session-Answer to PCRF (
		containing Session-Id_AVP
		indicating value_received in Abort-Session-Request

Interoperability Test Description		
		containing Result-Code_AVP indicating DIAMETER_SUCCESS(2001)) and IMS_P-CSCF sends Session-Termination-Request to PCRF (containing Session-Id_AVP indicating value_received in Abort-Session-Request) and IMS_P-CSCF triggers_call_release } }

	5	TP_EPC_6010_01
		ensure that {
		when { IMS_P-CSCF triggers_call_release}
		then { IMS_P-CSCF sends BYE to S-CSCF
		containing Request_URI
		indicating contact_address from Contact_header of UE_A and
		containing To_header
		indicating the initial 200_OK_From_value and
		containing From_header
		indicating the initial INVITE_To_value and
		containing Call-ID_header
		indicating the initial INVITE_Call_Id_value and
		containing CSeq_header
		including an incremented Sequence_Number and
		containing Route_header
		indicating specific_routing_information for UE_A and
		containing Reason_header
		indicating 503_service_unavailable
		}
		}

Interoperability Test Description		

	6	TP_EPC_7004_04
		ensure that {
		when { PCRF triggers_termination of SIP_signalling session }
		then { PCRF sends Abort-Session-Request to IMS_P-CSCF
		containing Session-Id_AVP
		indicating session of SIP_session
		containing Abort-Cause_AVP
		indicating BEARER_RELEASED (0)
		}
		}

	7	TP_EPC_7004_05
		ensure that {
		when { IMS_P-CSCF receives Abort-Session-Request for SIP_session
		}
		then { IMS_P-CSCF sends Abort-Session-Answer to PCRF (
		containing Session-Id_AVP
		indicating value_received in Abort-Session-Request
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001)
		) and
		IMS_P-CSCF sends Session-Termination-Request to PCRF (
		containing Session-Id_AVP
		indicating value_received in Abort-Session-Request
		) and
		IMS_P-CSCF triggers_IMS_de-registration
		}
		}

	8	TP_EPC_6009_01
		ensure that {
		when { PCRF receives Session-Termination-Request from IMS_P-CSCF
		containing Session-Id_AVP
		indicating session for SIP_session
		}
		then { PCRF sends Session-Termination-Answer to IMS_P-CSCF
		containing Session-Id_AVP
		indicating SIP_session value_received in Session-
		Termination-Request
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001)}

	9	TP_EPC_6011_01
		ensure that {
		when { IMS_P-CSCF triggers_administrative_de-registration }
		then { IMS_P-CSCF sends REGISTER to IMS_S-CSCF
		containing Request_URI
		indicating stored_domain_URI for affected_IMPU of UE_A
		containing To_header
		indicating affected_IMPU --IP Multimedia Public Identity
		containing From_header
		indicating affected_IMPU
		containing Contact_header
		indicating Contact_header_value
		containing Authorization_header
		indicating an integrity-protected_parameter
		indicating yes
		containing Expires_header
		indicating 0
		containing Reason_header
		indicating 503_service_unavailable
		}
		}

	10	TP_EPC_6003_02
		ensure that {
		when { UE_A sends packets to UE_B / P-CSCF }
		then { EPC filters the IP_packets }
		then { the IP_packets not visible on PO_SGi }
		when { UE_B sends media to UE_A }
		then { EPC filters the IP_packets }
		then { the IP_packets not visible on PO_SGi }
		}

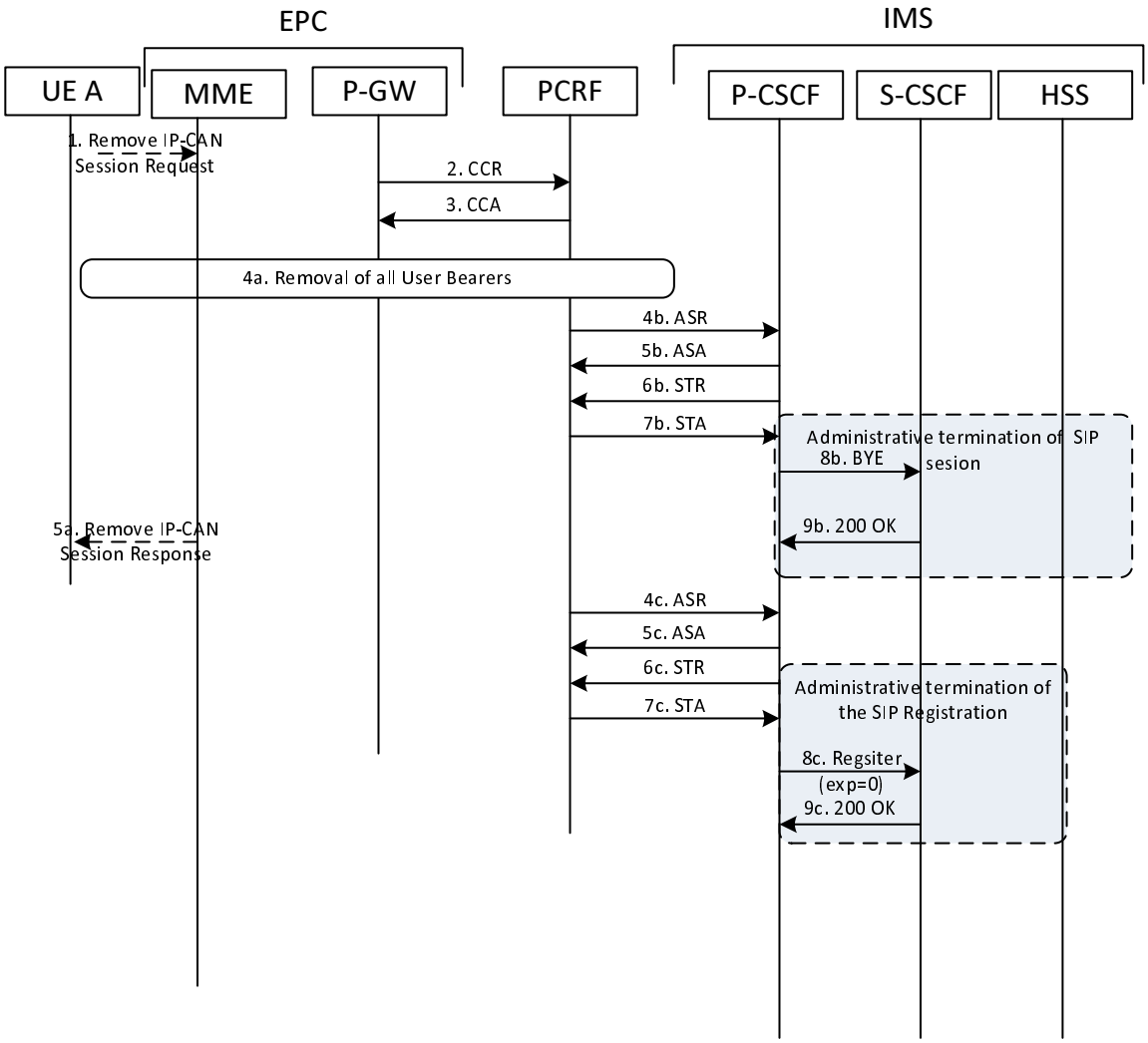


Figure 25: UE Initiated Network Detachment (IMS Registered & IMS sessions)

Step	Direction						Message	Comment
	USER		UEA	EPC	PCRF	IMS		
1		→						User initiates detachment on UE-A.
2			→					The UE-A requests IP-CAN session dis-establishment to the EPC (MME).
3				→			DIAMETER CCR	The P-GW sends a CCR message to the PCRF to inform the PCRF that the default bearer is being released.
4							DIAMETER CCA	The PCRF responds with a CCA.
5				←	→		DIAMETER ASR	PCRF sends ASR to IMS P-CSCF (for session bearer).
6					←		DIAMETER ASA	IMS P-CSCF responds.
7					←		DIAMETER STR	IMS P-CSCF send s STR to abort the Rx session (session bearer).
8					→		DIAMETER STA	EPC P-GW responds.
9					→		DIAMETER ASR	PCRF sends ASR to IMS P-CSCF (for default bearer).
10					←		DIAMETER ASA	IMS P-CSCF responds.
11					←		DIAMETER STR	IMS P-CSCF send s STR to abort the Rx session (default bearer).
12					→		DIAMETER STA	EPC P-GW responds.
13			←					The MME responds to the UE, confirming that the IP-CAN has been successfully released.
14		←						User is informed that the default bearer has been successfully released.

7.4.4 HSS Initiated Network Detachment (no IMS Registration)

Interoperability Test Description		
Identifier:	**TD_IMSEPC_HSS_Network_Detachment**	
Purpose:	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_IMSEPC	
SUT:	IMS, PCRF and EPC	
Ref.:	TS 129 212 [6], clause 4.5.7 (Indication of IP-CAN session termination). TS 129 272 [8], clause 5.2.1.2 (Cancel location procedure over S6a reference point).	
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:	**Check**	

	1	TP_EPC_7004_04
		ensure that {
		when { HSS triggers a network detachment }
		then { a DIAMETER CL-Request message is generated to EPC-MME
		(
		containing the IMSI in the User-Name AVP
		containing the Cancellation-Type AVP set to
		"Subscriptiion_Withdrawal" (2)
		containing the CLR-Flags AVP
		)
		}
		}

	2	TP_EPC_7004_05
		ensure that {
		when { EPC MME receives a DIAMETER CL-Request }
		then { release of the EPC bearer is initiated via EPC S-GW }
		and { UE is requested to detach }
		
		}

	3	TP_EPC_7004_06
		ensure that {
		when { EPC MME initiates release of the EPC bearer }
		then { EPC removes_relevant_bearers } and
		
		when { P-GW is invoked with a delete session request}
		then { a DIAMETER CC-Request message is generated
		(
		containing CC_Request_Type AVP set to
		"TERMINATION_REQUEST"
		) }
		}

	4	TP_EPC_7004_02
		ensure that {
		when {PCRF receives the CC-Request message}
		then {a DIAMETER CC-Answer message is sent to P-GW
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001)
		}
		}
		}

	5	TP_EPC_7004_07
		ensure that {
		when { EPC MME is informed of EPC bearer release }
		and { UE acknowledges the detach request }
		then { a DIAMETER CL-Answer message is generated
		(
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001)
		)
		}
		}

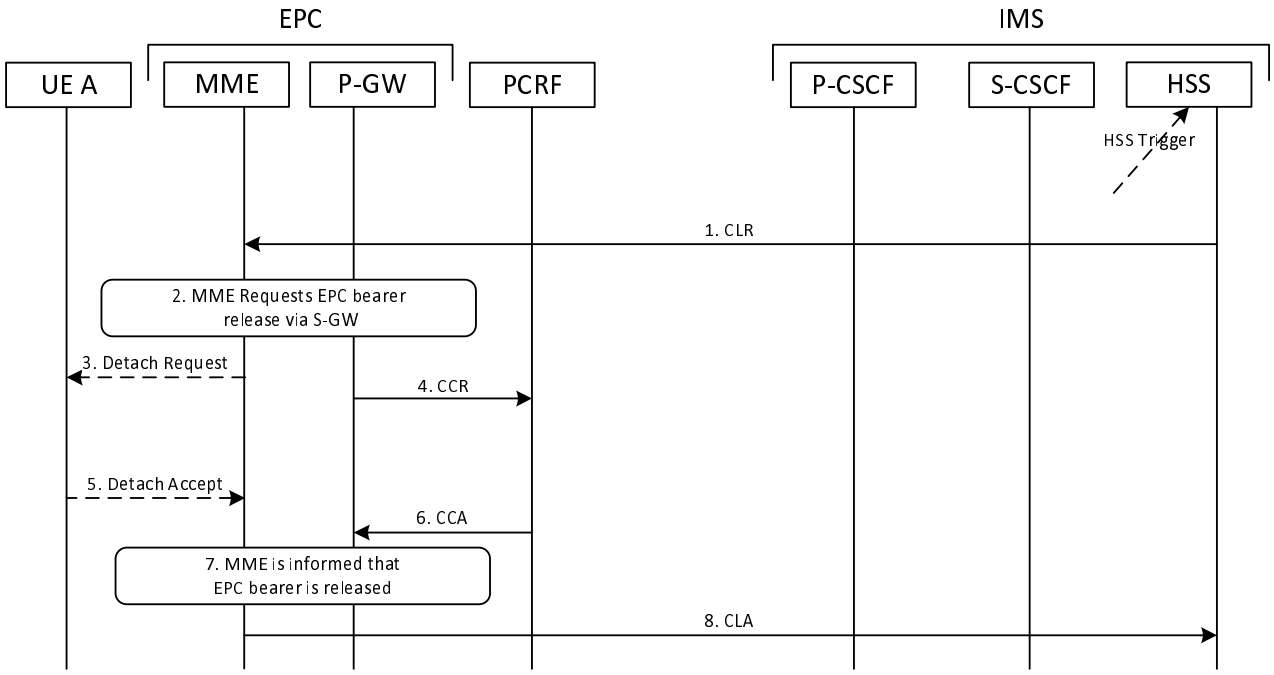


Figure 26: HSS Initiated Network Detachment (not IMS Registered)

Step	Direction					Message	Comment
	USER	UEA	EPC	PCRF	IMS		
1							HSS initiates detachment on UE-A (e.g. by withdrawing subscription from the UE).
2				←		DIAMETER CLR	HSS sends a CLR message to the EPC MME.
3			←				The UE is requested to Detach.
4							The EPC MME initiates the release of the EPC bearer via the EPC S-GW.
5				→		DIAMETER CCR	The P-GW sends a CCR message to the PCRF to inform the PCRF that the default bearer is being released.
6				←		DIAMETER CCA	The PCRF responds with a CCA.
7			→	←			The UE responds to the MME UE, confirming the Detach request.
8				→		DIAMETER CLA	The MME responds 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 24 and 25 respectively with appropriate messages being triggered at the PCRF on receipt of the DIAMETER CCR message.

7.4.5 MME Purge User Data

Interoperability Test Description	
Identifier:	**TD_IMSEPC_Purge_User_Data**
Purpose:	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_IMSEPC
SUT:	PCRF and EPC
Ref.:	TS 129 272 [8], clause 5.2.1.3 (Purge UE data over S6a reference point).

Interoperability Test Description		
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:	**Check**	

	1	TP_EPC_7004_07
		ensure that {
		when { MME triggers a purge of user data }
		then { a DIAMETER PU-Request message is generated to HSS
		(
		containing the IMSI in the User-Name AVP
		containing the PUR-Flags AVP
		)
		}
		}

	2	TP_EPC_7004_08
		ensure that {
		when {HSS receives the PU-Request message}
		then {a DIAMETER PU-Answer message is sent to P-GW
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001)
		}
		}
		}

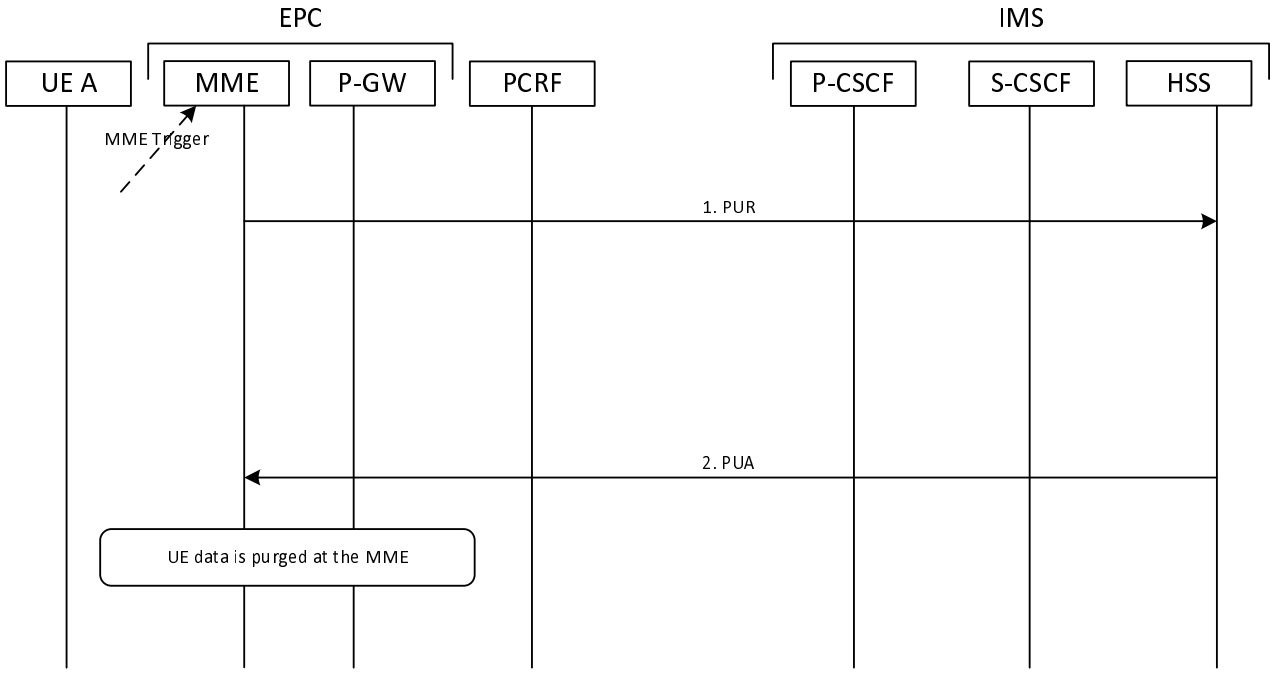


Figure 27: MME Purging of User data

Step	Direction						Message	Comment
	USER	UEA	EPC	PCRF	IMS			
1								MME triggers purging of user data.
2				→			DIAMETER PUR	MME sends a PUR message to the HSS.
3				←			DIAMETER PUA	The HSS responds to the MME.
4								The user data is deleted at the MME.

8 Test Descriptions (Roaming)

The Test Descriptions presented here mirror those from clause 7 but cover the roaming case whereby the UE attaches in a visited network. The configuration is assumed to be as shown in figure 5 (IMS_EPC_Roaming) whereby the EPC and IMS P-CSCF reside in the visited network and there is interaction via the home and visited PCRFs over the S9 reference point and between the P-CSCF and I/S-CSCF via the Mw reference point.

8.1 Network Attachment & IMS Registration - Default Bearer Operations

8.1.1 Initial Network Attachment and Establishment of the Default Bearer

Interoperability Test Description		
Identifier:	**TD_IMSEPC_Roam_Network_Attachment**	
Purpose:	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.	
Config.:	CF_IMSEPC_Roam	
SUT:	IMS, PCRF and EPC	
Ref.:	TS 124 229 [2], clause 9.2.1 (Connecting to the IP-CAN and P-CSCF discovery). TS 124 229 [2], clause L.2.2.1 (EPS bearer context activation and P-CSCF discovery). TS 129 212 [6], clause 4.5.1-1) (PCC procedures over Gx reference point/Request for PCC Rules). TS 129 212 [6], clause 4a.5.1-1) (PCC procedures over Gx reference point/Gateway control and QoS Rules Request). TS 129 272 [8], clause 5.2.1.1 (Update Location procedure over S6a reference point). TS 129 215 [9], clause 4.5.1.1 (S9 session establishment). TS 129 215 [9], clause 4.5.3.1 (Request PCC & QOS Rules).	
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
	4	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.
	5	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.

Interoperability Test Description		
Conformance Criteria:	**Check**	

	1	TP_EPC_8001_01
		Ensure that{
		when { MME is invoked with an IP_CAN session establishment request}
		then { a DIAMETER AIR message is generated
		(containing the IMSI in the User-Name AVP
		containing the Visited-PLMN-Id AVP
		containing the Requested-EUTRAN-Authentication-Info AVP
		)
		}

	2	TP_EPC_8001_02
		Ensure that{
		when { HSS is invoked with a AIR}
		then { a DIAMETER AIA message is generated (
		containing the Result-Code AVP
		indicating DIAMETER_SUCCESS(2001)
		containing the Authentication-Info AVP
		)
		}

	3	TP_EPC_8001_03
		Ensure that{
		when { MME has authenticated the user}
		then { a DIAMETER ULR message is generated
		(containing the IMSI in the User-Name AVP
		containing the ULR-Flags AVP
		containing the Visited-PLMN-Id AVP
		containing the RAT-Type AVP
		)
		}

	4	TP_EPC_7001_02
		Ensure that{
		when { HSS is invoked with a ULR}
		then { a DIAMETER ULA message is generated (
		containing the Result-Code AVP
		indicating DIAMETER_SUCCESS(2001)
		containing the Subscription-Data AVP
		if the received ULR flags do not indicate "skip subscriber data"
		)
		}

	5	As clause 7.1.1 step 3

	6	TP_EPC_8001_04
		Ensure that{
		when { Visited PCRF is invoked with a DIAMETER CCR message}
		then { a DIAMETER CCR message is generated to the home PCRF
		(containing AVPs received from P-GW in step 5
		containing Subsession-Enforcement-Info AVP made up of
		Subsession-Id AVP
		Subsession-Operation AVP set to ESTABLISHMENT (1)
		)
		}

	7	TP_EPC_8001_05 Ensure that{ when { home PCRF is invoked with a CCR from visited PCRF} then { a DIAMETER CCA message is generated to the visited PCRF (containing the Result-Code AVP indicating DIAMETER_SUCCESS(2001) containing Subsession-Decision-Info AVP containing Subsession-Id AVP containing QoS-Information AVP made up of APN-Aggregate-Max-Requested-Bandwidth-UL AVP APN-Aggregate-Max-Requested-Bandwidth-DL AVP Bearer-Identifier AVP containing Default-EPS-Bearer-QoS AVP made up of QoS-Class-Identifier AVP set to "5" Allocation-Retention-Priority AVP made up of Priority-Level AVP Pre-emption-Capablity AVP Pre-emption-Vulnerability AVP

Interoperability Test Description		
		) }
	8	TP_EPC_8001_06 Ensure that{ when { visited PCRF receives CCA from home PCRF} then { a DIAMETER CCA message is generated to the P-GW (
		containing the Result-Code AVP indicating DIAMETER_SUCCESS(2001) containing QoS-Information AVP made up of APN-Aggregate-Max-Requested-Bandwidth-UL AVP APN-Aggregate-Max-Requested-Bandwidth-DL AVP Bearer-Identifier AVP containing Default-EPS-Bearer-QoS AVP made up of QoS-Class-Identifier AVP set to "5" Allocation-Retention-Priority AVP made up of Priority-Level AVP Pre-emption-Capablity AVP Pre-emption-Vulnerability AVP
		) }
	9	TP_EPC_6001_01 ensure that { when { UE_A completes initial network_attachment to EPC } then { receives IP_configuration_data (
		containing IPv4_address of UE_A or containing IPv6_address of UE_A or containing (IPv4_address and IPv6_address) of UE_A
		) containing DNS_information containing P-CSCF_information (
		indicating the P-CSCF-IP_address or indicating the P-CSCF-FQDN_address
		) } }

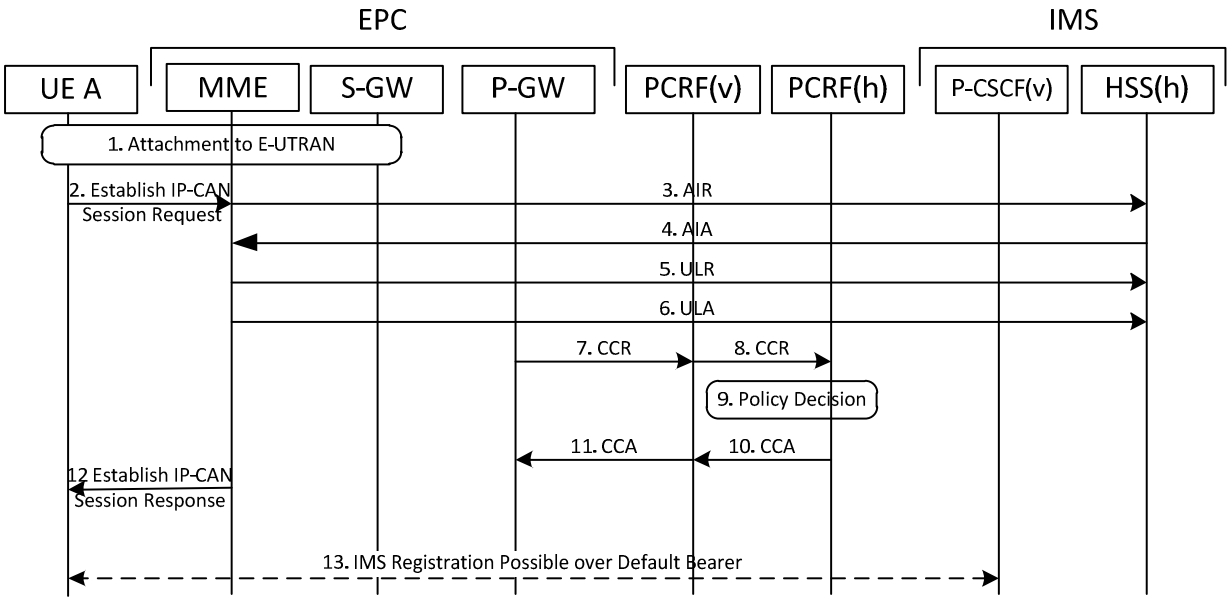


Figure 28: Initial Network Attachment (Roaming)

Step	Direction						Message	Comment
	USER	UEA	EPC	PCRF (v)	PCRF (h)	HSS		
1		→						User initiates attachment on UE-A.
2			→					The UE-A requests IP-CAN session establishment to the EPC (MME).
3				→		→	DIAMETER IAR	The MME sends a IAR message to the HSS/SPR.
4				←			DIAMETER IAA	The HSS responds.
5				→		→	DIAMETER ULR	The MME sends a ULR message to the HSS/SPR.
6				←			DIAMETER ULA	The HSS responds.
7				→			DIAMETER CCR	The P-GW sends a CCR message to the visited PCRF to request the default bearer.
8					→		DIAMETER CCR	The visited PCRF invokes the home PCRF.
9								The home PCRF checks if the user is entitled to set up the requested bearer.
10					←		DIAMETER CCA	The home PCRF responds with a CCA to the visited PCRF.
11				←			DIAMETER CCA	The visited PCRF responds to the EPC (P-GW).
12		←						The MME responds to the UE, confirming that the IP-CAN has been successfully set up.
13								User is informed that the default bearer has been successfully set up.

4) The default bearer is established with the following parameters (see (see TS 123 203 [i.5])) 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

8.1.2 IMS Initial Registration - Successful

Interoperability Test Description		
Identifier:	**TD_IMSEPC_Roam_Registration_Initial_Successful**	
Purpose:	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.	
Config.:	CF_IMSEPC_ROAM	
SUT:	IMS, PCRF and EPC	
Ref.:	TS 124 229 [2], clause 5.4.1.2 (Initial registration and user-initiated re-registration). TS 129 214 [5], clause 4.4.5a (Provisioning of AF Signalling Flow Information). TS 129 214 [5], clause A.8 (Provision of Signalling Flow Information at P-CSCF). TS 129 214 [5], annex B (Flow identifiers: Format definition and examples). TS 129 212 [6], clause 4.5.2 (Provision of PCC rules) and clause 4.5.3 (Provision of Event Triggers). TS 129 215 [9], clause 4.5.3.6 (Rx over S9).	
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.

Interoperability Test Description		
	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.
Conformance Criteria:	**Check**	
	1-2	As checks 1-2 in clause 7.1.2

	3	TP_EPC_8001_07
		ensure that {
		when { visited PCRF receives AA-Request from IMS_P-CSCF }
		then { visited PCRF sends AA-Request to home PCRF
		}
		}

	4	TP_EPC_8001_08
		ensure that {
		when { home PCRF receives AA-Request from visited PCRF }
		then { PCRF sends AA-Answer to IMS_P-CSCF
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001) and
		containing Acceptable-Service-Info_AVP (
		containing one or more Media-Component-Description_AVP(
		containing Media-Component-Number_AVP
		indicating 0 and
		containing Media-Sub-Component AVP (
		containing Flow-Description_AVP (
		indicating permit_in_ip from (UE_A-IP_address and UE_A_port_number) to (P-CSCF-IP_address and P-CSCF_port_number) or
		indicating permit_in_udp from (UE_A-IP_address and UE_A_port_number) to (P-CSCF-IP_address and P-CSCF_port_number) or
		indicating permit_in_tcp from (UE_A-IP_address and UE_A_port_number) to (P-CSCF-IP_address and P-CSCF_port_number)
		) and
		containing Flow-Description_AVP (
		indicating permit_out_ip from (P-CSCF-IP_address P-CSCF_port_number) to UE_A-IP_address or
		indicating permit_out_udp from (P-CSCF-IP_address P-CSCF_port_number) to UE_A-IP_address or
		indicating permit_out_tcp from (P-CSCF-IP_address P-CSCF_port_number) to UE_A-IP_address
		) and
		containing Flow-Usage_AVP
		indicating AF_SIGNALING(0) and
		containing Flow-Status_AVP
		indicating ENABLED(2) and
		containing AF-Signalling-Protocol_AVP
		indicating SIP(1)
		)
		) and
		containing IP-CAN_AVP
		indicating Current_IP_CAN_Type of UE_A and
		containing RAT-Type_AVP
		indicating Current_RAT_Type of UE_A
		}
		}

	5	TP_EPC_8001_09
		ensure that {
		when { visited PCRF receives AA-Answer from home PCRF }
		then { visited PCRF sends AA-Answer to IMS_P-CSCF
		}
		}

	6-7	As checks 4-5 in clause 7.1.2.

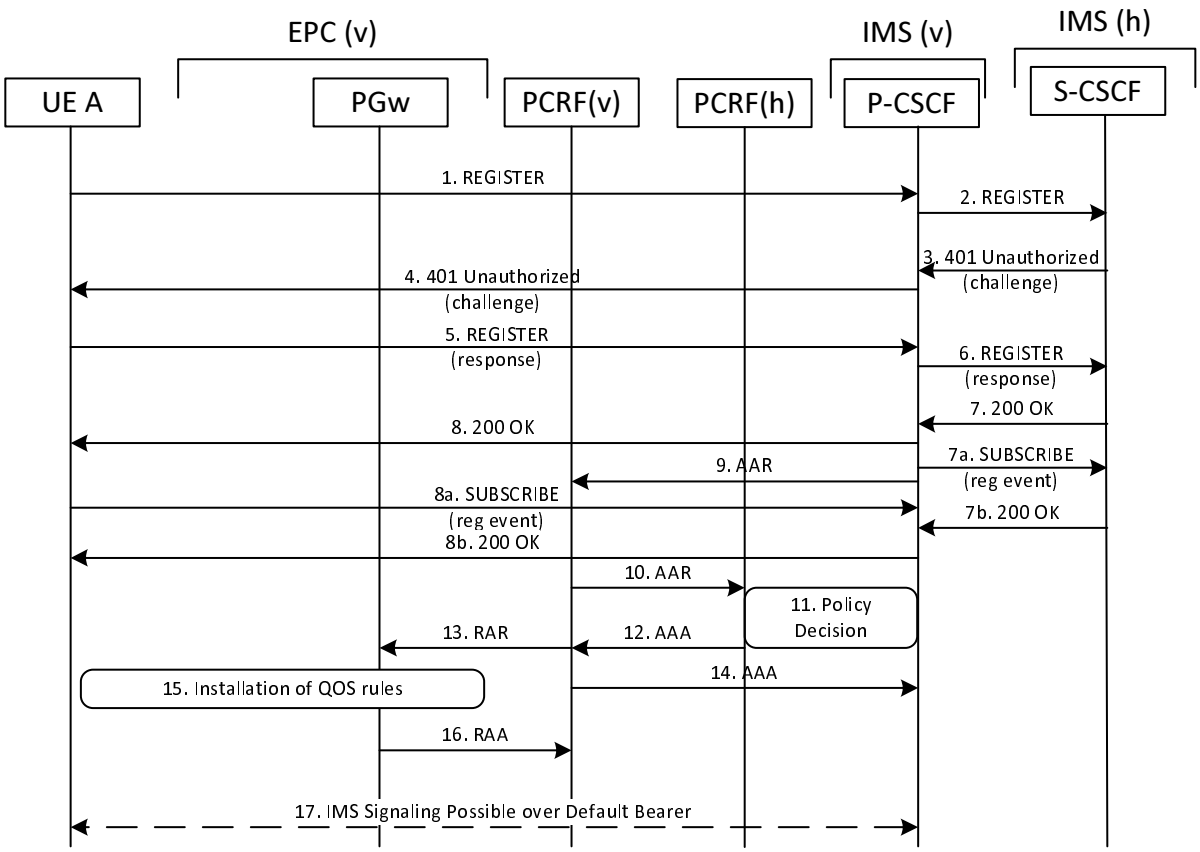


Figure 29: IMS Initial Registration - success (Roaming)

Step	Direction							Message	Comment
	USER	UEA	EPC	PCRF (v)	PCRF (h)	IMS			
1		→							User initiates IMS Registration.
2			→			→		SIP REGISTER	The UE-A requests IMS Registration.
3			←			←		SIP 401 Response	IMS rejects the REGISTER and issues a challenge.
4			→			→		SIP REGISTER	The REGISTER is re-sent with an Authorization header.
5			←			←		SIP 200 OK	The IMS registration is successful.
6									User is informed that the IMS registration is successful.
7					←			DIAMETER AAR	The P-CSCF initiates session binding to the default bearer.
8					→			DIAMETER AAR	The AAR is conveyed to the home PCRF.
8a, 8b									The P-CSCF subscribes to the registration event package to be notified of a de-registration.
9					←			DIAMETER AAA	The home PCRF responds to the visited PCRF.
10						→		DIAMETER AAA	The visited PCRF responds to the P-CSCF.
10a, 10b									The UE subscribes to the registration event package to be notified of a de-registration.
11				←				DIAMETER RAR	The PCRF pushes a flow description to the P-GW to modify the default bearer.
12				→				DIAMETER RAA	The P-GW in the EPC responds to the PCRF.
13									The default bearer has been successfully modified and bi-directional IMS signalling is possible.

NOTE 1: In the Flow-Description AVP, instead of protocol "ip", alternative values as "udp" or "tcp" can be used. These are more specific, but might require the use of multiple Media-Sub-Component AVP.

NOTE 2: The Flow-Number AVP is derived according to the respective rules in TS 129 214 [5], annex B.

8.1.3 IMS Initial Registration - Failure

This test description is identical to clause 7.1.3. The only difference is that the P-CSCF resides in the visited network and the S-CSCF resides in the home network. The Mw reference point therefore crosses the n/w boundary between the visited and home networks.

8.2 SIP Session and Dedicated Bearer Operations

As in clause 7.2, 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.

8.2.1 SIP Session Establishment

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 7.2.1.

8.2.1.1 Originating Leg

Interoperability Test Description		
Identifier:	**TD_IMSEPC_Session_Establishment_Roam_Originating_1**	
Purpose:	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 PRFR 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).	
Config.:	CF_IMSEPC_ROAM	
SUT:	IMS, PCRF and EPC	
Ref.:	TS 124 229 [2], clause 5.2.7.2 (Initial INVITE/Originating Case) TS 129 214 [5], clause 4.4.1 (Initial Provisioning of Session Information) TS 129 214 [5], clause A.1 (Provision of Service Information at the P-CSCF) TS 129 214 [5], clause A.2 (Enabling of IP Flows) TS 129 214 [5], annex B (Flow identifiers: Format definition and examples) TS 129 212 [6], clause 4.5.2 (Provision of PCC rules) TS 129 215 [9], clause 4.5.3.6 (Rx over S9)	
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 an IMS signalling bearer. • UE_B 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 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.

Interoperability Test Description		
	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.
	8	Verify that media between UE_A and UE_B is transported with appropriate PCC characteristics.
Conformance Criteria:	**Check**	
	1-2	As clause 7.2.1.1 checks 1-2

	3	TP_EPC_8002_01
		ensure that {
		when { visited PCRF receives AA-Request from IMS_P-CSCF }
		then { visited PCRF sends AA-Request to home PCRF
		}
		}

	4	TP_EPC_8002_02 ensure that when { home PCRF receives AA-Request from visited PCRF } then { home PCRF sends AA-Answer to visited PCRF (containing containing Result-Code_AVP Indicatome ing DIAMETER_SUCCESS(2001) and containing Acceptable-Service-Info_AVP (containing one or more Media-Component-Description_AVP indicating values_derived from AA-Request) } }

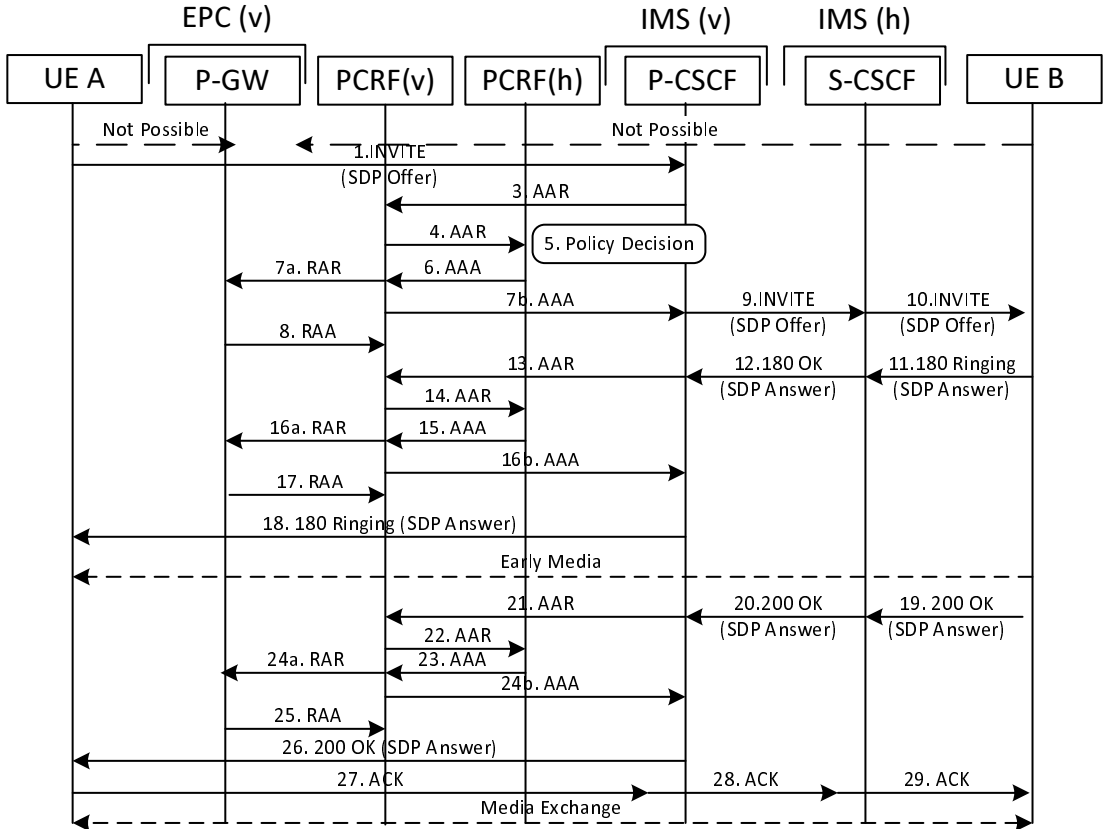
	5	TP_EPC_8002_03
		ensure that when
		{ visited PCRF receives AA-Answer from home PCRF }
		then PCRF invokes the EPC P-GW with a RAR {
		containing a Charging-Rule-Install AVP
		containing a Charging-Rule-Definition AVP
		containing a Charging-Rule-Name AVP
		containing a Flow-Information AVP
		containing Flow-Description AVP
		containing a Flow-Status AVP set as received from PCRF
		containing a Flows AVP
		containing containing Media-Component-Number AVP
		as received from PCRF
		containing QOS-Information AVP
		containing QOS-Class-Identifier AVP set to QCI_1 (1)
		for voice or QCI_2(2) for video
		containing Max-Requested-Bandwidth-UL AVP
		containing Max-Requested-Bandwidth-DL AVP
		containing Guaranteed-Bitrate-UL AVP
		containing Guaranteed-Bitrate-DL AVP
		containing Allocation-Retention-Priority AVP
		}

	6-9	As clause 7.2.1.1 steps 4-7
	10	As step 3
	11	As step 4
	12	TP_EPC_8002_03 ensure that { when { visited PCRF receives AA-Answer from home PCRF } then {visited PCRF invokes the EPC P-GW with a RAR } containing a Charging-Rule-Install AVP containing a Charging-Rule-Definition AVP containing a Charging-Rule-Name AVP containing a Flow-Information AVP containing Flow-Description AVP containing a Flow-Status AVP set as received from PCRF containing a Flows AVP containing containing Media-Component-Number AVP as received from PCRF containing QOS-Information AVP containing QOS-Class-Identifier AVP set to QCI_1 (1) for voice or QCI_2(2) for video containing Max-Requested-Bandwidth-UL AVP containing Max-Requested-Bandwidth-DL AVP containing Guaranteed-Bitrate-UL AVP containing Guaranteed-Bitrate-DL AVP containing Allocation-Retention-Priority AVP

Interoperability Test Description		
		}
	13-16	As clause 7.2.1.1 steps 9-12
	17	As step 3
	18	As step 4

	19	TP_EPC_8002_03
		ensure that {
		when { visited PCRF receives AA-Answer from home PCRF }
		then {PCRF invokes the EPC P-GW with a RAR }
		containing a Charging-Rule-Install AVP
		containing a Charging-Rule-Definition AVP
		containing a Charging-Rule-Name AVP
		containing a Flow-Information AVP
		containing Flow-Description AVP
		containing a Flow-Status AVP set as received from PCRF
		containing a Flows AVP
		containing containing Media-Component-Number AVP
		as received from PCRF
		containing QOS-Information AVP
		containing QOS-Class-Identifier AVP set to QCI_1 (1)
		for voice or QCI_2(2) for video
		containing Max-Requested-Bandwidth-UL AVP
		containing Max-Requested-Bandwidth-DL AVP
		containing Guaranteed-Bitrate-UL AVP
		containing Guaranteed-Bitrate-DL AVP
		containing Allocation-Retention-Priority AVP
		}

	20-23	As clause 7.2.1.1 steps 14-17



NOTE: For brevity, 100rel is not used in the 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 30: SIP Session Establishment - Originating Leg (Roaming)

Step	Direction						Message	Comment
	UEA	EPC	PCRF (v)	PCRF (h)	IMS	UEB		
1							SIP INVITE (SDP)	UEA initiates the SIP session with an INVITE containing the SDP offer.
2							DIAMETER AAR	The IMS P-CSCF invokes the visited PCRF.
3							DIAMETER AAR	The visited PCRF invokes the home PCRF.
4							DIAMETER AAA	The home PCRF responds to the visited PCRF.
5							DIAMETER RAR	Visited PCRF sends RAR to EPC P-GW.
6							DIAMETER RAA	EPC P-GW responds.
7							DIAMETER AAA	Visited PCRF responds to IMS P-CSCF.
8							SIP INVITE (SDP)	IMS forwards the INVITE to UEB.
9							SIP 180 (SDP)	The UE responds with the 180 with SDP answer.
10							DIAMETER AAR	The IMS P-CSCF invokes the visited PCRF to modify the bearer.
11							DIAMETER AAR	The visited PCRF invokes the home PCRF.
12							DIAMETER AAA	The home PCRF responds to the visited PCRF.
13							DIAMETER RAR	PCRF sends RAR to EPC P-GW.
14							DIAMETER RAA	EPC P-GW responds.
15							DIAMETER AAA	PCRF responds to IMS P-CSCF.
16							SIP 180 (SDP)	P-CSCF forwards the SIP 180 (SDP) to UEA.
17							SIP 200 OK (SDP)	The UE responds with the SIP 200 OK (SDP).
18							DIAMETER AAR	The IMS P-CSCF invokes the PCRF to complete the bearer set up.
19							DIAMETER AAR	The visited PCRF invokes the home PCRF.
20							DIAMETER AAA	The home PCRF responds to the visited PCRF.
21							DIAMETER RAR	PCRF sends RAR to EPC P-GW.
22							DIAMETER RAA	EPC P-GW responds.
23							DIAMETER AAA	PCRF responds to IMS P-CSCF.
24							SIP 200 OK (SDP)	P-CSCF forwards the SIP 200 OK (SDP) to UEA.
25							SIP ACK	The UEA sends ACK to 200 OK (INVITE).
26							SIP ACK	The ACK is sent to UEB.
27								The dedicated bearer(s) is/are set up. Media can flow between the UEs.

8.2.1.2 Terminating Leg

Interoperability Test Description	
Identifier:	**TD_IMSEPC_Roam_Session_Establishment_Terminating_1**
Purpose:	To demonstrate the establishment of dedicated bearers at the terminating 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 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).
Config.:	CF_IMSEPC_Roam
SUT:	IMS, PCRF and EPC
Ref.:	TS 124 229 [2], clause 5.2.7.3 (Initial INVITE/Terminating Case). TS 129 214 [5], clause 4.4.1 (Initial Provisioning of Session Information). TS 129 214 [5], clause A.1 (Provision of Service Information at the P-CSCF). TS 129 214 [5], clause A.2 (Enabling of IP Flows). TS 129 214 [5], annex B (Flow identifiers: Format definition and examples). TS 129 212 [6], clause 4.5.2 (Provision of PCC rules). TS 129 215 [9], clause 4.5.3.6 (Rx over S9).

Interoperability Test Description		
Pre-test conditions:	• Roaming UE_B previously attached to EPC. • EPC established a Default Bearer allowing UE_B - P-CSCF IP communication. • UE_B previously registered to IMS. • EPC established an IMS 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.
	7	Verify that media between UE_A and UE_B is transported with appropriate PCC characteristics.
Conformance Criteria:	**Check**	
	1-2	As clause 7.2.1.2 checks 1-2

	3	TP_EPC_8002_01
		ensure that {
		when { visited PCRF receives AA-Request from IMS_P-CSCF }
		then { visited PCRF sends AA-Request to home PCRF
		}
		}

	4	TP_EPC_8002_02 ensure that when { home PCRF receives AA-Request from visited PCRF } then { home PCRF sends AA-Answer to visited PCRF (containing containing Result-Code_AVP Indicatome ing DIAMETER_SUCCESS(2001) and containing Acceptable-Service-Info_AVP (containing one or more Media-Component-Description_AVP indicating values_derived from AA-Request) } }

	5	TP_EPC_8002_03
		ensure that when
		{ visited PCRF receives AA-Answer from home PCRF }
		then visited PCRF invokes the EPC P-GW with a RAR {
		containing a Charging-Rule-Install AVP
		containing a Charging-Rule-Definition AVP
		containing a Charging-Rule-Name AVP
		containing a Flow-Information AVP
		containing Flow-Description AVP
		containing a Flow-Status AVP set as received from PCRF
		containing a Flows AVP
		containing containing Media-Component-Number AVP
		as received from PCRF
		containing QOS-Information AVP
		containing QOS-Class-Identifier AVP set to QCI_1 (1)
		for voice or QCI_2(2) for video
		containing Max-Requested-Bandwidth-UL AVP
		containing Max-Requested-Bandwidth-DL AVP
		containing Guaranteed-Bitrate-UL AVP
		containing Guaranteed-Bitrate-DL AVP
		containing Allocation-Retention-Priority AVP
		
		}

	6	TP_EPC_7002_03
		ensure that {
		when { P-GW receives RA-Request from PCRF }
		then { P-GW sends RA-Answer to PCRF
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001)
		}
		}

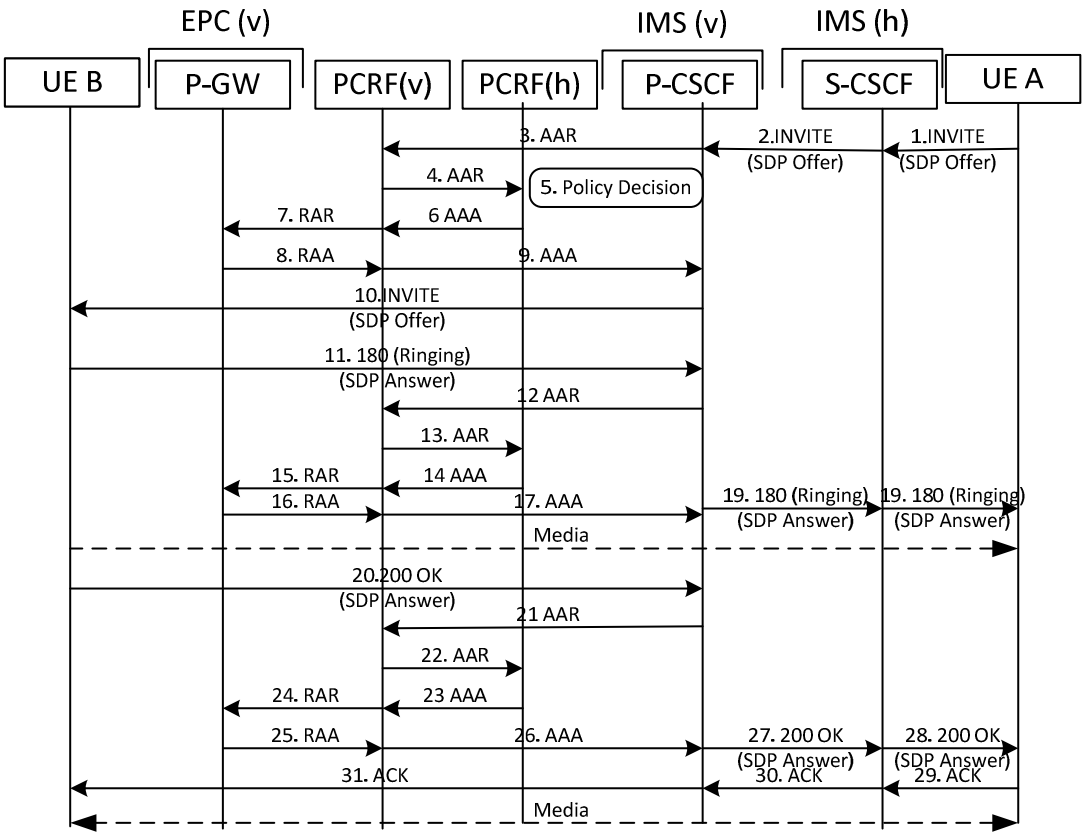
Interoperability Test Description		
	7-9	As clause 7.2.1.2 checks 5-7
	10-11	As checks 3-4

	12	TP_EPC_8002_03
		ensure that {
		when { visited PCRF receives AA-Answer from home PCRF }
		then {PCRF invokes the EPC P-GW with a RAR }
		containing a Charging-Rule-Install AVP
		containing a Charging-Rule-Definition AVP
		containing a Charging-Rule-Name AVP
		containing a Flow-Information AVP
		containing Flow-Description AVP
		containing a Flow-Status AVP set as received from PCRF
		containing a Flows AVP
		containing containing Media-Component-Number AVP
		as received from PCRF
		containing QOS-Information AVP
		containing QOS-Class-Identifier AVP set to QCI_1 (1)
		for voice or QCI_2(2) for video
		containing Max-Requested-Bandwidth-UL AVP
		containing Max-Requested-Bandwidth-DL AVP
		containing Guaranteed-Bitrate-UL AVP
		containing Guaranteed-Bitrate-DL AVP
		containing Allocation-Retention-Priority AVP
		}

	13-16	As clause 7.2.1.2 checks 9-12
	17-18	As checks 3-4

	19	TP_EPC_8002_03
		ensure that {
		when { visited PCRF receives AA-Answer from home PCRF }
		then {PCRF invokes the EPC P-GW with a RAR }
		containing a Charging-Rule-Install AVP
		containing a Charging-Rule-Definition AVP
		containing a Charging-Rule-Name AVP
		containing a Flow-Information AVP
		containing Flow-Description AVP
		containing a Flow-Status AVP set as received from PCRF
		containing a Flows AVP
		containing containing Media-Component-Number AVP
		as received from PCRF
		containing QOS-Information AVP
		containing QOS-Class-Identifier AVP set to QCI_1 (1)
		for voice or QCI_2(2) for video
		containing Max-Requested-Bandwidth-UL AVP
		containing Max-Requested-Bandwidth-DL AVP
		containing Guaranteed-Bitrate-UL AVP
		containing Guaranteed-Bitrate-DL AVP
		containing Allocation-Retention-Priority AVP
		}

	20-23	As clause 7.2.1.2 checks 15-18



NOTE 1: The Gx interaction may take place after completion of the Rx interaction.
NOTE 2: For brevity, 100rel is not used in figure 31. 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 31: SIP Session Establishment - Terminating Leg (Roaming)

Step	Direction						Message	Comment
	UEA	EPC	PCRF (v)	PCRF (h)	IMS	UEB		
1							SIP INVITE (SDP)	UEA initiates the SIP session with an INVITE containing the SDP offer.
2							DIAMETER AAR	The IMS P-CSCF invokes the visited PCRF for UE_B.
3							DIAMETER AAR	The visited PCRF invokes the home PCRF.
4							DIAMETER AAA	The home PCRF responds to the visited PCRF.
5							DIAMETER RAR	Visited PCRF sends RAR to EPC P-GW.
6							DIAMETER RAA	EPC P-GW responds.
7							DIAMETER AAA	Visited PCRF responds to IMS P-CSCF.
8							SIP INVITE (SDP)	IMS forwards the INVITE to UEB.
9							SIP 180 (SDP)	The UE responds with the 180 with SDP answer.
10							DIAMETER AAR	The IMS P-CSCF invokes the visited PCRF to modify the bearer.
11							DIAMETER AAR	The visited PCRF invokes the home PCRF.
12							DIAMETER AAA	The home PCRF responds to the visited PCRF.
13							DIAMETER RAR	PCRF sends RAR to EPC P-GW.
14							DIAMETER RAA	EPC P-GW responds.
15							DIAMETER AAA	PCRF responds to IMS P-CSCF.
16							SIP 180 (SDP)	P-CSCF forwards the SIP 180 (SDP) to S-CSCF and onto UEA.
17							SIP 200 OK (SDP)	The UE responds with the SIP 200 OK (SDP).
18							DIAMETER AAR	The IMS P-CSCF invokes the PCRF to complete the bearer set up.
19							DIAMETER AAR	The visited PCRF invokes the home PCRF.
20							DIAMETER AAA	The home PCRF responds to the visited PCRF.
21							DIAMETER RAR	PCRF sends RAR to EPC P-GW.
22							DIAMETER RAA	EPC P-GW responds.
23							DIAMETER AAA	PCRF responds to IMS P-CSCF.
24							SIP 200 OK (SDP)	P-CSCF forwards the SIP 200 OK (SDP) to S-CSCF and onto UEA.
25							SIP ACK	The UEA sends ACK to 200 OK (INVITE).
26							SIP ACK	The ACK is sent to UEB.
27								The dedicated bearer(s) is/are set up. Media can flow between the UEs.

8.2.2 SIP Session Modification

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.).

8.2.2.1 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_IMSEPC_Roam_Session_Modification_Originating_1**	
Purpose	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.	
Config.:	CF_IMSEPC_Roam	
SUT:	IMS, PCRFs and EPC	
Ref.:	TS 124 229 [2], clause 5.2.9.1 (Subsequent requests/UE-originating Case). TS 129 214 [5], clause 4.4.2 (Modification of Session Bearers). TS 129 214 [5], clause A.1 (Provision of Service Information at the P-CSCF). TS 129 214 [5], clause A.2 (Enabling of IP Flows). TS 129 214 [5], annex B (Flow identifiers: Format definition and examples). TS 129 212 [6], clause 4.5.2 (Provision of PCC rules). TS 129 215 [9], clause 4.5.3.6 (Rx over S9).	
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.	
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.
	7	Verify that media between UE_B and UE_A can no longer be exchanged and is filtered out by EPC.

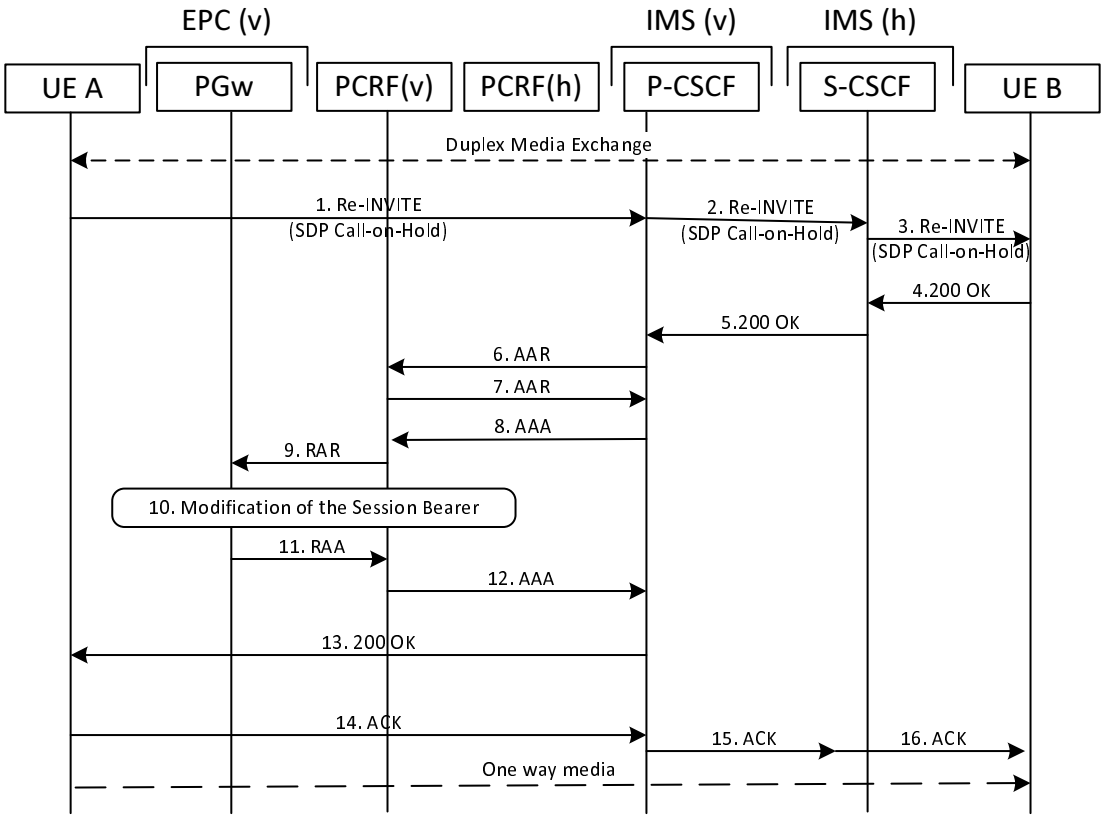
Interoperability Test Description		
Conformance Criteria:	**Check**	
	1-2	As clause 7.2.2.1 checks 1-2

	3	TP_EPC_8002_01
		ensure that {
		when { visited PCRF receives AA-Request from IMS_P-CSCF }
		then { visited PCRF sends AA-Request to home PCRF
		}
		}

	4	TP_EPC_8002_02 ensure that when { home PCRF receives AA-Request from visited PCRF } then { home PCRF sends AA-Answer to visited PCRF (containing containing Result-Code_AVP Indicatome ing DIAMETER_SUCCESS(2001) and containing Acceptable-Service-Info_AVP (containing one or more Media-Component-Description_AVP indicating values_derived from AA-Request) } }

	5	TP_EPC_8002_03
		ensure that {
		when { visited PCRF receives AA-Answer from home PCRF }
		then {visited PCRF invokes the EPC P-GW with a RAR }
		containing a Charging-Rule-Install AVP
		containing a Charging-Rule-Definition AVP
		containing a Charging-Rule-Name AVP
		containing a Flow-Information AVP
		containing Flow-Description AVP
		containing a Flow-Status AVP set as received from PCRF
		containing a Flows AVP
		containing containing Media-Component-Number AVP
		as received from PCRF
		containing QOS-Information AVP
		containing QOS-Class-Identifier AVP set to QCI_1 (1)
		for voice or QCI_2(2) for video
		containing Max-Requested-Bandwidth-UL AVP
		containing Max-Requested-Bandwidth-DL AVP
		containing Guaranteed-Bitrate-UL AVP
		containing Guaranteed-Bitrate-DL AVP
		containing Allocation-Retention-Priority AVP
		
		}

	6-9	As clause 7.2.2.1 checks 4-7



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 32: SIP Session Modification - Originating Leg (Roaming)

Step	Direction						Message	Comment
	UEA	EPC	PCRF (v)	PCRF (h)	IMS	UEB		
1					→		SIP INVITE (SDP)	UEA initiates the SIP session with a re-I NVITE containing the new SDP offer. In this case, the SPD will differ in a media attribute line(s) set to "sendonly" indi cating the existing media stream(s) are being placed on hold.
2						→	SIP INVITE (SDP)	IMS forwards the INVITE to UEB.
3					←		SIP 200 OK (SDP)	The UE responds with the SDP answer. The SDP answer will differ in a media attribute line(s) set to "recvonly" indi cating the existing media stream(s) are being placed on hold.
4				←			DIAMETER AAR	The IMS P-CSCF invokes the PCRF to modify the bearer(s) to reflect the new offer/answer exchange.
5				→			DIAMETER AAR	The visited PCRF invokes the home PCRF.
6				←			DIAMETER AAA	The home PCRF responds to the visited PCRF.
7			←				DIAMETER RAR	PCRF sends RAR to EPC P-GW.
8			→				DIAMETER RAA	EPC P-GW responds.
9				→			DIAMETER AAA	PCRF responds to IMS P-CSCF.
10		←					SIP 200 OK (SDP)	P-CSCF forwards the SIP 200 OK (SDP) to UEA.
11					→		SIP ACK	The UEA sends ACK to 200 OK (INVITE).
12						→	SIP ACK	The ACK is sent to UEB.
13					→			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.

8.2.2.2 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_IMSEPC_Roam_Session_Modification_Terminating_1**	
Purpose:	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.	
Config.:	CF_IMSEPC_Roam	
SUT:	IMS, PCRF and EPC	
Ref.:	TS 124 229 [2], clause 5.2.9.2 (Subsequent requests/UE-terminating Case). TS 129 214 [5], clause 4.4.2 (Modification of Session Bearers). TS 129 214 [5], clause A.1 (Provision of Service Information at the P-CSCF). TS 129 214 [5], clause A.2 (Enabling of IP Flows). TS 129 214 [5], annex B (Flow identifiers: Format definition and examples). TS 129 212 [6], clause 4.5.2 (Provision of PCC rules). TS 129 215 [9], clause 4.5.3.6 (Rx over S9).	
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.	
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.
	7	Verify that media between UE_B and UE_A can no longer be exchanged and is filtered out by EPC.
Conformance Criteria:	**Check**	
	1-2	As clause 7.2.2.2 checks 1-2

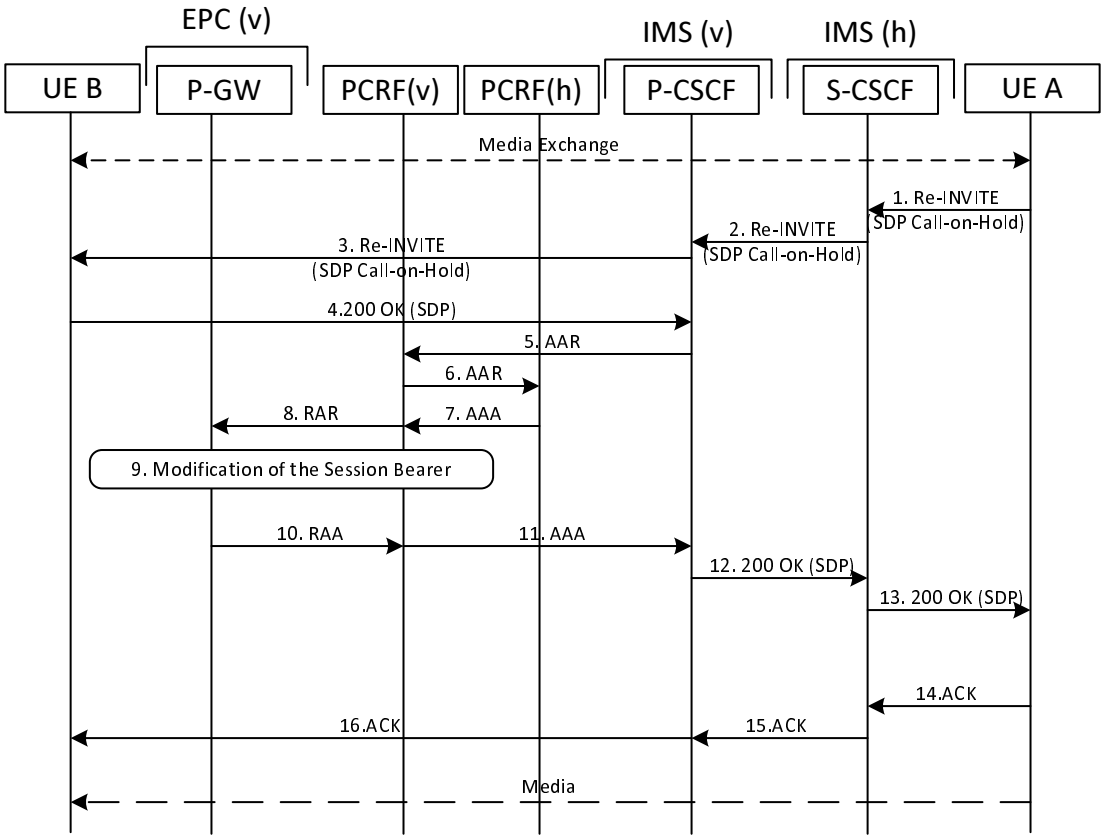
	3	TP_EPC_8002_01
		ensure that {
		when { visited PCRF receives AA-Request from IMS_P-CSCF }
		then { visited PCRF sends AA-Request to home PCRF
		}
		}

	4	TP_EPC_8002_02 ensure that when { home PCRF receives AA-Request from visited PCRF } then { home PCRF sends AA-Answer to visited PCRF (containing containing Result-Code_AVP Indicatome ing DIAMETER_SUCCESS(2001)

Interoperability Test Description		
		and containing Acceptable-Service-Info_AVP (containing one or more Media-Component-Description_AVP indicating values_derived from AA-Request) } }

	5	TP_EPC_8002_03
		ensure that {
		when { visited PCRF receives AA-Answer from home PCRF }
		then {visited PCRF invokes the EPC P-GW with a RAR }
		containing a Charging-Rule-Install AVP
		containing a Charging-Rule-Definition AVP
		containing a Charging-Rule-Name AVP
		containing a Flow-Information AVP
		containing Flow-Description AVP
		containing a Flow-Status AVP set as received from PCRF
		containing a Flows AVP
		containing containing Media-Component-Number AVP
		as received from PCRF
		containing QOS-Information AVP
		containing QOS-Class-Identifier AVP set to QCI_1 (1)
		for voice or QCI_2(2) for video
		containing Max-Requested-Bandwidth-UL AVP
		containing Max-Requested-Bandwidth-DL AVP
		containing Guaranteed-Bitrate-UL AVP
		containing Guaranteed-Bitrate-DL AVP
		containing Allocation-Retention-Priority AVP
		}

	6-9	As clause 7.2.2.2 checks 4-7



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 33: SIP Session Modification - Terminating Leg (Roaming)

Step	Direction						Message	Comment
	UEA	EPC	PCRF (v)	PCRF (h)	IMS	UEB		
1							SIP INVITE (SDP)	UEA initiates the SIP session with a re-I NVITE containing the new SDP offer. In this case, the SPD will differ in a media attribute line(s) set to "sendonly" indicating the existing media stream(s) are being placed on hold.
2							SIP INVITE (SDP)	IMS forwards the INVITE to UEB.
3							SIP 200 OK (SDP)	The UE responds with the SDP answer. The SDP answer will differ in a media attribute line(s) set to "recvonly" indicating the existing media stream(s) are being placed on hold.
4							DIAMETER AAR	The IMS P-CSCF invokes the PCRF to modify the bearer(s) to reflect the new offer/answer exchange.
5							DIAMETER AAR	The visited PCRF invokes the home PCRF.
6							DIAMETER AAA	The home PCRF responds to the visited PCRF.
7							DIAMETER RAR	PCRF sends RAR to EPC P-GW.
8							DIAMETER RAA	EPC P-GW responds.
9							DIAMETER AAA	PCRF responds to IMS P-CSCF.
10							SIP 200 OK (SDP)	P-CSCF forwards the SIP 200 OK (SDP) to UEA via the S-CSCF.
11							SIP ACK	The UEA sends ACK to 200 OK (INVITE).
12							SIP ACK	The ACK is sent to UEB.
13								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.

8.2.3 SIP Session Release

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 7.2.3 but involving a roaming UE.

8.2.3.1 UE Initiated Session Release

Interoperability Test Description	
Identifier:	**TD_IMSEPC_Roam_Session_Release_UE_Initiated**
Purpose:	To demonstrate IMS session termination (UE initiated) and the tear down of related dedicated bearers. The UE is roaming.
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.
Config.:	CF_IMSEPC_Roam
SUT:	IMS, PCRF and EPC
Ref.:	TS 124 229 [2], clause 5.2.8.2 (Call release initiated by any other entity). TS 129 214 [5], clause 4.4.4 (AF Session Termination). TS 129 212 [6], clause 4.5.2 (Provision of PCC rules). TS 129 215 [9], clause 4.5.3.6 (Rx over S9).
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 IP communication. • UE_A & UE_B previously registered to IMS and IMS 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 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 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 media between UE_A and UE_B can no longer be exchanged and is filtered out by EPC.
Conformance Criteria:	**Check**	
	1-2	As clause 7.2.3.1 checks 1-2.

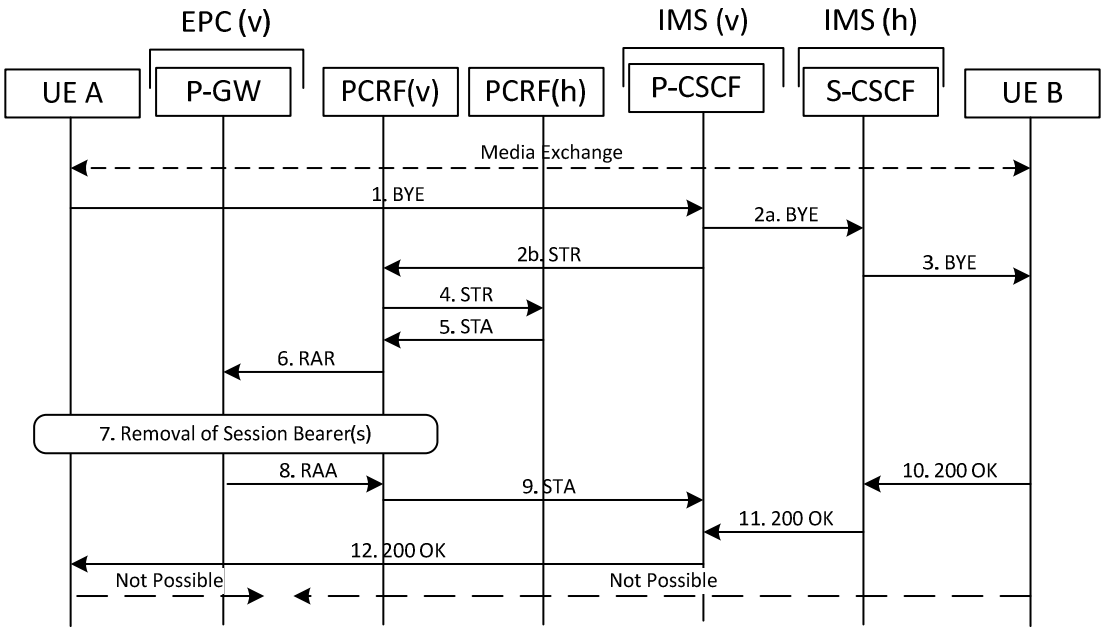
	3	TP_EPC_8002_04
		ensure that {
		when { visited PCRF receives ST-Request from IMS_P-CSCF }
		then { visited PCRF sends ST-Request to home PCRF
		}
		}

	4	TP_EPC_8002_05 ensure that when { home PCRF receives ST-Request from visited PCRF } then { home PCRF sends ST-Answer to visited PCRF (containing containing Result-Code_AVP Indicating DIAMETER_SUCCESS(2001)) } }

	5	TP_EPC_8002_06
		ensure that {
		when { visited PCRF receives ST-Answer from home PCRF }
		then {visited PCRF invokes the EPC P-GW with a RAR }
		containing a Charging-Rule-Remove AVP
		containing a Charging-Rule-Name AVP
		}

	6	TP_EPC_7002_03
		ensure that {
		when { P-GW receives RA-Request from visited PCRF }
		then { P-GW sends RA-Answer to PCRF
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001)
		}
		}

	7-8	As clause 7.2.3.1 checks 5-6



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

Figure 34: SIP Session Tear-down - UE initiated release (Roaming)

Step	Direction						Message	Comment
	UEA	EPC	PCRF (v)	PCRF (h)	IMS	UEB		
1	→	→					SIP BYE	UEA initiates the SIP session release by sending a BYE message.
2					→		SIP BYE	IMS forwards the BYE to UEB.
3				←			DIAMETER STR	The IMS P-CSCF invokes the visited PCRF to terminate the Rx session.
4				→			DIAMETER STR	The visited PCRF invokes the home PCRF.
5				←			DIAMETER STA	The home PCRF responds.
6			←				DIAMETER RAR	PCRF sends RAR to EPC P-GW.
7			→				DIAMETER RAA	EPC P-GW responds.
8							DIAMETER STA	PCRF responds to IMS P-CSCF.
9				→			SIP 200 OK	The UE sends 200 OK to the BYE.
10					←		SIP 200 OK	P-CSCF forwards the SIP 200 OK to UEA.
11	←	←						The dedicated bearer(s) has/have been released.

8.2.3.2 Network Initiated Session Release

Interoperability Test Description	
Identifier:	**TD_IMSEPC_Roam_Session_Release_Network_Initiated**
Purpose:	To demonstrate IMS session termination (network initiated) 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.
Config.:	CF_IMSEPC_Roam
SUT:	IMS, PCRF and EPC
Ref.:	TS 124 229 [2], clause 5.2.8.2 (Call release initiated by any other entity). TS 129 214 [5], clause 4.4.4 (AF Session Termination). TS 129 212 [6], clause 4.5.2 (Provision of PCC rules). TS 129 215 [9], clause 4.5.3.6 (Rx over S9).

Interoperability Test Description		
Pre-test conditions:	• UE_A and UE_B previously attached to EPC. UE_B is roaming. • EPC 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 negotiated media stream types after call establishment.
	2	UE_B receives a Call-Release (BYE) operation, 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:	**Check**	
	1-2	As clause 7.2.3.2 checks 1-2

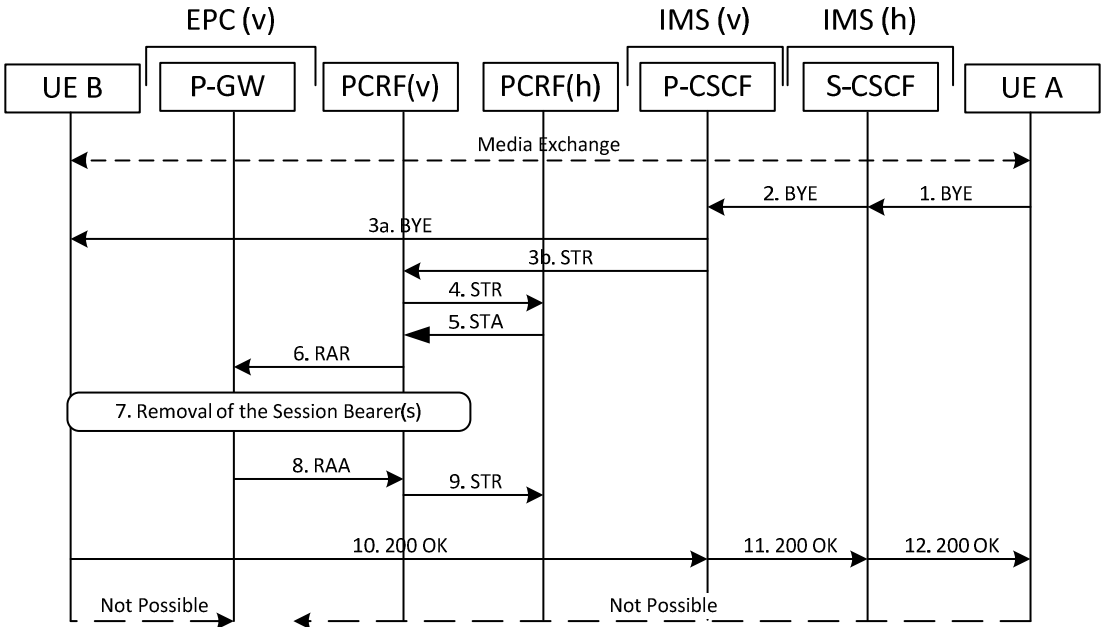
	3	TP_EPC_8002_04
		ensure that {
		when { visited PCRF receives ST-Request from IMS_P-CSCF }
		then { visited PCRF sends ST-Request to home PCRF
		}
		}

	4	TP_EPC_8002_05 ensure that when { home PCRF receives ST-Request from visited PCRF } then { home PCRF sends ST-Answer to visited PCRF (containing containing Result-Code_AVP Indicating DIAMETER_SUCCESS(2001)) } }

	5	TP_EPC_8002_06
		ensure that {
		when { visited PCRF receives ST-Answer from home PCRF }
		then {visited PCRF invokes the EPC P-GW with a RAR }
		containing a Charging-Rule-Remove AVP
		containing a Charging-Rule-Name AVP
		}

	6	TP_EPC_7002_03
		ensure that {
		when { P-GW receives RA-Request from visited PCRF }
		then { P-GW sends RA-Answer to PCRF
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001)
		}
		}

	7-8	As clause 7.2.3.2 checks 5-6



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

Figure 35: SIP Session Tear-down - Network Initiated (Roaming)

Step	Direction						Message	Comment
	UEA	EPC	PCRF (v)	PCRF (h)	IMS	UEB		
1							SIP BYE	UEA initiates the SIP session release by sending a BYE message.
2							SIP BYE	IMS forwards the BYE to UEB.
3							DIAMETER STR	The IMS P-CSCF invokes the visited PCRF to terminate the Rx session.
4							DIAMETER STR	The visited PCRF invokes the home PCRF.
5							DIAMETER STA	The home PCRF responds.
6							DIAMETER RAR	PCRF sends RAR to EPC P-GW.
7							DIAMETER RAA	EPC P-GW responds.
8							DIAMETER STA	PCRF responds to IMS P-CSCF.
9							SIP 200 OK	The UE sends 200 OK to the BYE.
10							SIP 200 OK	P-CSCF forwards the SIP 200 OK to UEA.
11								The dedicated bearer(s) has/have been released.

8.2.4 SIP Session Abort/Reject

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 7.2.4 but involving a roaming UE.

8.2.4.1 SIP Session Abort - Originating Leg

Interoperability Test Description	
Identifier:	**TD_IMSEPC_Roam_Session_Abort_Originating**
Purpose:	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.
Config.:	CF_IMSEPC_Roam

Interoperability Test Description		
SUT:	IMS, PCRF and EPC	
Ref.:	TS 124 229 [2], clause 5.2.7.2 (Initial INVITE/Originating Case). TS 129 214 [5], clause 4.4.4 (AF Session Termination). TS 129 212 [6], clause 4.5.2 (Provision of PCC rules). TS 129 215 [9], clause 4.5.3.6 (Rx over S9).	
Pre-test conditions:	• UE_A & UE_B previously attached to EPC. 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. • EPC 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.
	9	Verify that media between UE_B and UE_A can no longer be exchanged and is filtered out by EPC.
Conformance Criteria:	**Check**	
	1-15	As checks 1-15 of clause 8.2.1.1 (SIP Session Establishment, originating leg to the point at which the call is in ringing)

	16	TP_EPC_6032_01
		ensure that {
		when { UE_A sends media to UE_B }
		then { EPC filters the IP_packets }
		then { the IP_packets not visible on PO_SGi }
		when { UE_B sends early_media to UE_A }
		then { EPC uses_correct_bearers for service_data_flows }
		then { UE_A receives media }
		}

	17	TP_EPC_6034_02
		ensure that {
		when { IMS_P-CSCF receives CANCEL from UE_A }
		then { IMS_P-CSCF sends Session-Termination-Request to PCRF
		containing Session-Id_AVP
		indicating session for SIP_session
		}
		}

	18-19	As steps 3-4 of clause 8.2.3.1 (tunnelling STR & STA between the visited and home PCRFs)

	20	TP_EPC_8002_06
		ensure that {
		when { visited PCRF receives ST-Answer from home PCRF }
		then {visited PCRF invokes the EPC P-GW with a RAR }
		containing a Charging-Rule-Remove AVP
		containing a Charging-Rule-Name AVP
		}

	21	TP_EPC_7002_03
		ensure that {
		when { P-GW receives RA-Request from visited PCRF }
		then { P-GW sends RA-Answer to PCRF
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001)
		}
		}

Interoperability Test Description		

	22	TP_EPC_7002_19
		ensure that {
		when { PCRF receives RA-Answer from EPC P-GW }
		then { PCRF sends Session-Termination-Answer to IMS_P-CSCF
		containing Session-Id_AVP
		indicating session for IMS_signalling session
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001)
		}
		}

	23	TP_EPC_6003_02
		ensure that {
		when { UE_A sends media to UE_B }
		then { EPC filters the IP_packets }
		then { the IP_packets not visible on PO_SGi }
		when { UE_B sends media to UE_A }
		then { EPC filters the IP_packets }
		then { the IP_packets not visible on PO_SGi }
		}

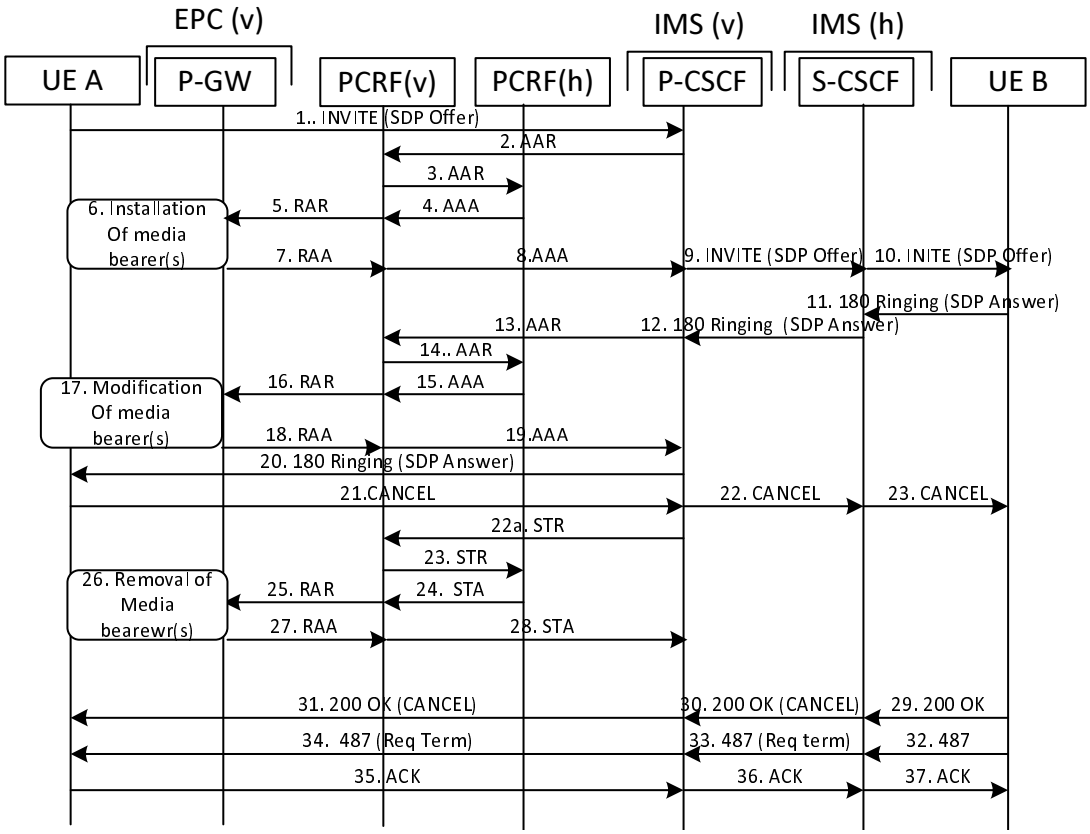


Figure 36: SIP Session Abort - Originating Leg (Roaming)

Step	Direction						Message	Comment
	UEA	EPC	PCRF (v)	PCRF (h)	IMS	UEB		
1							SIP INVITE (SDP)	UEA initiates the SIP session with an NVITE containing the SDP offer.
2							DIAMETER AAR	The IMS P-CSCF invokes the visited PCRF.
4							DIAMETER AAR	The visited PCRF invokes the home PCRF.
5							DIAMETER AAA	The home PCRF responds.
6							DIAMETER RAR	Visited PCRF sends RAR to EPC P-GW.
7							DIAMETER RAA	EPC P-GW responds.
8							DIAMETER AAA	Visited PCRF responds to IMS P-CSCF.
9							SIP INVITE (SDP)	IMS forwards the INVITE to UEB.
10							SIP 180 OK (SDP)	UE-B responds with a 180(ringing) response with SDP and notification of early media.
11							DIAMETER AAR	The IMS P-CSCF invokes the visited PCRF.
12							DIAMETER AAR	The visited PCRF invokes the home PCRF.
13							DIAMETER AAA	The home PCRF responds.
14							DIAMETER RAR	Visited PCRF sends RAR to EPC P-GW.
15							DIAMETER RAA	EPC P-GW responds.
16							DIAMETER AAA	Visited PCRF responds to IMS P-CSCF.
17							SIP 180 OK (SDP)	IMS forwards the 180 (ringing) to UEA.
18								Early media is flowing from UE-B to UE-A.
19							SIP CANCEL	UEA aborts the session.
20							SIP CANCEL	IMS forwards the CANCEL to UEB.
21							DIAMETER STR	The IMS P-CSCF invokes the visited PCRF to release the media bearer.
22							DIAMETER STR	The visited PCRF invokes the home PCRF.
23							DIAMETER STA	The home PCRF responds.
24							DIAMETER RAR	Visited PCRF sends RAR to EPC P-GW.
25							DIAMETER RAA	EPC P-GW responds.
26							DIAMETER STA	Visited PCRF responds to IMS P-CSCF.
27							SIP 200 OK (CANCEL)	UE-B responds 200 OK.
28							SIP 200 OK (CANCEL)	P-CSCF forwards the SIP 200 OK (CANCEL) to UEA.
29							SIP 487 (INV)	UE-B responds 487 (Request Terminated)
30							SIP 487 (INV)	P-CSCF forwards the SIP 487 to UEA.
31							SIP ACK	The UEA sends ACK to 487 (INVITE).
32							SIP ACK	The ACK is sent to UEB.
33								The dedicated bearer(s) has/have been released.

8.2.4.2 SIP Session Abort - Terminating Leg

Interoperability Test Description	
Identifier:	**TD_IMSEPC_Roam_Session_Abort_Terminating**
Purpose:	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.
Config.:	CF_IMSEPC_Roam
SUT:	IMS, PCRF and EPC
Ref.:	TS 124 229 [2], clause 5.2.7.3 (Initial INVITE/Terminating Case). TS 129 214 [5], clause 4.4.4 (AF Session Termination). TS 129 212 [6], clause 4.5.2 (Provision of PCC rules). TS 129 215 [9], clause 4.5.3.6 (Rx over S9).

Interoperability Test Description		
Pre-test conditions:	• UE_A & UE_B previously attached to EPC. UEB 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. • EPC 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.
	9	Verify that media between UE_B and UE_A can no longer be exchanged and is filtered out by EPC.
Conformance Criteria:	**Check**	
	1-15	As checks 1-15 of clause 8.2.1.2 (SIP Session Establishment, terminating leg, to the point at which the call is ringing)

	16	TP_EPC_6032_01
		ensure that {
		when { UE_A sends media to UE_B }
		then { EPC filters the IP_packets }
		then { the IP_packets not visible on PO_SGi }
		when { UE_B sends early_media to UE_A }
		then { EPC uses_correct_bearers for service_data_flows }
		then { UE_A receives media }
		}

	17	TP_EPC_6034_02
		ensure that {
		when { IMS_P-CSCF receives CANCEL from IMS_S-CSCF }
		then { IMS_P-CSCF sends Session-Termination-Request to PCRF
		containing Session-Id_AVP
		indicating session for SIP_session
		}
		}

	18-19	As steps 3-4 of clause 8.2.3.2 (tunnelling STR/STA between the visited and him PCRFs).

	20	TP_EPC_8002_06
		ensure that {
		when { visited PCRF receives ST-Answer from home PCRF }
		then {PCRF invokes the EPC P-GW with a RAR }
		containing a Charging-Rule-Remove AVP
		containing a Charging-Rule-Name AVP
		}

	21	TP_EPC_7002_03
		ensure that {
		when { P-GW receives RA-Request from PCRF }
		then { P-GW sends RA-Answer to PCRF
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001)
		}
		}

	22	TP_EPC_7002_19
		ensure that {
		when { PCRF receives RA-Answer from EPC P-GW }
		then { PCRF sends Session-Termination-Answer to IMS_P-CSCF
		containing Session-Id_AVP
		indicating session for IMS_signalling session
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001)
		}
		}

Interoperability Test Description		

	23	TP_EPC_6003_02
		ensure that {
		when { UE_A sends media to UE_B }
		then { EPC filters the IP_packets }
		then { the IP_packets not visible on PO_SGi }
		when { UE_B sends media to UE_A }
		then { EPC filters the IP_packets }
		then { the IP_packets not visible on PO_SGi }
		}

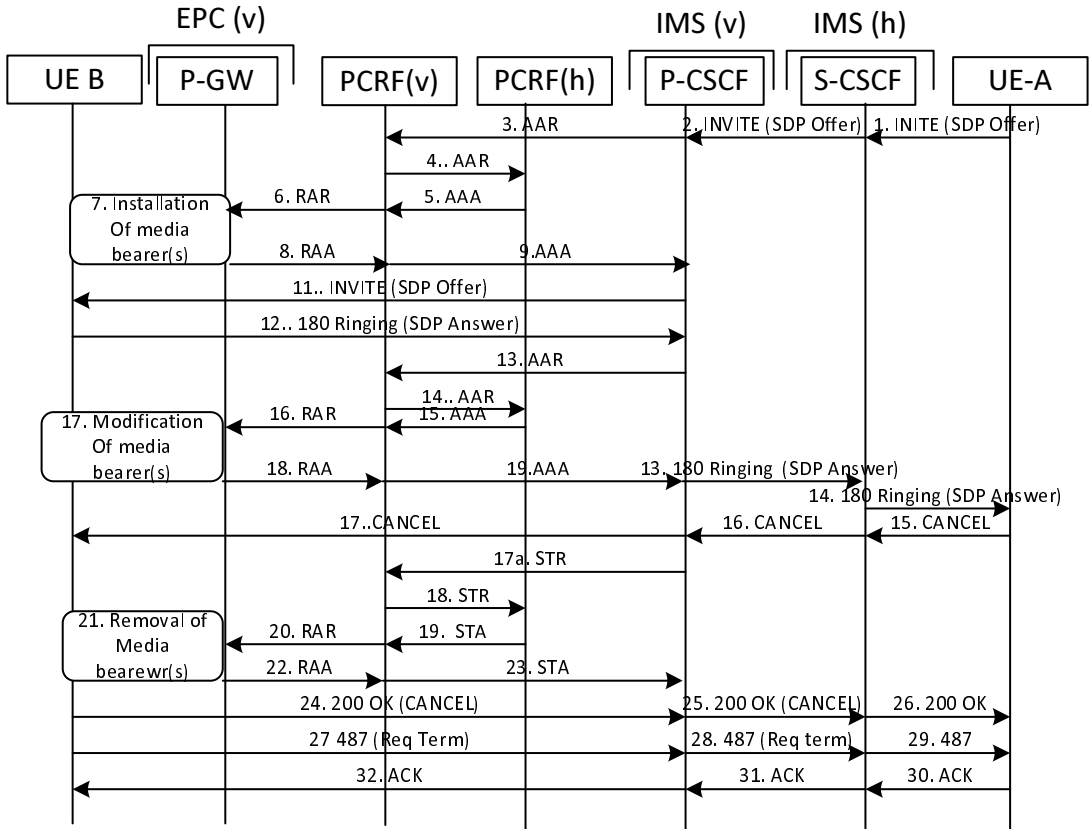


Figure 37: SIP Session Abort - Terminating Leg (Roaming)

Step	Direction						Message	Comment
	UEA	EPC	PCRF (v)	PCRF (h)	IMS	UEB		
1					→		SIP INVITE (SDP)	UEA initiates the SIP session with an NVITE containing the SDP offer.
2				←			DIAMETER AAR	The terminating IMS P-CSCF invokes the visited PCRF.
4				→			DIAMETER AAR	The visited PCRF invokes the home PCRF.
5				←			DIAMETER AAA	The home PCRF responds.
6			←				DIAMETER RAR	Visited PCRF sends RAR to EPC P-GW.
7			→				DIAMETER RAA	EPC P-GW responds.
8					←		DIAMETER AAA	Visited PCRF responds to IMS P-CSCF.
9					→		SIP INVITE (SDP)	IMS forwards the INVITE to UEB.
10					←		SIP 180 OK (SDP)	UE-B responds with a 180 (ringing) response with SDP and notification of early media.
11				←			DIAMETER AAR	The IMS P-CSCF invokes the visited PCRF.
12				→			DIAMETER AAR	The visited PCRF invokes the home PCRF.
13				←			DIAMETER AAA	The home PCRF responds.
14			←				DIAMETER RAR	Visited PCRF sends RAR to EPC P-GW.
15			→				DIAMETER RAA	EPC P-GW responds.
16					←		DIAMETER AAA	Visited PCRF responds to IMS P-CSCF.
17	←						SIP 180 OK (SDP)	Terminating P-CSCF forwards the 180 (ringing) to UEA via S-CSCF.
18								Early media is flowing from UE-B to UE-A.
19					→		SIP CANCEL	UEA aborts the session.
20					→		SIP CANCEL	IMS forwards the CANCEL to UEB.
21				←			DIAMETER STR	The IMS P-CSCF invokes the visited PCRF to release the media bearer.
22				→			DIAMETER STR	The visited PCRF invokes the home PCRF.
23				←			DIAMETER STA	The home PCRF responds.
24			←				DIAMETER RAR	Visited PCRF sends RAR to EPC P-GW.
25			→				DIAMETER RAA	EPC P-GW responds.
26					←		DIAMETER STA	Visited PCRF responds to IMS P-CSCF.
27					←		SIP 200 OK (CANCEL)	UE-B responds 200 OK.
28	←						SIP 200 OK (CANCEL)	P-CSCF forwards the SIP 200 OK (CANCEL) to UEA via S-CSCF.
29					←		SIP 487 (INV)	UE-B responds 487 (Request Terminated)
30	←						SIP 487 (INV)	P-CSCF forwards the SIP 487 to UEA via S-CSCF
31							SIP ACK	The UEA sends ACK to 487 (INVITE).
32					→		SIP ACK	The ACK is sent to UEB.
33								The dedicated bearer(s) has/have been released.

8.2.4.3 SIP Session Reject - Originating Leg

Interoperability Test Description	
Identifier:	**TD_IMSEPC_Roam_Session_Reject _Originating**
Purpose:	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.
Config.:	CF_IMSEPC_Roam
SUT:	IMS, PCRF and EPC
Ref.:	TS 124 229 [2], clause 5.2.7.2 (Initial INVITE/Originating Case). TS 129 214 [5], clause 4.4.4 (AF Session Termination). TS 129 212 [6], clause 4.5.2 (Provision of PCC rules). TS 129 215 [9], clause 4.5.3.6 (Rx over S9).

Interoperability Test Description		
Pre-test conditions:	• UE_A & UE_B previously attached to EPC. 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. • EPC 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	Verify that media bearer is initiated and reflects the SDP offer.
	4	UE_B rejects session establishment
	5	Verify that P-CSCF terminates the Rx session, triggering the 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 cannot be exchanged and is filtered out by EPC.
Conformance Criteria:	**Check**	
	1-8	As checks 1-8 of clause 8.2.1.1 (SIP Session Establishment, originating leg, to the point at which the INVITE is forwarded from the P-CSCF and delivered to UEB)

	9	TP_EPC_7002_21
		ensure that {
		when { IMS_P-CSCF receives 486_response on INVITE from IMS-S-CSCF
		}
		then { IMS_P-CSCF sends Session-Termination-Request to PCRF
		containing Session-Id_AVP
		indicating session for SIP_session
		}
		}

	10-11	As steps 3-4 of clause 8.2.3.1 (tunnelling STR & STA between the visited and home PCRFs)

	12	TP_EPC_8002_06
		ensure that {
		when { visited PCRF receives ST-Answer from home PCRF }
		then {visited PCRF invokes the EPC P-GW with a RAR }
		containing a Charging-Rule-Remove AVP
		containing a Charging-Rule-Name AVP
		}

	13	TP_EPC_7002_03
		ensure that {
		when { P-GW receives RA-Request from PCRF }
		then { P-GW sends RA-Answer to PCRF
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001)
		}
		}

	14	TP_EPC_7002_19
		ensure that {
		when { PCRF receives RA-Request from PC P-GW }
		then { PCRF sends Session-Termination-Answer to IMS_P-CSCF
		containing Session-Id_AVP
		indicating session for IMS_signalling session
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001)
		}
		}

	15	TP_EPC_6003_02
		ensure that {
		when { UE_A sends media to UE_B }
		then { EPC filters the IP_packets }
		then { the IP_packets not visible on PO_SGi }
		when { UE_B sends media to UE_A }
		then { EPC filters the IP_packets }
		then { the IP_packets not visible on PO_SGi }
		}

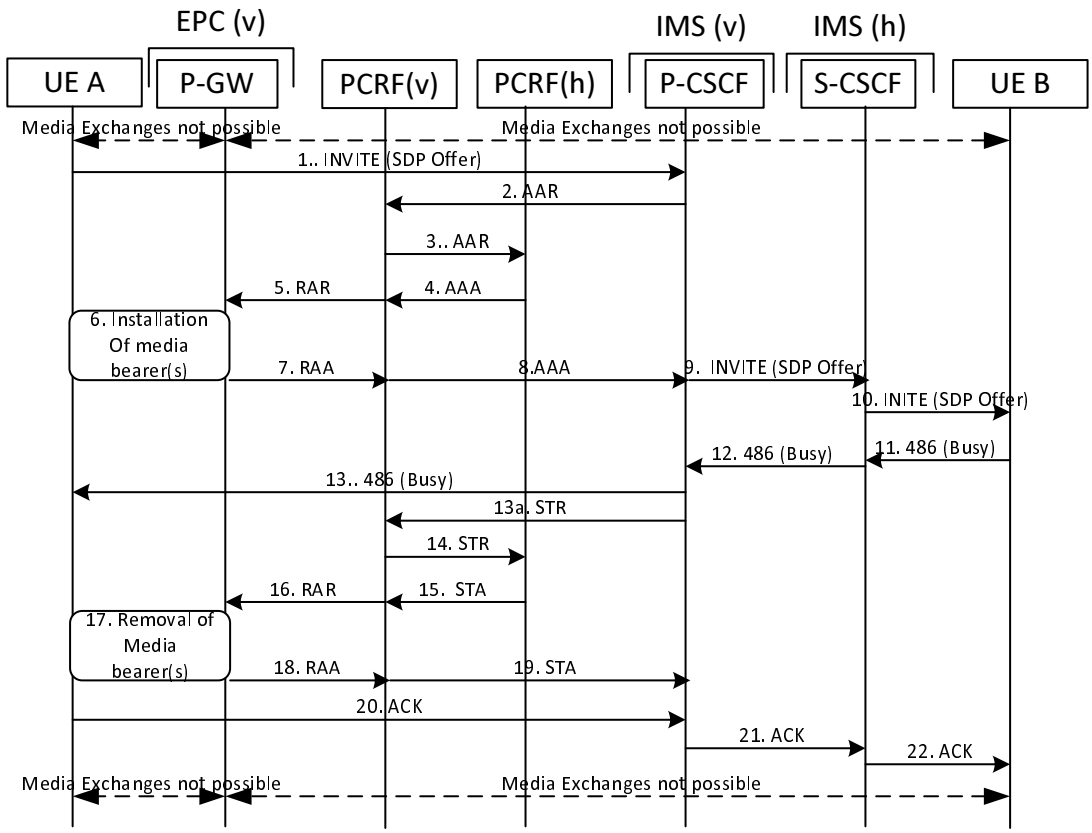


Figure 38: SIP Session Reject - Originating Leg (Roaming)

Step	Direction						Message	Comment
	UEA	EPC	PCRF (v)	PCRF (h)	IMS	UEB		
1							SIP INVITE (SDP)	UEA initiates the SIP session with an INVITE containing the SDP offer.
2							DIAMETER AAR	The IMS P-CSCF invokes the visited PCRF.
4							DIAMETER AAR	The visited PCRF invokes the home PCRF.
5							DIAMETER AAA	The home PCRF responds.
6							DIAMETER RAR	Visited PCRF sends RAR to EPC P-GW.
7							DIAMETER RAA	EPC P-GW responds.
8							DIAMETER AAA	Visited PCRF responds to IMS P-CSCF.
9							SIP INVITE (SDP)	IMS forwards the INVITE to UEB.
10							SIP 486 (Busy)	UE-B responds with a 486 (busy) response.
11							DIAMETER STR	The IMS P-CSCF invokes the visited PCRF to release the media bearer.
12							DIAMETER STR	The visited PCRF invokes the home PCRF.
13							DIAMETER STA	The home PCRF responds.
14							DIAMETER RAR	Visited PCRF sends RAR to EPC P-GW.
15							DIAMETER RAA	EPC P-GW responds.
16							DIAMETER STA	Visited PCRF responds to IMS P-CSCF.
17							SIP 486 (Busy)	P-CSCF forwards the 486 (busy) response to UEA.
18							SIP ACK	The UEA sends ACK to 486 (busy).
19							SIP ACK	The ACK is sent to UEB.
20								The dedicated bearer(s) has/have been released.

8.2.4.4 SIP Session Reject - Terminating Leg

Interoperability Test Description		
Identifier:	**TD_IMSEPC_Roam_Session_Reject _Terminating**	
Purpose:	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.	
Config.:	CF_IMSEPC_Roam	
SUT:	IMS, PCRF and EPC	
Ref.:	TS 124 229 [2], clause 5.2.7.3 (Initial INVITE/Terminating Case). TS 129 214 [5], clause 4.4.4 (AF Session Termination). TS 129 212 [6], clause 4.5.2 (Provision of PCC rules). TS 129 215 [9], clause 4.5.3.6 (Rx over S9).	
Pre-test conditions:	• UE_A & UE_B previously attached to EPC. 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. • EPC 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 the media between UE_B and UE_A can no longer be exchanged and is filtered out by EPC.
Conformance Criteria:	**Check**	
	1-8	As checks 1-8 of clause 8.2.1.2 (SIP Session Establishment, terminating leg, to the point at which the INVITE is forwarded from the P-CSCF and delivered to UEB)

	9	TP_EPC_6034_04
		ensure that {
		when { IMS_P-CSCF receives 486_response on INVITE from UE_B }
		then { IMS_P-CSCF sends Session-Termination-Request to PCRF
		containing Session-Id_AVP
		indicating session for SIP_session
		}
		}

	10-11	As steps 3-4 of clause 8.2.3.1 (tunnelling STR & STA between the visited and home PCRFs)

	12	TP_EPC_8002_06
		ensure that {
		when { visited PCRF receives ST-Answer from home PCRF }
		then {visited PCRF invokes the EPC P-GW with a RAR }
		containing a Charging-Rule-Remove AVP
		containing a Charging-Rule-Name AVP
		}

	13	TP_EPC_7002_03
		ensure that {
		when { P-GW receives RA-Request from PCRF }
		then { P-GW sends RA-Answer to PCRF
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001)
		}
		}

	14	TP_EPC_7002_19 ensure that { when { PCRF receives RA-Answer from EPC P-GW } then { PCRF sends Session-Termination-Answer to IMS_P-CSCF

Interoperability Test Description		
		containing Session-Id_AVP indicating session for IMS_signalling session containing Result-Code_AVP indicating DIAMETER_SUCCESS(2001) } }

	15	TP_EPC_6003_02
		ensure that {
		when { UE_A sends media to UE_B }
		then { EPC filters the IP_packets }
		then { the IP_packets not visible on PO_SGi }
		when { UE_B sends media to UE_A }
		then { EPC filters the IP_packets }
		then { the IP_packets not visible on PO_SGi }
		}

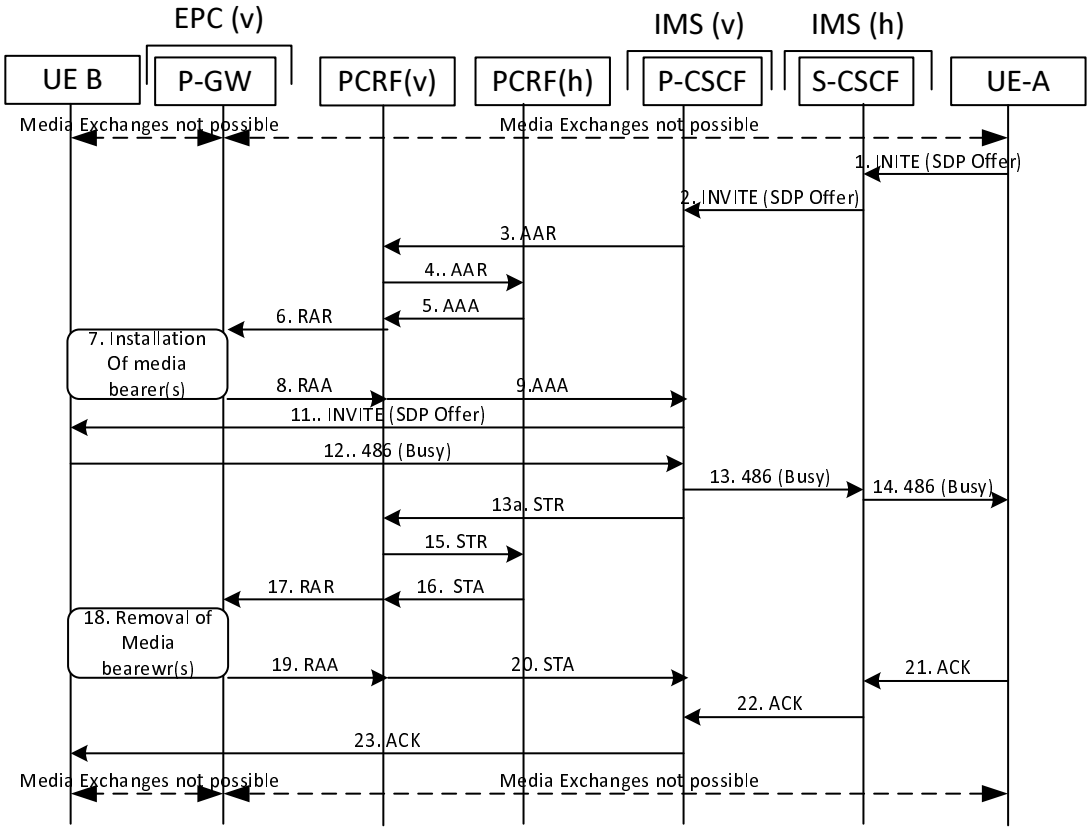


Figure 39: SIP Session Reject - Terminating Leg (Roaming)

Step	Direction						Message	Comment
	UEA	EPC	PCRF (v)	PCRF (h)	IMS	UEB		
1							SIP INVITE (SDP)	UEA initiates the SIP session with an INVITE containing the SDP offer.
2							DIAMETER AAR	The IMS P-CSCF invokes the visited PCRF.
4							DIAMETER AAR	The visited PCRF invokes the home PCRF.
5							DIAMETER AAA	The home PCRF responds.
6							DIAMETER RAR	Visited PCRF sends RAR to EPC P-GW.
7							DIAMETER RAA	EPC P-GW responds.
8							DIAMETER AAA	Visited PCRF responds to IMS P-CSCF.
9							SIP INVITE (SDP)	IMS forwards the INVITE to UEB.
10							SIP 486 (Busy)	UE-B responds with a 486 (busy) response.
11							DIAMETER STR	The IMS P-CSCF invokes the visited PCRF to release the media bearer.
12							DIAMETER STR	The visited PCRF invokes the home PCRF.
13							DIAMETER STA	The home PCRF responds.
14							DIAMETER RAR	Visited PCRF sends RAR to EPC P-GW.
15							DIAMETER RAA	EPC P-GW responds.
16							DIAMETER STA	Visited PCRF responds to IMS P-CSCF.
17							SIP 486 (Busy)	P-CSCF forwards the 486 (busy) response to UEA.
18							SIP ACK	The UEA sends ACK to 486 (busy).
19							SIP ACK	The ACK is sent to UEB.
20								The dedicated bearer(s) has/have been released.

8.3 IMS De-Registration

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 7.3 but involving a roaming UE.

8.3.1 IMS De-registration (no SIP session active)

Interoperability Test Description		
Identifier:	**TD_IMSEPC_Roam_DeRegistration_UE**	
Purpose:	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.	
Config.:	CF_IMSEPC_Roam	
SUT:	IMS, PCRF and EPC	
Ref.:	TS 124 229 [2], clause 5.4.1.4.1 (User-initiated de-registration/Normal cases). TS 129 214 [5], clause 4.4.5a (Provisioning of AF Signalling Flow Information). TS 129 214 [5], clause 4.4.4 (AF Session Termination). TS 129 214 [5], clause A.8 (Provision of Signalling Flow Information at P-CSCF). TS 129 212 [6], clause 4.5.2 (Provision of PCC rules). TS 129 215 [9], clause 4.5.3.6 (Rx over S9).	
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

Interoperability Test Description		
		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:	**Check**	
	1-2	As steps 1-2 of clause 7.3.1 (UE initiated IMS de-registration)
	3-4	As steps 3-4 of clause 8.2.3.1 (tunnelling STR & STA between the visited and home PCRFs)

	5	TP_EPC_8002_06
		ensure that {
		when { visited PCRF receives ST-Answer from home PCRF }
		then {visited PCRF invokes the EPC P-GW with a RAR }
		containing a Charging-Rule-Remove AVP
		containing a Charging-Rule-Name AVP
		}

	6	TP_EPC_7002_03
		ensure that {
		when { P-GW receives RA-Request from PCRF }
		then { P-GW sends RA-Answer to PCRF
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001)
		}
		}

	7	TP_EPC_7002_19
		ensure that {
		when { PCRF receives RA-Answer from EPC P-GW }
		then { PCRF sends Session-Termination-Answer to IMS_P-CSCF
		containing Session-Id_AVP
		indicating session for IMS_signalling session
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001)
		}
		}

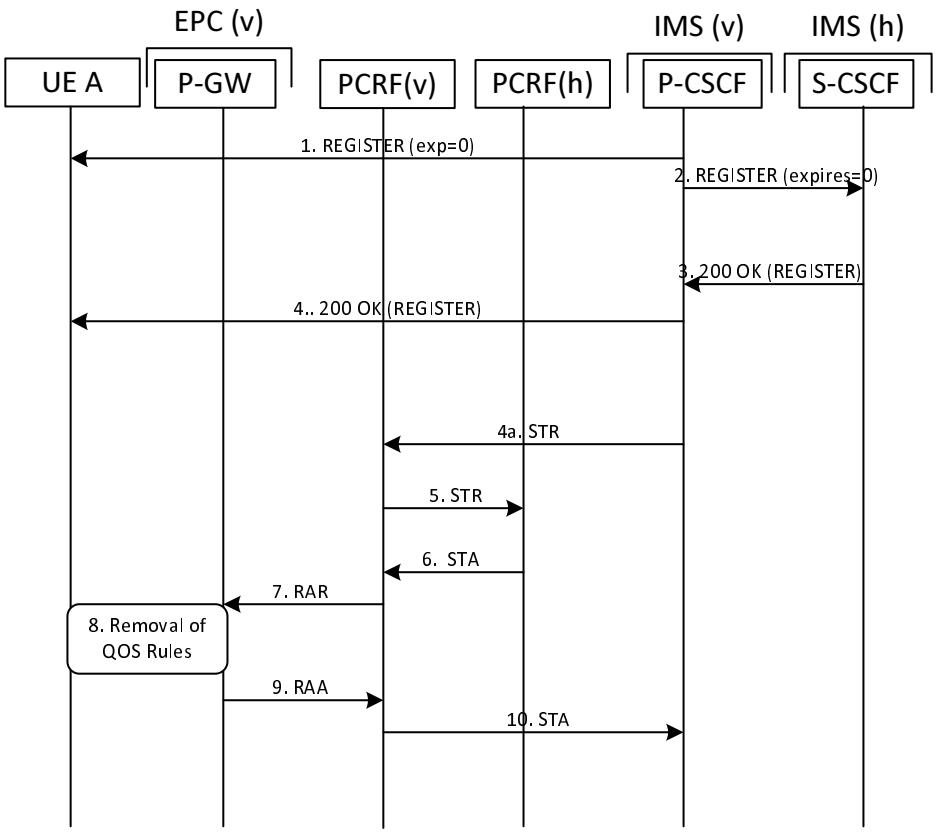


Figure 40: IMS De-registration (Roaming)

Step	Direction						Message	Comment
	User	UE	EPC	PCRF (v)	PCRF (h)	IMS		
1								User triggers IMS de-registration.
2		→					SIP REGISTER	The UE-A requests IMS De-Registration.
3			→	→			SIP 200 OK Response	IMS de-registers the user and responds OK.
4								User is informed that de-registration is complete.
5				←			DIAMETER STR	The P-CSCF initiates removal of the session binding to the default bearer.
6				→			DIAMETER STR	The visited PCRF invokes the home PCRF.
7				←			DIAMETER STA	The home PCRF responds.
8			←				DIAMETER RAR	The PCRF removes the QOS rules at the P-GW to modify the default bearer.
9				→			DIAMETER RAA	The P-GW in the EPC responds to the PCRF.
10					→		DIAMETER STA	Visited PCRF responds to IMS P-CSCF.
11								The default bearer has been successfully modified.

8.3.2 IMS Administrative De-Registration (no SIP session active)

Interoperability Test Description	
Identifier:	**TD_IMSEPC_Roam_DeRegistration_Administrative**
Purpose:	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.

Interoperability Test Description		
Config.:	CF_IMSEPC_Roam	
SUT:	IMS, PCRF and EPC	
Ref.:	TS 124 229 [2], clause 5.4.1.5 (Network-initiated de-registration). TS 129 214 [5], clause 4.4.5a (Provisioning of AF Signalling Flow Information). TS 129 214 [5], clause 4.4.4 (AF Session Termination). TS 129 214 [5], clause A.8 (Provision of Signalling Flow Information at P-CSCF). TS 129 212 [6], clause 4.5.2 (Provision of PCC rules). TS 129 215 [9], clause 4.5.3.6 (Rx over S9).	
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:	**Check**	
	1-2	As steps 1-2 of clause 7.3.2 (Admin. initiated IMS de-registration)
	3-4	As steps 3-4 of clause 8.2.3.1 (tunnelling STR & STA between the visited and home PCRFs)

	5	TP_EPC_8002_06
		ensure that {
		when { visited PCRF receives ST-Answer from home PCRF }
		then {visited PCRF invokes the EPC P-GW with a RAR }
		containing a Charging-Rule-Remove AVP
		containing a Charging-Rule-Name AVP
		}

	6	TP_EPC_7002_03
		ensure that {
		when { P-GW receives RA-Request from PCRF }
		then { P-GW sends RA-Answer to PCRF
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001)
		}
		}

	7	TP_EPC_7002_19
		ensure that {
		when { PCRF receives RA-Answer from EPC P-GW }
		then { PCRF sends Session-Termination-Answer to IMS_P-CSCF
		containing Session-Id_AVP
		indicating session for IMS_signalling session
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001)
		}
		}

	8-9	As steps 5-6 of clause 7.3.2.

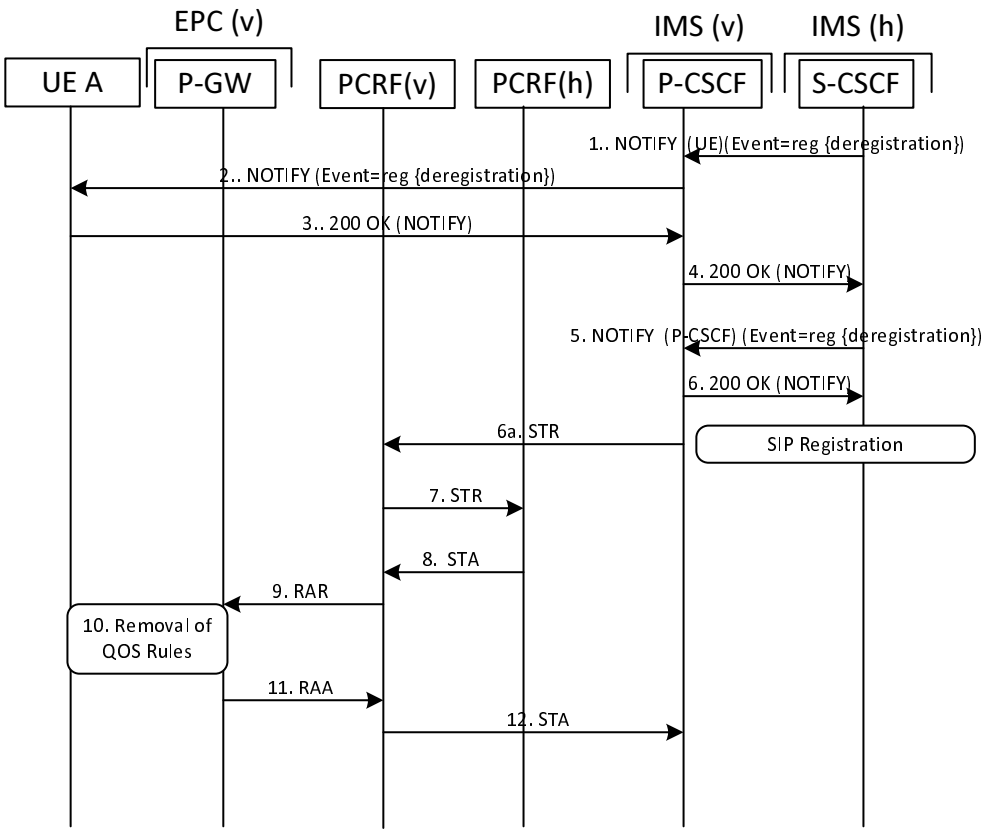


Figure 41: IMS Administrative De-Registration (Roaming)

Step	Direction						Message	Comment
	User	UE	EPC	PCRF (v)	PCRF (h)	IMS		
1								IMS initiates admin. De-Registration.
2			←				SIP NOTIFY	IMS informs the UE of the de-registration via a SIP Notify (UE previously subscribed to the reg-event package).
3							SIP 200 OK	UE responds OK.
4								User is informed that de-registration is complete.
5				←			DIAMETER STR	The P-CSCF initiates removal of the session binding to the default bearer.
6				→			DIAMETER STR	The visited PCRF invokes the home PCRF.
7				←			DIAMETER STA	The home PCRF responds.
8			←				DIAMETER RAR	The PCRF removes the QOS rules at the P-GW to modify the default bearer.
9				→			DIAMETER RAA	The P-GW in the EPC responds to the PCRF.
10						→	DIAMETER STA	Visited PCRF responds to IMS P-CSCF.
11								The default bearer has been successfully modified.

8.3.3 IMS Registration Expiration (no SIP session active)

Interoperability Test Description		
Identifier:	**TD_IMSEPC_Roam_DeRegistration_Expiration**	
Purpose:	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.	
Config.:	CF_IMSEPC_Roam	
SUT:	IMS, PCRF and EPC	
Ref.:	TS 129 214 [5], clause 4.4.5a (Provisioning of AF Signalling Flow Information). TS 129 214 [5], clause 4.4.4 (AF Session Termination). TS 129 214 [5], clause A.8 (Provision of Signalling Flow Information at P-CSCF). TS 129 212 [6], clause 4.5.2 (Provision of PCC rules). TS 129 215 [9], clause 4.5.3.6 (Rx over S9).	
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:	**Check**	
	1	As check 1 of clause 7.3.3.
	2-3	As steps 3-4 of clause 8.2.3.1 (tunnelling STR & STA between the visited and home PCRFs)

	4	TP_EPC_8002_06
		ensure that {
		when { visited PCRF receives ST-Answer from home PCRF }
		then {visited PCRF invokes the EPC P-GW with a RAR }
		containing a Charging-Rule-Remove AVP
		containing a Charging-Rule-Name AVP
		}

	5	TP_EPC_7002_03
		ensure that {
		when { P-GW receives RA-Request from PCRF }
		then { P-GW sends RA-Answer to PCRF
		containing Result-Code_AVP
		indicating DIAMETER_SUCCESS(2001)
		}
		}

	6-7	As steps 5-6 of clause 7.3.4.

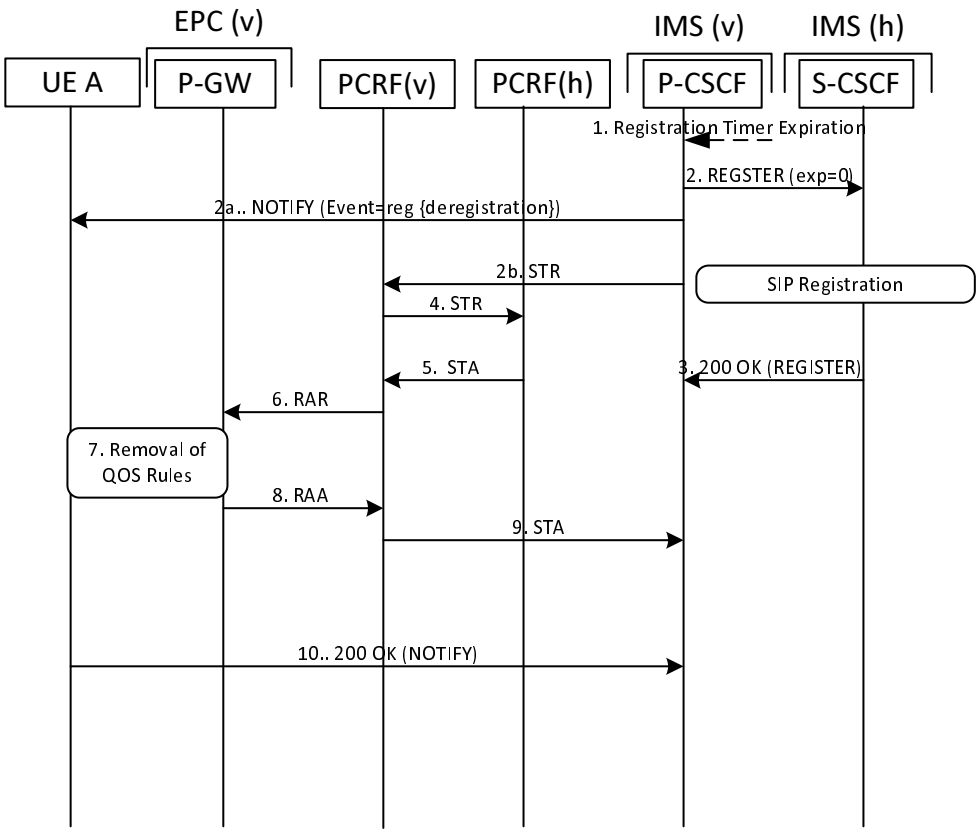
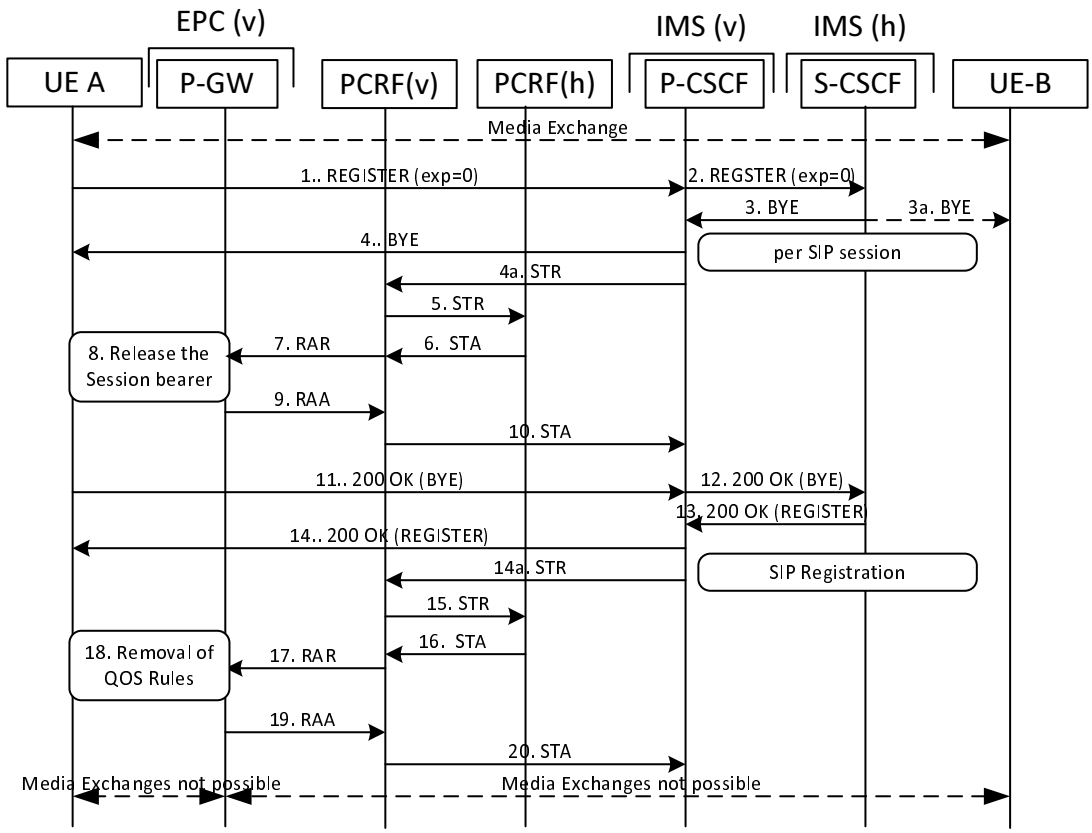


Figure 42: IMS Registration Expiration (Roaming)

Step	Direction							Message	Comment
	User	UE	EPC	PCRF (v)	PCRF (h)	IMS			
1									IMS initiates De-Registration due to timer expiry.
2			←	←		←		SIP NOTIFY	IMS informs the UE of the de-registration via a SIP Notify (UE previously subscribed to the reg-event package).
3								SIP 200 OK	UE responds OK.
4			→	→		→			User is informed that the UE is de-registered.
5				←		←		DIAMETER STR	The P-CSCF initiates removal of the session binding to the default bearer.
6				→	→			DIAMETER STR	The visited PCRF invokes the home PCRF.
7				←	←			DIAMETER STA	The home PCRF responds.
8			←	←				DIAMETER RAR	The PCRF removes the QOS rules at the P-GW to modify the default bearer.
9				→	→			DIAMETER RAA	The P-GW in the EPC responds to the PCRF.
10				→	→	→		DIAMETER STA	Visited PCRF responds to IMS P-CSCF.
11									The default bearer has been successfully modified.

8.3.4 IMS De-registration with Active SIP Sessions

Interoperability Test Description		
Identifier:	**TD_IMSEPC_Roam_DeRegistration_UE_Active_Session**	
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 exchange any longer 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.	
Config.:	CF_IMSEPC_Roam	
SUT:	IMS, PCRF and EPC	
Ref.:	TS 124 229 [2], clause 5.4.1.4.1 (User-initiated de-registration). TS 124 229 [2], clause 5.4.5.1 (S-CSCF-initiated call release). TS 129 214 [5], clause 4.4.5a (Provisioning of AF Signalling Flow Information). TS 129 214 [5], clause 4.4.4 (AF Session Termination). TS 129 214 [5], clause A.8 (Provision of Signalling Flow Information at P-CSCF). TS 129 212 [6], clause 4.5.2 (Provision of PCC rules). TS 129 215 [9], clause 4.5.3.6 (Rx over S9).	
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".	
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:	**Check**	
	1-2	As checks 1-2 in clause 7.3.4.
	3-10	As checks 1-8 in clause 8.2.3.2 (N/W initiated Session Release)
	11-18	As checks 1-7 of clause 8.3.1 (UE initiated IMS de-registration)



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

Figure 43: IMS UE De-registration with Active Session (Roaming)

Step	Direction							Message	Comment
	User	UE	EPC	PCRF (v)	PCRF (h)	IMS			
1									User triggers IMS de-registration.
2		→						SIP REGISTER	The UE-A requests IMS De-Registration.
3			→		→			SIP BYE	IMS releases the active SIP session.
4			←		→			SIP 200 OK	UE responds OK (to the BYE).
5									User is informed that the session is released.
6		←			←			DIAMETER STR	The P-CSCF initiates release of the session bearer.
7					→			DIAMETER STR	The visited PCRF invokes the home PCRF.
8					←			DIAMETER STA	The home PCRF responds.
9				←				DIAMETER RAR	The PCRF invokes the P-GW to release the session bearer.
10				→				DIAMETER RAA	The P-GW in the EPC responds to the PCRF.
11					→			DIAMETER STA	Visited PCRF responds to IMS P-CSCF.
12									The session bearer has been released.
13			←					SIP 200 OK Response	IMS de-registers the user and responds OK.
14		←							User is informed that the de-registration is complete.
15					←			DIAMETER STR	The P-CSCF initiates removal of the session binding to the default bearer.
16					→			DIAMETER STR	The visited PCRF invokes the home PCRF.
17					←			DIAMETER STA	The home PCRF responds.
18				←				DIAMETER RAR	The PCRF removes the QOS rules at the P-GW to modify the default bearer.
19				→				DIAMETER RAA	The P-GW in the EPC responds to the PCRF.
20					→			DIAMETER STA	Visited PCRF responds to IMS P-CSCF.
21									The default bearer has been successfully modified.

8.4 Network Detachment

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 7.4 but involving a roaming UE.

8.4.1 UE Initiated Network Detachment (no IMS Registration)

Interoperability Test Description	
Identifier:	**TD_IMSEPC_Roam_UE_Network_Detachment**
Purpose:	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_IMSEPC_Roam
SUT:	PCRF and EPC
Ref.:	TS 129 212 [6], clause 4.5.7 (Indication of IP-CAN session termination). TS 129 215 [9], clause 4.5.1.2 (S9 session termination). TS 129 215 [9], clause 4.5.3.3 (S9 session/sub-session termination initiated by the V-PCRF).
Pre-test conditions:	• Roaming UE_A previously attached to EPC with a single attachment

Interoperability Test Description		
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:	**Check**	

	1	TP_EPC_8004_01
		ensure that {
		when { UE_A starts_complete_network_detachment from EPC }
		then { EPC removes_relevant_bearers } and
		
		when { P-GW is invoked with a delete session request}
		then { a DIAMETER CC-Request message is generated
		(
		containing CC_Request_Type AVP set to
		"TERMINATION_REQUEST"
		)
		}
		}

	2	TP_EPC_8004_02 Ensure that{ when { Visited PCRF is invoked with a DIAMETER CCR message} then { a DIAMETER CCR message is generated to the home PCRF (containing AVPs received from P-GW containing Subsession-Enforcement-Info AVP made up of Subsession-Id AVP Subsession-Operation AVP set to TERMINATION (0)) }

	3	TP_EPC_8004_03
		Ensure that{
		when { home PCRF is invoked with a CCR from visited PCRF}
		then { a DIAMETER CCA message is generated to the visited PCRF
		(
		containing the Result-Code AVP
		indicating DIAMETER_SUCCESS(2001)
		containing Subsession-Decision-Info AVP
		containing Subsession-Id AVP
		)
		}

	4	TP_EPC_8004_04
		Ensure that{
		when { visited PCRF receives CCA from home PCRF}
		then { a DIAMETER CCA message is generated to the P-GW
		(
		containing the Result-Code AVP
		indicating DIAMETER_SUCCESS(2001)
		
		)
		}

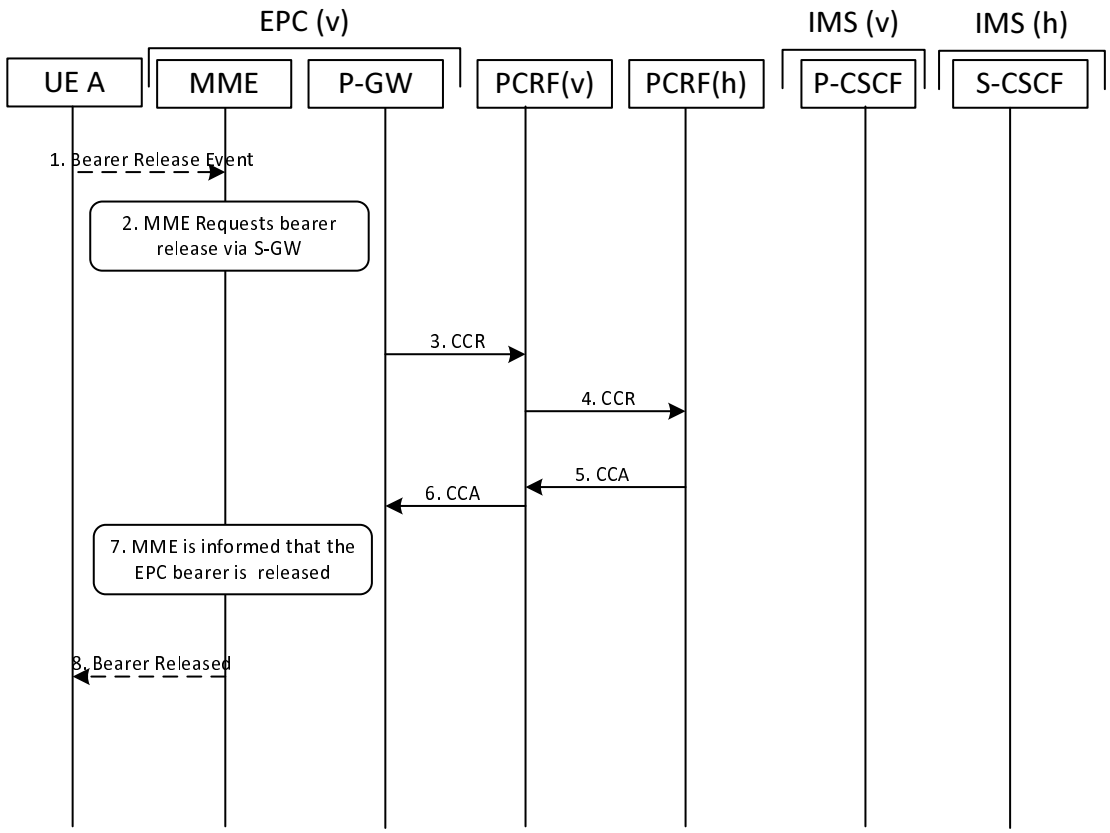


Figure 44: UE Initiated Network Detachment - not IMS Registered (Roaming)

Step	Direction						Message	Comment
	User	UE	EPC	PCRF (v)	PCRF (h)	IMS		
1								User initiates detachment on UE-A.
2		→	→					The UE-A requests IP-CAN session dis-establishment to the EPC (MME).
3				→			DIAMETER CCR	The P-GW sends a CCR message to the V-PCRF to inform the PCRF that the default bearer is being released.
4					→		DIAMETER CCR	The visited PCRF invokes the home PCRF.
5					←		DIAMETER CCA	The home PCRF responds.
6				←			DIAMETER CCA	The V-PCRF responds with a CCA.
7			←					The MME responds to the UE, confirming that the IP-CAN has been successfully released.
8		←						User is informed that the default bearer has been successfully released.

8.4.2 UE Initiated Network Detachment with Previously Established IMS Registration

Interoperability Test Description	
Identifier:	**TD_IMSEPC_Roam_UE_Network_Detachment_IMS_Reg**
Purpose:	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_IMSEPC_Roam

Interoperability Test Description		
SUT:	IMS, PCRF and EPC	
Ref.:	TS 129 214 [5], clause 4.4.6.1 (IP-CAN Session Termination). TS 129 212 [6], clause 4.5.7 (Indication of IP-CAN session termination). TS 129 215 [9], clause 4.5.1.2 (S9 session termination). TS 129 215 [9], clause 4.5.3.3 (S9 session/sub-session termination initiated by the V-PCRF). TS 129 215 [9], clause 4.5.3.6 (Rx over S9).	
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.
	3	Verify that PCRF informs IMS P-CSCF of the loss of the bearer.
	4	Verify that IMS performs P-CSCF-initiated administrative de-registration on
	5	Verify that IMS P-CSCF terminates the Rx session with PCRF.
	6	Verify that the Rx messages are sent over S9 between the visited and home PCRFs.
	7	Verify that the S9 session is terminated.
Conformance Criteria:	**Check**	
	1-4	`As checks 1-4 of clause 8.4.1.`

	5	`TP_EPC_8004_05`
		`ensure that {`
		`  when { home PCRF triggers_termination of SIP_signalling session }`
		`  then { home PCRF sends Abort-Session-Request to visited PCRF`
		`  containing Session-Id_AVP`
		`  indicating session of SIP_session`
		`  containing Abort-Cause_AVP`
		`  indicating BEARER_RELEASED (0)`
		`  }`
		`}`

	6	`TP_EPC_8004_06`
		`ensure that {`
		`  when { visited PCRF receives the Abort-Session-Request}`
		`  then { visited PCRF sends Abort-Session-Request to P-CSCF`
		`  containing Session-Id_AVP`
		`  indicating session of SIP_session`
		`  containing Abort-Cause_AVP`
		`  indicating BEARER_RELEASED (0)`
		`  }`
		`}`

Interoperability Test Description		
	7	As step 4 of clause 7.4.2.

	8	TP_EPC_8004_07
		ensure that {
		when { visted PCRF receives Abort-Session-Answer from IMS_P-CSCF
		containing Session-Id_AVP
		indicating session for SIP_session
		containing Result-Code AVP
		indicating DIAMETER_SUCCESS (2001)
		}
		then { visited PCRF sends Abort-Session-Answer to home PCRF
		containing AVPs as received from P-CSCF}

	9	TP_EPC_8004_08
		ensure that {
		when { visted PCRF receives Session-Termination-Request from IMS_P-CSCF
		containing Session-Id_AVP
		indicating session for SIP_session
		}
		then { visited PCRF sends Session-Termination-Request to home PCRF
		containing Session-Id_AVP
		indicating SIP_session value_received from IMS P-CSCF}

	10	TP_EPC_8004_09
		ensure that {
		when { home PCRF receives Session-Termination-Request from visited PCRF
		containing Session-Id_AVP
		indicating session for SIP_session
		}
		then { home PCRF sends Session-Termination-Answer to visited PCRF
		containing Session-Id_AVP
		indicating SIP_session value_received from visited
		containing Result-Code AVP
		indicating DIAMETER_SUCCESS (2001) }

	11	As step 6 of clause 7.4.2.

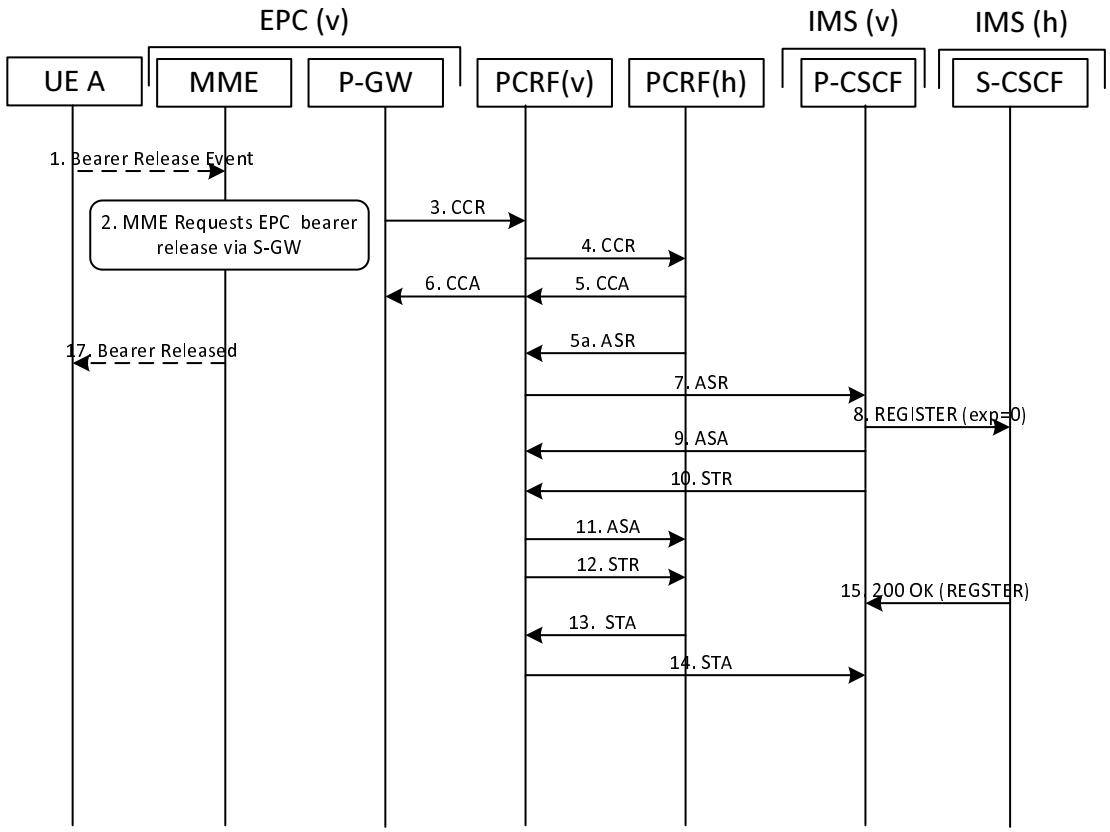


Figure 45: UE Initiated Network Detachment - IMS Registered (Roaming)

Step	Direction						Message	Comment
	User	UE	EPC	PCRF (v)	PCRF (h)	IMS		
1								User initiates detachment on UE-A.
2		→	→					The UE-A requests IP-CAN session dis-establishment to the EPC (MME).
3				→			DIAMETER CCR	The P-GW sends a CCR message to the V-PCRF to inform the PCRF that the default bearer is being released.
4					→		DIAMETER CCR	The visited PCRF invokes the home PCRF.
5					←		DIAMETER CCA	The home PCRF responds.
6				←			DIAMETER CCA	The V-PCRF responds with a CCA.
7			←					The MME responds to the UE, confirming that the IP-CAN has been successfully released.
8		←						User is informed that the default bearer has been successfully released.
9					←		DIAMETER ASR	Home PCRF sends ASR to the P-CSCF (via the visited PCRF).
10					→	→	DIAMETER ASR	Visited PCRF passes ASR thru to the P-CSCF.
11						←	DIAMETER ASA	P-CSCF responds with ASA.
12					←		DIAMETER ASA	ASA message is passed onto the home PCRF.
13					→		DIAMETER STR	IMS P-CSCF send s STR to abort the Rx session.
14					→		DIAMETER STR	Visited PCRF passes the message to the home PCRF.
15					←		DIAMETER STA	Home PCRF responds with STA.
16					←	→	DIAMETER STA	Visited PCRF passes the response to the P-CSCF.

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

Interoperability Test Description		
Identifier:	**TD_IMSEPC_Roam_UE_Network_Detachment_IMS_Session**	
Purpose:	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_IMSEPC_Roam	
SUT:	IMS, PCRF and EPC	
Ref.:	TS 124 229 [2], clause 5.2.8.1.2 (P-CSCF-initiated call release/Release of an existing session). TS 129 214 [5], clause 4.4.6.1 (IP-CAN Session Termination). TS 129 212 [6], clause 4.5.7 (Indication of IP-CAN session termination). TS 129 215 [9], clause 4.5.1.2 (S9 session termination). TS 129 215 [9], clause 4.5.3.3 (S9 session/sub-session termination initiated by the V-PCRF). TS 129 215 [9], clause 4.5.3.6 (Rx over S9).	
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
	2	Verify that EPC aborts affected Rx sessions with IMS.
	3	Verify that IMS performs P-CSCF-initiated call release on affected SIP sessions and admin IMS De-registration.
	4	Verify that media is no longer exchanged after these procedures.

Interoperability Test Description		
	5	Verify that media between UE and other endpoint can no longer be exchanged and is filtered out by EPC.
	6	Verify that the Rx messages are sent over S9 between the visited and home PCRFs.
	7	Verify that the S9 session is terminated.
Conformance Criteria:	**Check**	
	1-4	As steps 1-4 of clause 8.4.1
	5-10	As steps 5-10 of clause 8.4.2 (related to the SIP session bearer)
	11	As step 5 of clause 7.4.3 (sending of BYE)
	12-17	As steps 5-10 of clause 8.4.2 (related to the SIP signalling bearer)
	18	As step 6 of clause 7.4.2 (sending of REGISTER)

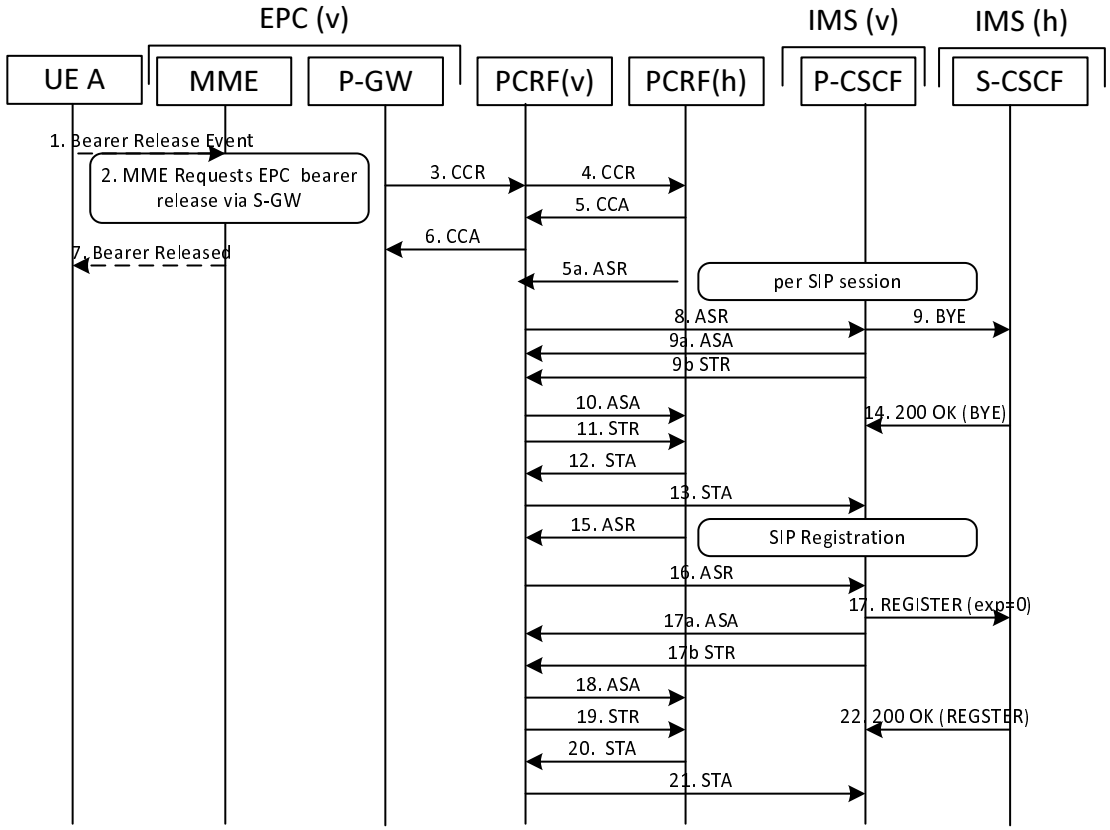


Figure 46: UE Initiated Network Detachment - IMS Registered & IMS sessions (Roaming)

Step	Direction						Message	Comment
	User	UE	EPC	PCRF (v)	PCRF (h)	IMS		
1								User initiates detachment on UE-A.
2		→	→					The UE-A requests IP-CAN session dis-establishment to the EPC (MME).
3				→			DIAMETER CCR	The P-GW sends a CCR message to the V-PCRF to inform the PCRF that the default bearer is being released.
4					→		DIAMETER CCR	The visited PCRF invokes the home PCRF.
5					←		DIAMETER CCA	The home PCRF responds.
6				←			DIAMETER CCA	The V-PCRF responds with a CCA.
7			←					The MME responds to the UE, confirming that the IP-CAN has been successfully released.
8		←						User is informed that the default bearer has been successfully released.
9					←		DIAMETER ASR	Home PCRF sends ASR to the P-CSCF (via the visited PCRF) for session bearer.
10						→	DIAMETER ASR	Visited PCRF passes ASR thru to the P-CSCF.
11							DIAMETER ASA	P-CSCF responds with ASA.
12					←		DIAMETER ASA	ASA message is passed onto the home PCRF.
13							DIAMETER STR	IMS P-CSCF send s STR to abort the Rx session.
14					→		DIAMETER STR	Visited PCRF passes the message to the home PCRF.
15							DIAMETER STA	Home PCRF responds with STA.
16					←	→	DIAMETER STA	Visited PCRF passes the response to the P-CSCF.
17					←		DIAMETER ASR	Home PCRF sends ASR to the P-CSCF (via the visited PCRF) for default bearer.
18						→	DIAMETER ASR	Visited PCRF passes ASR thru to the P-CSCF.
19							DIAMETER ASA	P-CSCF responds with ASA.
20					←		DIAMETER ASA	ASA message is passed onto the home PCRF.
21							DIAMETER STR	IMS P-CSCF send s STR to abort the Rx session.
22					→		DIAMETER STR	Visited PCRF passes the message to the home PCRF.
23							DIAMETER STA	Home PCRF responds with STA.
24					←	→	DIAMETER STA	Visited PCRF passes the response to the P-CSCF.

8.4.4 HSS Initiated Network Detachment (no IMS Registration)

Interoperability Test Description	
Identifier:	**TD_IMSEPC_Roam_HSS_Network_Detachment**
Purpose:	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_IMSEPC_Roam
SUT:	IMS, PCRF and EPC
Ref.:	TS 129 212 [6], clause 4.5.7 (Indication of IP-CAN session termination). TS 129 272 [8], clause 5.2.1.2 (Cancel location procedure over S6a reference point). TS 129 215 [9], clause 4.5.1.2 (S9 session termination). TS 129 215 [9], clause 4.5.3.3 (S9 session/sub-session termination initiated by the V-PCRF).
Pre-test conditions:	• Roaming UE_A previously attached to EPC with a single attachment

Interoperability Test Description		
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.
	4	Verify that EPC MME informs the UE of the detachment.
Conformance Criteria:	**Check**	

	1	TP_EPC_7004_04
		ensure that {
		when { HSS triggers a network detachment }
		then { a DIAMETER CL-Request message is generated to EPC-MME
		(
		containing the IMSI in the User-Name AVP
		containing the Cancellation-Type AVP set to
		"Subscriptiion_Withdrawal" (2)
		containing the CLR-Flags AVP
		)
		}
		}

	2	TP_EPC_7004_05
		ensure that {
		when { EPC MME receives a DIAMETER CL-Request }
		then { release of the EPC bearer is initiated via EPC S-GW }
		and { UE is requested to detach }
		
		}

	3	TP_EPC_7004_06
		ensure that {
		when { EPC MME initiates release of the EPC bearer }
		then { EPC removes_relevant_bearers } and
		
		when { P-GW is invoked with a delete session request}
		then { a DIAMETER CC-Request message is generated
		(
		containing CC_Request_Type AVP set to
		"TERMINATION_REQUEST"
		)
		}
		}

	4	TP_EPC_8004_02
		Ensure that{
		when { Visited PCRF is invoked with a DIAMETER CCR message}
		then { a DIAMETER CCR message is generated to the home PCRF
		(
		containing AVPs received from P-GW
		containing Subsession-Enforcement-Info AVP made up of
		Subsession-Id AVP
		Subsession-Operation AVP set to TERMINATION (0)
		)
		}

	5	TP_EPC_8004_03
		Ensure that{
		when { home PCRF is invoked with a CCR from visited PCRF}
		then { a DIAMETER CCA message is generated to the visited PCRF
		(
		containing the Result-Code AVP
		indicating DIAMETER_SUCCESS(2001)
		containing Subsession-Decision-Info AVP
		containing Subsession-Id AVP
		)
		}

	6	TP_EPC_8004_04
		Ensure that{
		when { visited PCRF receives CCA from home PCRF}
		then { a DIAMETER CCA message is generated to the P-GW
		(
		containing the Result-Code AVP
		indicating DIAMETER_SUCCESS(2001)
		
		)
		}

	7	TP_EPC_7004_07 ensure that {

Interoperability Test Description		
		when { EPC MME is informed of EPC bearer release } and { UE acknowledges the detach request } then { a DIAMETER CL-Answer message is generated (containing Result-Code_AVP indicating DIAMETER_SUCCESS(2001)) } }

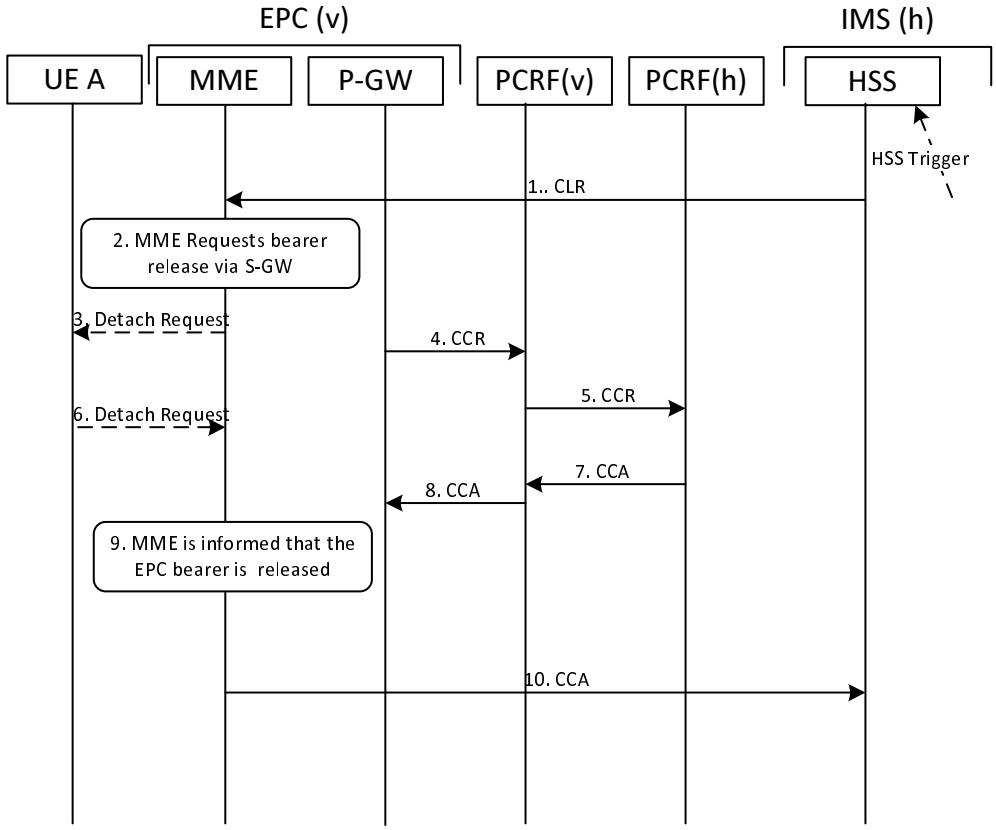


Figure 47: HSS Initiated Network Detachment - not IMS Registered (Roaming)

Step	Direction							Message	Comment
	User	UE	EPC	PCRF (v)	PCRF (h)	IMS			
1									HSS initiates detachment on UE-A (e.g. by withdrawing subscription from the UE).
2				←				DIAMETER CLR	HSS sends a CLR message to the EPC MME.
3			←						The UE is requested to Detach.
4									The EPC MME initiates the release of the EPC bearer via the EPC S-GW.
5				→				DIAMETER CCR	The P-GW sends a CCR message to the V-PCRF to inform the PCRF that the default bearer is being released.
6					→			DIAMETER CCR	The visited PCRF invokes the home PCRF.
7					←			DIAMETER CCA	The home PCRF responds.
8				←				DIAMETER CCA	The V-PCRF responds with a CCA to the P-GW.
9		→							The UE responds to the MME UE, confirming the Detach request..
10							→	DIAMETER CLA	The MME responds 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.

8.4.5 MME Purge User Data

This test description is identical to clause 7.4.5. 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.

Annex A (normative): zip file with TPLan code

The test purposes with identifiers of type TP_EPC_60xx_xx used in the present document have been originally generated in the TPLan text files in the archive file ts_103029v050101p0.zip which accompanies the present document.

The other test purposes (name types TP_EPC_70xx_xx and TP_EPC_80xx_xx) are only found in the present document and not repeated in the archive file.

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History

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