Multi Device
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1 Introduction

1.1 Overview

1.1.1 General for the multi-device concept

The IP Multimedia Subsystem (IMS) Multi-device Profile, documented in this Permanent Reference Document (PRD), defines a profile that identifies a set of features which are defined in 3GPP specifications that a device (the User Equipment (UE)) and network are required to implement in order to guarantee an interoperable, high quality IMS-based multi-device voice and video telephony service.

Multi-device refers to a logical grouping or federation of devices which may be reached via one or more phone numbers/identities (encompassing both an MSISDN and a Public User Identity (IMPU)). Services available to a federated identity are then available on all of the devices within the federation. A federation thus consists of two or more devices. The identity which represents the federation is inherited from one of the individual devices within the federation. This device is known as a primary device.

A primary device has a Universal Integrated Circuit Card (UICC) and the identity assigned to the federation is one of the UICC-based identities used by that device for its previous set of (individual) services. Other devices in the federation are known as secondary devices.

A federated group of devices can be associated with either a single user (a "single user federation") or else multiple users (a "multi-user federation").

A user can also be allowed to use more than one identity. This is the concept of multi-identity and can be supported on a single device or on multiple devices.

1.1.2 Support in this version of the document

The primary use of this version of the specification is to allow support of a federated group of devices used by a single user.

The identity of a primary device is used as the default identity of the federation, but other identities within the subscription can be shared by the devices in the federation. This allows the user to make and receive calls on any of their devices.

A federation may have a single federated identity or multiple federated identities. In this version of the specification, multiple federated identities are in the implicit registration set (IRS) as specified in 3GPP release 14, allowing the user to use the identities within its own subscription.

A multi-user federation is not in scope of this version of the document.

1.2   Relationship to existing standards

1.2.1   3GPP specifications

This profile is based solely on the specifications as listed in section 1.5. For references to 3GPP, 3GPP Release 14 is taken as a basis; i.e. unless otherwise stated, the latest version of release 14 applies and the same is applicable for other releases if referenced. When GSMA documents are referenced, the base version is as specified in the GSMA documents. Documents of other standards bodies are referenced with a specific version.

1.3   Scope

This document defines a profile for multi-device voice and video services over IMS, by listing a minimum set of IMS core network and UE features and procedures that are considered essential to launch interoperable services. The defined profile is compliant with and based on 3GPP specifications. The scope of this profile is the interface between UE and network.

The profile does not limit anybody, by any means, to deploy other standardized features or optional features, in addition to the defined profile.

The present document does not specify any requirements on the federation process. Instead, it specifies information needed to be provided to the devices in order for the device to successfully use IMS functions

A network can implement a multi-device service without affecting the UNI, such as mapping a native identity to a federated identity. This specification does not preclude such implementations, but the network functions are out of scope of this specification.

Requirements on the user interface are out of scope of this document.

1.4   Definition of acronyms and terms

1.4.1   Acronyms

Acronym	Description
3GPP	3rd Generation Partnership Project
CW	Communication Waiting
EPC	Evolved Packet Core
IMPI	IP Multimedia Private User Identity
IMPU	IP Multimedia Public User Identity
IMS	IP Multimedia Subsystem
ISDN	Integrated Services Digital Network
ISIM	IP Multimedia Subscriber Identity Module
IP	Internet protocol
IRS	Implicit Registration Set
MDV2	Multi Device Voice and Video
MSISDN	Mobile Subscriber ISDN Number

Acronym	Description
PRD	Permanent Reference Document
SDP	Session Description Protocol;
SMS	Short Message Service
SIP	Session Initiation Protocol
UDUB	User Determined User Busy
UE	User Equipment
UICC	Universal Integrated Circuit Card
URI	Uniform Resource Identifier
USIM	Universal Subscriber Identity Module

1.4.2   Terms

Term	Description
Downloadable Client	An IMS client used to access telephony and messaging services that has been downloaded or pre-installed onto a UE and is unable to access any UICC credentials for telephony services that may be present on the device. When resident on a UE, the UE may act only as a Secondary Device.
Federation	A federation is a group of devices that are configured (via the federation process) to use a given identity, or identities, for telephony and messaging purposes.
Federation Process	The mechanism by which the federation is created/destroyed. The mechanism may be controlled from the UE or other sources. The precise details of the mechanism are out of scope in this version of the document. As part of the federation process the operator can configure the UE with relevant parameters.
Federated identity	An identity used by all of the devices in the federation for telephony and messaging purposes.
Multi-User Federation	A federation of devices which are used by multiple end users/group of users. In this case, the devices of the federation are shared between a group of individuals such as family members, work colleagues or some other group.
Native Client	An IMS client used to access telephony and messaging services that is native to a UE carrying a UICC and able to access the credentials on that UICC. When resident on a UE, the UE may act as a primary or secondary device.
Primary device	A native client that has been selected to provide the federated identity to a federation and that is registered to IMS using credentials (e.g. IP Multimedia Private User Identity (IMPI), IMPU) obtained from an IP Multimedia Subscriber Identity Module (ISIM) or derived from a Universal Subscriber Identity Module (USIM). One (non-barred) IMPU of this device is the federated identity shared with other devices in the federation.
Secondary device	A device that has been selected to belong to a federation that is registered to IMS via any valid IMS authentication mechanism, that has its own IMPI and optionally its own IMPU (which is different from the federated identity), and shares the federated identity from the primary device of the federation.
Single-User Federation	A federation of devices all of which are used by a single end user.
Subscription	IMS subscription as defined in 3GPP TS 23.228 [13]

Term	Description
UE	The term UE is used for devices where it is irrelevant if the device is a primary device or a secondary device.
UICC	In this specification UICC is also used to refer to embedded UICC (eUICC)

1.5 Document cross-references

Ref	Doc Number	Title
[1]	IETF RFC 2119	Key words for use in RFCs to Indicate Requirement Levels.
[2]	GSMA PRD IR.92	IMS Profile for Voice and SMS.
[3]	GSMA PRD IR.94	IMS Profile for Conversational Video Service
[4]	GSMA PRD NG.102	IMS Profile for Converged IP Communications
[5]	GSMA PRD RCC.07	Rich Communication Suite 7.0 Advanced Communications Services and Client Specification v8.0
[6]	GSMA PRD RCC.14	Service Provider Device Configuration v5.0
[7]	GSMA PRD RCC.15	IMS Device Configuration and Supporting Services v4.0
[8]	GSMA PRD IR.51	IMS Profile for Voice, Video and SMS over untrusted Wi-Fi access v5.0
[9]	IETF RFC 4235	An INVITE-Initiated Dialog Event Package for the Session Initiation Protocol (SIP)
[10]	3GPP TS 24.229	"IP multimedia call control protocol based on Session Initiation Protocol (SIP) and Session Description Protocol (SDP); Stage 3"
[11]	GSMA PRD NG.106	"IMS profile for Video, Voice and SMS over trusted Wi-Fi access"
[12]	IETF RFC 7315	"Private Header (P-Header) Extensions to the Session Initiation Protocol (SIP) for the 3GPP"
[13]	3GPP TS 23.228	IP Multimedia Subsystem (IMS); Stage 2

1.6 Conventions

"The key words "must", "must not", "required", "shall", "shall not", "should", "should not", "recommended", "may", and "optional" in this document are to be interpreted as described in RFC 2119 **Error! Reference source not found.**."

2 IMS feature set

2.1 General

The IMS profile part lists the mandatory capabilities that are required over the Gm reference point. The Multi Device Voice and Video (MDV2) services are based on GSMA PRD IR.92 [2] and GSMA PRD IR.94 [3]. The connection over EPC (Evolved Packet Core) integrated Wi-Fi access are specified in GSMA PRD IR.51 [8] and GSMA PRD NG.106 [11], and over direct Wi-Fi is in GSMA PRD RCC.07 [5].

2.2 Support of generic IMS functions

2.2.1 Registration pre-requisites

In order to perform a SIP registration, the UE first needs to attach to the network, discover a Proxy Call Session Control Function (P-CSCF) address and be provided with at least one identity to be included in the REGISTER request. The source of this data is dependent on whether the device has and uses a UICC for telephony and messaging purposes as indicated in Table 1.

Data Item	Native client	Downloadable client
APN	IMS-APN	Internet APN / Direct Wi-Fi access
P-CSCF Address	As section 4.4 of PRD IR.92 [2] and section 6.9 of PRD IR.51 [8].	Via configuration (e.g. RCC.15 [7])
IMPU	As section 2.2.1 of PRD IR.92 [2].	Via configuration (e.g. RCC.15 [7])
IMPI	As section 2.4.2.2 of PRD NG.102 [4].	Via configuration (e.g. RCC.15 [7])
+sip.instance	As section 2.2.1 of PRD IR.92 [2]	Via configuration (e.g. RCC.15 [7]) or generated by the UE (UUID).

Table 1: Pre-requisite items for IMS Registration

2.2.2   SIP registration procedures

A native client must register to the IMS network for MDV[2] service by following IMS registration procedures specified in section 2.5 of GSMA PRD NG.102 [4]. A native client supporting audio only must conform to section 2.2.1 of GSMA PRD IR.92 [2] and a native client supporting video must conform to section 2.2.1 of GSMA PRD IR.94 [3].

A downloadable client must register to the IMS network for MDV[2] service by following IMS registration procedures specified in section 2.2.1 of GSMA PRD IR.92 [2] for voice support and section 2.2.1 of GSMA PRD IR.94[3] for video support, with the following differences:

- the IMPU and IMPI are obtained as shown in Table 1.
- the +sip.instance header field is obtained as shown in Table 1.
- the Internet APN is used instead of the IMS-APN in line with Table 1.
- the feature tag for RCS IP Call (+g.gsma.rcs.ipcall) is also included as defined in section 2.4.4.1 of GSMA PRD RCC.07 [5].

The registration parameters for native and downloadable clients are summarized in Table 1.

A UE will receive a P-Associated-URI header field in the 200 (OK) response to the REGISTER request. All identities in the P-Associated-URI are identities within the subscription.

A UE in a federation must subscribe to the reg event package as specified in section 2.2.1 of GSMA PRD IR.92 [2]. This ensures that all federated devices are aware of all other active devices within the federation.

2.2.3   Authentication

A native client and the IMS core network must conform to section 2.2.2 of GSMA PRD IR.92 [2].

A downloadable client should authenticate as described in section 2.12.1.1.2 of GSMA PRD RCC.07 [5]. It is the operator responsibility to provide the device with the necessary credentials via configuration.

2.2.4   Addressing

A UE and the IMS core network must conform to section 2.2.3 of GSMA PRD IR.92 [2].

2.2.5   Call establishment and termination

A UE and the IMS core network must conform to section 2.2.3 of GSMA PRD IR.92 [2] and to section 2.2.2 of GSMA PRD IR.94 [3].

2.2.6   Forking

The UE must conform to section 2.2.5 of GSMA PRD IR.92 [2].

The network must support forking by sending a SIP CANCEL request including a Reason header field with values of:

- SIP; cause=200; text="Call completed elsewhere"
- SIP; cause=603; text="Declined"

- SIP; cause=600; text="Busy Everywhere"

for forked calls as defined in 3GPP TS 24.229 [10].

> **Note:**   The network uses Application Server based forking in order to fulfil requirements on parallel or sequential ringing.

As stated in section 2.2.4 of GSMA PRD IR.92 [2], the UE must send a SIP 486 (Busy here) response to the network to indicate User Determined User Busy (UDUB). The Network can treat a 486 (Busy Here) response as a trigger to release other terminating legs via SIP CANCEL based on some criteria independent of the UNI (e.g. if received from the primary device of a federated group). In this case, the Reason header must contain "cause=600" as indicated above.

2.2.7   The use of signalling compression

The UE must not use signalling compression.

2.2.8   Early media and announcements

The UE must conform to section 2.2.7 of GSMA PRD IR.92 [2].

2.2.9   SIP session timer

The UE must conform to section 2.2.8 of GSMA PRD IR.92 [2].

2.3   Supplementary services

IMS supplementary services should be available on all federated devices based on the device capabilities.

2.3.1   Supplementary services overview

The UE and the network must conform to section 2.3 of GSMA PRD IR.92 [2] and section 2.3 of GSMA PRD IR.94 [3] with the additions and clarifications related to multi-device aspects added in the following subsections.

2.3.2   Supplementary service configuration

The primary device uses the Ut interface for supplementary service configuration as specified in section 2.3.2 of GSMA PRD IR.92 [2]. Secondary devices can use other mechanisms not specified in the present document.

2.3.3   Ad-hoc multi party conference

For ad-hoc multiparty conference where one device from the federation participates no specific procedures beyond what is specified in section 2.3.3 of GSMA PRD IR.92 [2] are needed.

2.3.4   Communication waiting

No specific requirements are needed besides what is specified in section 2.3.4 of GSMA PRD IR.92 [2]. The IMS network must treat the early dialogs for the incoming waiting call separately. No multi-device specific procedures are needed, i.e. a busy device receiving an incoming session gives Communication Waiting (CW) indication to the user whilst other devices ring.

2.3.5   Message waiting indication

No specific requirements are needed besides what is specified in section 2.3.5 of GSMA PRD IR.92 [2].

2.3.6   Originating identification restriction

No specific requirements are needed besides what is specified in section 2.3.6 of GSMA PRD IR.92 [2].

2.3.7   Terminating identification restriction

No specific requirements are needed besides what is specified in section 2.3.7 of GSMA PRD IR.92 [2].

2.3.8   Communication diversion

When the network has determined that a session is to be diverted, the network must cancel any leg in early dialog state.

2.3.9   Communication barring

The IMS network must interpret the conditions related to barring of roaming users based on the location of the device originating/terminating a session.

2.3.10   Communication hold

No specific requirements are needed besides what is specified in section 2.3.10 of GSMA PRD IR.92 [2].

2.3.11   Explicit communication transfer – consultative

For Explicit Communication Transfer where one device from the federation participates, no specific procedures besides what is specified in section 2.3.11 of GSMA PRD IR.92[2] are needed.

2.3.12   Originating identification presentation

No specific requirements are needed besides what is specified in section 2.3.12 of GSMA PRD IR.92 [2].

2.4   Call set-up considerations

2.4.1   SIP precondition considerations

Native clients and the network must conform to section 2.4.1 of GSMA PRD IR.92 [2] and section 2.4.3 of GSMA PRD IR.94 [3].

Downloadable clients can optionally conform to section 2.4.1 of GSMA PRD IR.92 [2] and section 2.4.3 of GSMA PRD IR.94 [3].

2.4.2   Integration of resource management and SIP

Native clients and the network must conform to section 2.4.2 of GSMA PRD IR.92 [2] and section 2.4.1 of GSMA PRD IR.94 [3] and section 2.4.2 of GSMA PRD IR.51 [8].

As stated in section 3.4.2 of GSMA PRD RCC.07 [5], downloadable clients are not impacted by integration of resource management and SIP.

2.4.3   Voice media considerations

The UE and the network must conform to section 2.4.3 of GSMA PRD IR.92 [2].

2.4.4   Video media considerations

The UE and the network must conform to section 2.4.2 of GSMA PRD IR.94 [3].

2.4.5   Multimedia considerations

The UE and the network must conform to section 2.4.4 of GSMA PRD IR.92 [2].

2.4.6   Identity considerations

The UE receives the available identities within the subscription as P-Associated-URIs in the SIP 200 (OK) response to the REGISTER request, see section 2.2.1.

For outgoing calls, the UE and the network must support the P-Preferred-Identity header field in the outgoing INIVTE as described in section 5.1.2A.1.1 of 3GPP TS 24.229 [10]. The user can select, which of the available identities within the subscription has to use and if the selected identity is not the default public user identity, the UE must indicate the selected identity in the P-Preferred-Identity header field.

For incoming voice or video call, the network and the UE must support the P-Called-Party-ID header field to indicate the identity to which the received call was addressed as described in RFC 7315 [12].

> Note 1:   This solution only works if all identities belong to one subscription. There is currently no solution specified for identities belonging to different subscriptions. Such use case requires 3GPP work.

> Note 2:   The P-Preferred-Identity and P-Associated-URI header fields are not supported as AT commands. So there is no standardized mechanism to transport this information between the application layer and the lower layers in the device.

2.5   SMS over IP

The Identity Considerations described in section 2.4.6 are applied to SMS (Short Message Service) as follows.

For outgoing SMS, the UE and the network must support the P-Preferred-Identity header field in the outgoing MESSAGE as described in section 5.1.2A.1.1 of 3GPP TS 24.229 [10]. The user can select, which of the available identities within the subscription has to use and if the selected identity is not the default public user identity, then the UE must indicate the selected identity in the P-Preferred-Identity header field.

For incoming SMS, the network and the UE must support the P-Called-Party-ID header field to indicate the identity to which the received call was addressed as described in RFC 7315 [12].

Note: It is an operator option to support SMS over IP (Internet Protocol) for
             secondary devices. How the operator disables SMS over IP for these
             devices is out of scope for this document.

2.6   Emergency service

2.6.1   General

A native client uses the Mobile Subscriber ISDN Number (MSISDN), the native identity, for
originating emergency calls. Emergency calling is a regulatory service which is not affected
by multi-device. Emergency calls are defined in GSMA PRDs GSMA PRD IR.92 [2] section
5.2, GSMA PRD IR.94 [3] annex B.2 and GSMA PRD IR.51 [8] section 5.3 and GSMA PRD
NG.106 [11] section 5.3.

A primary device uses the identity allocated to the federation to make an emergency call and
any callback will go to all the devices in the federation.

A downloadable client may support emergency calls subject to local regulation. In this case,
location information may be provided by a market specific mechanism or may not be
available.

2.7   Call log

The details of populating a call log and to use a network provided call log for synchronization
of call logs between different devices is not supported in this version. The UEs may provide
a local call log.

The call log holds pertinent information such as Caller Id, call duration, call type, time of call
etc.

When a call is cancelled towards a terminating UE the CANCEL may contain a Reason
header as specified in section 2.2.6. The table below provides a mapping between the cause
value and how the UE should label the call in the call log. The call log function must support
using:

Cause value	Label
200	Call completed elsewhere
408	Missed
600	Rejected/Missed
603	Rejected

Table 2: Cause Value and Label Table

2.8   Radio and Packet Core Feature Set

Native clients and the network must conform to section 4 of GSMA PRD IR.92 [2], section 4
of GSMA PRD IR.94 [3] and section 4 of GSMA PRD IR.51 [4].

3 Federation and configuration of secondary devices

3.1 General

How the federation (i.e. the association of a primary device with one or more secondary devices) is set up is defined by the operator and is not described in the present document. It is assumed that all UEs in the same federation are provisioned in the same IMS network. The addition/removal of secondary devices can be controlled from the primary device (e.g. via an application) or using other mechanisms. In either case, the network can restrict the size of a federation.

3.2 Secondary device procedures

If the secondary device uses a downloadable client, then it is provided with the necessary data via configuration as described in section 2.2.1. For additional security, devices can use the SMS based configuration mechanism (One Time Password) as described in GSMA PRD RCC.14 [6].

Annex A   Document Management

A.1   Document History

Version	Date	Brief Description of Change	Approval Authority	Editor / Company
1.0	21/02/2018	NG.110 MUD First Draft	TG	Jörgen Axell, Ericsson
2.0	12/11/2018	Implementation of CR#1002 and CR#1003	TG	Jörgen Axell, Ericsson

A.2   Other Information

Type	Description
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