Technical Report

TR-494

IMS for 5G-RG Residential Voice Requirements

Issue: 1

Issue Date: March 2024

Notice

The Broadband Forum is a non-profit corporation organized to create guidelines for broadband network system development and deployment. This Technical Report has been approved by members of the Forum. This Technical Report is subject to change. This Technical Report is copyrighted by the Broadband Forum, and all rights are reserved. Portions of this Technical Report may be copyrighted by Broadband Forum members.

Intellectual Property

Recipients of this Technical Report are requested to submit, with their comments, notification of any relevant patent claims or other intellectual property rights of which they may be aware that might be infringed by any implementation of this Technical Report, or use of any software code normatively referenced in this Technical Report, and to provide supporting documentation.

Terms of Use

1. License

Broadband Forum hereby grants you the right, without charge, on a perpetual, non-exclusive and worldwide basis, to utilize the Technical Report for the purpose of developing, making, having made, using, marketing, importing, offering to sell or license, and selling or licensing, and to otherwise distribute, products complying with the Technical Report, in all cases subject to the conditions set forth in this notice and any relevant patent and other intellectual property rights of third parties (which may include members of Broadband Forum). This license grant does not include the right to sublicense, modify or create derivative works based upon the Technical Report except to the extent this Technical Report includes text implementable in computer code, in which case your right under this License to create and modify derivative works is limited to modifying and creating derivative works of such code. For the avoidance of doubt, except as qualified by the preceding sentence, products implementing this Technical Report are not deemed to be derivative works of the Technical Report.

2. NO WARRANTIES

THIS TECHNICAL REPORT IS BEING OFFERED WITHOUT ANY WARRANTY WHATSOEVER, AND IN PARTICULAR, ANY WARRANTY OF NONINFRINGEMENT IS EXPRESSLY DISCLAIMED. ANY USE OF THIS TECHNICAL REPORT SHALL BE MADE ENTIRELY AT THE IMPLEMENTER'S OWN RISK, AND NEITHER THE BROADBAND FORUM, NOR ANY OF ITS MEMBERS OR SUBMITTERS, SHALL HAVE ANY LIABILITY WHATSOEVER TO ANY IMPLEMENTER OR THIRD PARTY FOR ANY DAMAGES OF ANY NATURE WHATSOEVER, DIRECTLY OR INDIRECTLY, ARISING FROM THE USE OF THIS TECHNICAL REPORT.

3. THIRD PARTY RIGHTS

Without limiting the generality of Section 2 above, BROADBAND FORUM ASSUMES NO RESPONSIBILITY TO COMPILE, CONFIRM, UPDATE OR MAKE PUBLIC ANY THIRD PARTY ASSERTIONS OF PATENT OR OTHER INTELLECTUAL PROPERTY RIGHTS THAT MIGHT NOW OR IN THE FUTURE BE INFRINGED BY AN IMPLEMENTATION OF THE TECHNICAL REPORT IN ITS CURRENT, OR IN ANY FUTURE FORM. IF ANY SUCH RIGHTS ARE DESCRIBED ON THE TECHNICAL REPORT, BROADBAND FORUM TAKES NO POSITION AS TO THE VALIDITY OR INVALIDITY OF SUCH ASSERTIONS, OR THAT ALL SUCH ASSERTIONS THAT HAVE OR MAY BE MADE ARE SO LISTED.

Issue History

Issue Number	Approval Date	Issue Editor	Changes
1	March 2024	Roland Schott, Deutsche Telekom	Original, Issue #1

Comments or questions about this Broadband Forum Technical Report should be directed to info@broadband-forum.org.

Editor: Jörgen Axell, Ericsson
Roland Schott, Deutsche Telekom

Work Area Director(s): Christele Bouchat, Nokia
Manuel Paul, Deutsche Telekom

Project Stream Leader(s): Roland Schott, Deutsche Telekom

Table of Contents

Table of Tables

Executive Summary

This document contains the requirements for supporting IMS for 5G-RG devices to enable voice services for residential consumers through 5G wireless or wireline access network via W-AGF and 5G Core.

This document also includes the requirements regarding the set of network functions and relevant interfaces that realize the use cases defined by the BBF herewith. It also provides references to the relevant standard documents from GSMA, 3GPP, ITU-T and IETF.

This document is complementary to the IMS for 5G-RG Architecture document [55]. Latter document includes the architecture that needs to be implemented for enabling voice service and related message flows. The architecture document also depicts important use cases like emergency calls and covers aspects of Service-Based Architecture (SBA) from 3GPP.

1 Purpose and Scope

1.1 Purpose

This document defines the IP Multimedia Subsystem (IMS) Profile for voice. This identifies a minimum set of mandatory features which a 5G-RG connected to the 5GC directly over NR or through W-AGF (for wired connectivity). The features are required for the implementation in order to guarantee interoperable, high-quality IMS-based voice communication services as defined in 3GPP specifications. This document also maps the 5G RG voice requirements against GSMA NG.114 and the deviations from it.

The content includes the following aspects:

- Basic capabilities and supplementary features for IMS-based communication services for voice, video and messaging.
- IMS media negotiation, transport, and codecs.
- Radio, wireline and packet core feature set.
- Common functionalities that are relevant across the protocol stack and subsystems.
- UE configuration applicable to the 5G-RG to provide all necessary information to connect to, and to receive service from, a specific IMS telephony operator.

The main body of this document is applicable for a scenario where IMS-based voice service is deployed in the 5G System (NG-RAN, wireline access, 5GC, and 5G-RG). A 5G-RG or a network fully compliant with this IMS Profile for voice is compliant with all normative statements in the main body.

The present version of this TR is restricted to profiling of a 5G-RG connected to 5GC using NG-RAN or W-5GAN as specified in 3GPP TS 23.316 [2].

1.2 Scope

This document defines a profile for voice over IMS by listing a number of NG-RAN, W-5GAN, 5GC, IMS core and 5G-RG features and procedures that are considered essential to launch interoperable services. The defined profile is compliant with and based on:

- 3GPP specifications related to 5GS, voice services over IMS.
- BBF specifications related to convergence of fixed and wireless access.
- GSMA NG.114 [3] where features are aligned.

The scope of this profile is the interface between the 5G-RG and the network. The scope includes 5G-RG with capability to attach to the 5GC using NG-RAN. FN-RGs are not in scope.

The profile does not limit, by any means, deploying other standardized features or optional features, in addition to those defined in this profile.

1.3 Relationship to standards

This profile is based solely on the 3GPP and BBF specifications as listed in Section 2.2. 3GPP Release 16 is taken as a basis unless otherwise stated. When BBF documents are referenced, the 3GPP release reference is as specified in those BBF documents.

IMS features are based on 3GPP Release 16 unless otherwise stated, including those needed to support interworking with EPS (e.g., EPS Fallback (Evolved Packet System Fallback)).

2 References and Terminology

2.1 Conventions

In this Technical Report, several words are used to signify the requirements of the specification. These words are always capitalized. More information can be found be in RFC 2119 [1].

MUST	This word, or the term “REQUIRED”, means that the definition is an absolute requirement of the specification.
MUST NOT	This phrase means that the definition is an absolute prohibition of the specification.
SHOULD	This word, or the term “RECOMMENDED”, means that there could exist valid reasons in particular circumstances to ignore this item, but the full implications need to be understood and carefully weighed before choosing a different course.
SHOULD NOT	This phrase, or the phrase "NOT RECOMMENDED" means that there could exist valid reasons in particular circumstances when the particular behavior is acceptable or even useful, but the full implications need to be understood and the case carefully weighed before implementing any behavior described with this label.
MAY	This word, or the term “OPTIONAL”, means that this item is one of an allowed set of alternatives. An implementation that does not include this option MUST be prepared to inter-operate with another implementation that does include the option.

2.2 References

The following references are of relevance to this Technical Report. At the time of publication, the editions indicated were valid. All references are subject to revision; users of this Technical Report are therefore encouraged to investigate the possibility of applying the most recent edition of the references listed below.

A list of currently valid Broadband Forum Technical Reports is published at www.broadband-forum.org.

Document	Title	Source	Year
[1] RFC 2119	Key words for use in RFCs to Indicate Requirement Levels	IETF	1997
[2] TS 23.316	Wireless and wireline convergence access support for the 5G System (5GS)	3GPP	R16
[3] NG.114	IMS Profile for Voice, Video and Messaging over 5GS v5.0	GSMA	November 2022
[4] TS 24.229	IP multimedia call control protocol based on Session Initiation Protocol (SIP) and Session Description Protocol (SDP); Stage 3	3GPP	R16
[5] TS 23.003	Numbering, addressing and identification	3GPP	R16
[6] TS 31.103	Characteristics of the IP Multimedia Services Identity Module (ISIM) application	3GPP	R16
[7] RCC.15	IMS Device Configuration and Supporting Services v7.0 (Current)	GSMA	
[8] RFC 4122	A Universally Unique IDentifier (UUID) URN Namespace	IETF	2005
[9] TS 23.228	P Multimedia Subsystem (IMS); Stage 2	3GPP	R16
[10] RFC 3261	SIP: Session Initiation Protocol	IETF	2002
[11] RFC3840	Indicating User Agent Capabilities in the Session Initiation Protocol (SIP)	IETF	2004
[12] TS 22.030	Man-Machine Interface (MMI) of the User Equipment (UE)	3GPP	R16
[13] TS 24.628	Common Basic Communication procedures using IP Multimedia (IM) Core Network (CN) subsystem; Protocol specification	3GPP	R16
[14] RFC 5009	Private Header (P-Header) Extension to the Session Initiation Protocol (SIP) for Authorization of Early Media	IETF	2007
[15] RFC 6228	Session Initiation Protocol (SIP) Response Code for Indication of Terminated Dialog	IETF	2011
[16] RFC 4028	Session Timers in the Session Initiation Protocol (SIP)	IETF	2005
[17] TS 24.173	IMS Multimedia telephony communication service and supplementary services; Stage 3	3GPP	R16
[18] RCC.07	Rich Communication Suite - Advanced Communications Services and Client Specification v12.0	GSMA	
[19] TS 24.607	Originating Identification Presentation (OIP) and Originating Identification Restriction (OIR) using IP Multimedia (IM) Core Network (CN) subsystem; Protocol specification	3GPP	R16
[20] TS24.608	Terminating Identification Presentation (TIP) and Terminating Identification Restriction (TIR) using IP Multimedia (IM) Core Network (CN) subsystem; Protocol specification	3GPP	R16

[21]	TS 24.604	Communication Diversion (CDIV) using IP Multimedia (IM) Core Network (CN) subsystem; Protocol specification	3GPP	R16
[22]	TS 24.611	Anonymous Communication Rejection (ACR) and Communication Barring (CB) using IP Multimedia (IM) Core Network (CN) subsystem; Protocol specification	3GPP	R16
[23]	TS 24.610	Communication HOLD (HOLD) using IP Multimedia (IM) Core Network (CN) subsystem; Protocol specification	3GPP	R16
[24]	TS 24.606	Message Waiting Indication (MWI) using IP Multimedia (IM) Core Network (CN) subsystem; Protocol specification	3GPP	R16
[25]	TS 24.615	Communication Waiting (CW) using IP Multimedia (IM) Core Network (CN) subsystem; Protocol Specification	3GPP	R16
[26]	TS 24.605	Conference (CONF) using IP Multimedia (IM) Core Network (CN) subsystem; Protocol specification	3GPP	R16
[27]	TS 24.629	Explicit Communication Transfer (ECT) using IP Multimedia (IM) Core Network (CN) subsystem; Protocol specification	3GPP	R16
[28]	TS 24.238	Session Initiation Protocol (SIP) based user configuration; Stage 3	3GPP	R16
[29]	TS 24.147	Conferencing using the IP Multimedia (IM) Core Network (CN) subsystem; Stage 3	3GPP	R16
[30]	RFC 3842	A Message Summary and Message Waiting Indication Event Package for the Session Initiation Protocol (SIP)	IETF	2004
[31]	TS 26.114	IP Multimedia Subsystem (IMS); Multimedia telephony; Media handling and interaction	3GPP	R16
[32]	TS 26.441	Codec for Enhanced Voice Services (EVS); General overview	3GPP	R16
[33]	TS 26.445	Codec for Enhanced Voice Services (EVS); Detailed algorithmic description	3GPP	R16
[34]	TS 26.446	Codec for Enhanced Voice Services (EVS); Adaptive Multi-Rate - Wideband (AMR-WB) backward compatible functions	3GPP	R16
[35]	TS 26.447	Codec for Enhanced Voice Services (EVS); Error concealment of lost packets	3GPP	R16
[36]	TS 26.449	Codec for Enhanced Voice Services (EVS); Comfort Noise Generation (CNG) aspects	3GPP	R16
[37]	TS 26.450	Codec for Enhanced Voice Services (EVS); Discontinuous Transmission (DTX)	3GPP	R16
[38]	TS 26.451	Codec for Enhanced Voice Services (EVS); Voice Activity Detection (VAD)	3GPP	R16
[39]	TS 26.442	Codec for Enhanced Voice Services (EVS); ANSI C code (fixed-point)	3GPP	R16
[40]	TS 26.443	Codec for Enhanced Voice Services (EVS); ANSI C code (floating-point)	3GPP	R16

[41] TS 26.452	Codec for Enhanced Voice Services (EVS); ANSI C code; Alternative fixed-point using updated basic operators	3GPP	R16
[42] RFC 4961	Symmetric RTP / RTP Control Protocol (RTCP)	IETF	2007
[43] TS 23.122	Non-Access-Stratum (NAS) functions related to Mobile Station (MS) in idle mode	3GPP	R16
[44] TS 23.167	IP Multimedia Subsystem (IMS) emergency sessions	3GPP	R16
[45] TS 23.501	System architecture for the 5G System (5GS)	3GPP	R16
[46] TS 23.502	Procedures for the 5G System (5GS)	3GPP	R16
[47] TS 24.008	Mobile radio interface Layer 3 specification; Core network protocols	3GPP	R16
[48] TS 24.237	IP Multimedia (IM) Core Network (CN) subsystem IP Multimedia Subsystem (IMS) service continuity	3GPP	R16
[49] TS 24.501	Non-Access-Stratum (NAS) protocol for 5G System (5GS	3GPP	R16
[50] IR.92	IMS Profile for Voice and SMS, Version 15	GSMA	2020
[51] T-REC-V.152	V.152 Procedures for supporting voice-band data over IP networks, V.152	ITU-T	2010
[52] T-Rec V.IMP152	Rec V.152 Implementors Guide for ITU-T V.152 Procedures for supporting voice-band data over IP networks	ITU-T	2011
[53] RFC 7852	Additional Data Related to an Emergency Call	IETF	July 2016
[54] G.711, PCM	https://www.itu.int/rec/T-REC-G.711-198811-I/en	ITU-T	
[55] TR-493	IMS-for-5G-RG-Architecture	BBF	2024
[56] TS 33.203	Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; 3G security; Access security for IP-based services	3GPP	R16
[57] RFC 3262	Reliability of Provisional Responses in the Session Initiation Protocol (SIP)	IETF	June 2002
[58] TS 24.315	Universal Mobile Telecommunications System (UMTS); LTE; IP Multimedia Subsystem (IMS) Operator Determined Barring (ODB); Stage 3: protocol specification	3GPP	R16

2.3 Abbreviations

This Technical Report uses the following abbreviations:

3GPP	3rd Generation Partnership Project
3PCC	3rd Party Call Control
5GC	5G Core Network
5G NR	5G New Radio

5G-RG	5G Residential Gateway
5GS	5G System
AAA	Authentication, Authorization and Accounting
AAA	AA-Answer (Authorization and Authentication)
AAR	AA-Request (Authorization and Authentication)
A-BGF	Access Border Gateway Function
ACR	Anonymous Communication Rejection
ACS	Auto-Configuration Server
AGF	Access Gateway Function
AKA	Authentication and Key Agreement
AMF	Access and Mobility Management Function
AML	Advanced Mobile Location
AMR	Adaptive Multi-Rate
AMR-WB	Adaptive Multi-Rate Wideband
AN	Access Network
API	Application Programming Interface(s)
APN	Access Point Name
AS	Application Server
ATA	Analogous Telephone Adapter
ATSSS	Access Traffic Steering, Switching and Splitting
AuC	Authentication Center
AUTN	Authentication Token
AV	Authentication Vector
B2BUA	Back to Back User Agent
BBF	Broadband Forum
BGCF	Breakout Gateway Control Function
BRI	Basic Rate Interface
CDIV	Communication Diversion
CFU	Call Forwarding Unconditional
CK	Ciphering Key
CLIP	Call Line Identification Presentation
CLIR	Call Line Identification Restriction
CMR	Codec Mode Request
CPE	Customer Premises Equipment.
CPU	Central Processing Unit
DHCP	Dynamic Host Configuration Protocol
DNN	Data Network Name
DNS	Domain Name System
DSL	Digital Subscriber Line
DSLAM	Digital Subscriber Line Access Multiplexer
DTMF	Dual Tone Multifrequency

E-CSCF	Emergency Call Session Control Function
EMTEL	Emergency Telecommunications Subcommittee
ePCO	Extended Protocol Configuration Options
ESInet	Emergency Services IP Network
ETSI	European Telecommunications Standards Institute
EVS	Enhanced Voice Services
FMC	Fixed Mobile Convergence
FN-RG	Fixed Network Residential Gateway
FPGA	Field Programmable Gate Array
FQDN	Fully Qualified Domain Name
GMLC	Gateway Mobile Location Centre
GPS	Global Positioning System
GRUU	Globally Routable User agent URI
GSMA	GSM (Groupe Speciale Mobile) Association
GSMA PDR RCC	GSMA Permanent Reference Document Research Computing Centre
GPU	Graphical Processor Unit
HELD	HTTP Enabled Location Protocol
HSM	Hardware Security Module
HSS	Home Subscriber Server
HTTP/HTTPS	Hypertext transfer protocol / Hypertext transfer protocol secure
IANA	Internet Assigned Numbers Authority
I-BCF	Interconnection Border Control Function
I-BGF	Interconnection Border Gateway Function
I-CSCF	Interrogating Call Session Control Function
ICSI	IMS Communication Service Identifier
ID	Identifier
iFC	Initial Filter Criteria
IK	Integrity Key
IM CN	IP Multimedia (IM) Core Network (CN)
IM MGW	IP-Multi-Media Gateway
IMC	IMS Credentials
IMEI	International Mobile Equipment Identity
IMPI	IP Multimedia Private Identity
IMPU	IP Multimedia Public Identity
IMS	IP-Multi-Media Subsystem
IMS AGW	IMS Access Gateway
IMS AKA	IMS Authentication and Key Agreement
IMSI	International Mobile Subscriber Identity
IP-PBX	Internet Protocol Private Branch Exchange
IPSec	Internet Protocol Security
IRS	Implicit Registration Set

ISDN	Integrated Services Digital Network
ISIM	IP Multimedia Services (IMS) Subscriber Identity Module
JSON	JavaScript Object Notation
LRF	Location Retrieval Function
LS	Location Server
MAA	Multimedia Authentication Answer
MAR	Multimedia Authentication Request
MGCF	Media Gateway Control Function
MGW	Media Gateway
MMTel	MultiMedia Telephony (Application Server)
MRB	Multimedia Resource Broker
MRF	Media Resource Function
MRFC	Multimedia Resource Function Controller
MRFP	Multimedia Resource Function Processor
MSAN	Multi-Service Access Node
MSISDN	Mobile Subscriber Integrated Services Digital Network Number
MSRP	Message Session Relay Protocol
MTSI	Multimedia Telephony Service for IMS
MWI	Message Waiting Indication
NAS	Non-Access Stratum
NASS	Network Attachment Subsystem
NAT	Network Address Translation
NBA	NASS Bundled Authentication
NENA	National Emergency Number Association
NG-RAN	Next Generation Radio Access Network
P-ANI	P-Access Network Information
PAU	P-Associated-URI header
PCC	Policy and Charging Control
PCF	Policy Control Function
PCM	Pulse Code Modulation
PCRF	Policy and Charging Rules Function
P-CSCF	Proxy Call Session Control Function
PDP	Packet Data Protocol
PDU	Protocol Data Unit
POTS	Plain Old Telephone Service
PRACK	Provisional Response ACKnowledgment
PRI	Primary Rate Interface
PSAP	Public Safety Answering Point
PSTN	Public Switched Telephone Network
PUI	Public User Identity
QoS	Quality of Service

RAN	Radio Access Network
RAND	Random Challenge
RCS	Rich Communication Services
RDF	Routing Determination Function
RES	Response
RFC	Requests for Comments
RTP	Real-Time Transport Protocol
SA	Security Association
SAA	Server Assignment Answer
SAR	Server Assignment Request
SBA	Service Based Architecture
SBC	Session Border Controller
SBI	Service Based Interface
S-CSCF	Serving Call Session Control Function
SDP	Session Description Protocol
SIM	Subscriber Identity Module
SIP	Session Initiation Protocol
SLF	Subscription Locator Function
SMF	Session Management Function
SMS	Short Message Service
TAS	Telephony Application Server
TCP	Transmission Control Protocol
TFO	Tandem-Free Operation
TLS	Transport Layer Security
TR	Technical Report
TrFO	Transcoder-Free Operation
TrGW	Transition Gateway
TS	Technical Specifications
UAA	User Authorization Answer
UAR	User Authorization Request
UDP	User Datagram Protocol
UDUB	User Determined User Busy
UE	User Equipment
UICC	Universal Integrated Circuit Card
ULI	User Location Information
UMTS	Universal Mobile Telecommunications System
UNI	User Network Interface
UPF	User Plane Function
URI	Uniform Resource Identifier
URL	Uniform Resource Locator
URN	Uniform Resource Name

USIM	Universal Subscriber Identity Module
UUID	Universally Unique IDentifier
VoNR	Voice over New Radio
W-5GAN	Wireline 5G Access Network
WA	Work Area
W-AGF	Wireline Access Gateway Function
WLAN	Wireless Local Area Network.
WT	Working Text
WWC	Wireless Wireline Convergence
XCAP	XML Configuration Access Protocol
XML	Extensible Markup Language
XRES	Expected Response

3 Technical Report Impact

3.1 Energy Efficiency

TR-494 has considered the optimization of energy consumption (in terms of electricity requirements for GPU/FPGA and cooling requirement for heat generated by CPU intensive tasks) by specifying measures to avoid or reduce transcoding in the IMS network.

3.2 Security

Security has been considered by incorporating guidelines from GSMA/3GPP related to authentication/authorization/interface security.

3.3 Privacy

SIP privacy related features as defined by IETF SIP RFCs are included or referenced in this document.

4 Feature set

4.1 General

The IMS profile part lists the mandatory and optional capabilities that are required over the UNI in this profile.

4.2 Support of general IMS functions

This profile is applicable to an IMS Client as an embedded function within a 5G-RG device, or to an IMS Client embedded in a separate Analog Telephony Adapter device deployed behind a 5G-RG.

4.2.1 SIP Registration

4.2.1.1 Registration options and DNN usage

[R-1] The 5G-RG MUST register using the IMS well-known APN/DNN.

4.2.1.2 P-CSCF Discovery Mechanism

[R-2] The 5G-RG MUST follow the procedure for P-CSCF discovery defined in section U.2.2.1 of 3GPP TS 24.229 [4], option II. There are multiple options of P-CSCF discovery possible e.g., ePCO, DHCP, IMS config file, ISIM approach provisioned FQDN, but the recommended approach is ePCO.

4.2.1.3 Authentication for SIP Registration

[R-3] The authentication mechanism used for IMS registration MAY be either IMS-AKA or SIP Digest. Details of these mechanisms are set out in section 4.2.2 of this document.

4.2.1.4 IMS user and device identifiers in SIP Registration

The derivation of the IMPU (IMS Public Identity), IMPI (IMS Private User Identity) and +sip.instance identifiers in the SIP REGISTER request is as follows.

[R-4] If the 5G-RG device has an available IMEI (International Mobile Equipment Identity), then the +sip.instance header field parameter MUST be set to the IMEI URN as per TS 23.003 [5] section 13.8 matching the IMEI of the 5G-RG device.

[R-5] If the 5G-RG device does not have an available IMEI, then the +sip.instance header field parameter MUST be set to a string representation of a UUID as a URN as defined according to TS 23.003 [5].

[R-6] If the 5G-RG performs IMS registration with IMS-AKA authentication, then the IMS Public User Identity (IMPU) and IMS Private User Identity (IMPI) SHOULD be derived as follows.

a. For the IMPU, if an ISIM (IM Services Identity Module) application is present on the UICC, the public user identity in the first (or only) record in the Elementary File in the ISIM (see TS 31.103 [6] section 4.2.4) SHOULD be used. Otherwise, the temporary public user identity derived from the IMSI (TS 23.003 [5]).

b. For the IMPI, if an ISIM application is present on the UICC, the IMPI in the EFIMPI Elementary File in the ISIM (see section 4.2.2 of 3GPP TS 31.103 [6]) SHOULD be used. Otherwise, the IMPI derived from the USIM's IMSI as per section 13.3 of TS 23.003 [5].

[R-7] If the 5G-RG performs IMS registration with SIP Digest authentication, the IMPU and the IMPI SHOULD both be obtained from the IMS Management Object configured on the 5G-RG. The IMPU SHOULD be obtained from the configuration parameter Public_user_identity_List of the IMS Management Object, as defined in section 2.2 of GSMA PRD RCC.15 [7], and the IMPI SHOULD be obtained directly from the IMS Management Object.

4.2.1.5 Registration of IMS Services

[R-8] The 5G-RG MUST register using the well-known IMS APN/DNN for the purposes of obtaining MMTel Voice service.

4.2.1.6 SIP Registration Procedures

[R-9] The 5G-RG and the IMS core network MUST follow the Session Initiated Protocol (SIP) registration procedures defined in 3GPP TS 24.229 [4]. A 5G-RG device that is equipped to support IMS voice services SHOULD attempt to register with the IMS when it is initialized, and periodically re-register to maintain its registration.

The operator can configure the 5G-RG with RegRetryBaseTime and RegRetryMaxTime parameters to control the re-registration interval.

[R-10] The 5G-RG and the IMS core network MUST support network-initiated de-registration as defined in section 5.4.1.5 of 3GPP TS 24.229 [4].

[R-11] The 5G-RG MUST subscribe to the registration event package as defined in section 5.1.1.3 of 3GPP TS 24.229 [4].

[R-12] The 5G-RG MUST include the "+sip.instance" header field parameter (Instance ID) of the contact address as described in section 4.2.1.4 of this document.

[R-13] As stated in section 5.1.1.2.1 of 3GPP TS 24.229 [4], the 5G-RG SHOULD include a user part in the URI of the contact address such that the user part is globally unique and does not reveal any private information.

Note 1: To generate this user part, the 5G-RG can use a time-based UUID (Universal Unique Identifier) generated as defined in section 4.2 of IETF RFC 4122 [8].

[R-14] All IMS public user identities provided in the implicit registration set used for the enabled IMS services by the IMS core network MUST be alias user identities and MUST include a tel URI (Uniform Resource Identifier). The public user identity that is assigned to the implicit registration set used for the enabled IMS services, MUST be used by the 5G-RG when registering for the MMTel Voice service and is derived as described in section 4.2.1.4 of this document.

Note 2: According to 3GPP TS 23.228 [9], a public user identity is an alias of another public user identity, if both identities belong to the same implicit registration set, are linked to the same service profile and have the same service data configured for each and every service.

[R-15] The 5G-RG MUST set the URI of the From header field of the REGISTER request, for user-initiated re-registration or for user-initiated de-registration, to the public user identity which was used in the URI of the From header field of the REGISTER request that created the binding being refreshed or being removed.

[R-16] The 5G-RG MUST set the URI of the “To” header field of the REGISTER request, for user-initiated re-registration and for user-initiated de-registration, to the public user identity that was used in the URI of the “To” header field of the REGISTER request that created the binding being refreshed or being removed.

Note 3: The "tag" header field parameter can differ in the From header field and in the To header field for the different REGISTER requests.

[R-17] For backwards compatibility the network MUST support all formats of URIs compliant with 3GPP TS 24.229 [4].

[R-18] The 5G-RG MUST perform a re-registration prior to the expiry time of the existing registration as described in section 5.1.1.4.1 of 3GPP TS 24.229 [4].

[R-19] If the 5G-RG receives a SIP 305 (Use Proxy) response to a re-registration, then the 5G-RG MUST acquire a P-CSCF different from the currently used P-CSCF and initiate a new initial registration as described in section 5.1.1.4.1 of 3GPP TS 24.229 [4]. If the 5G-RG receives a SIP 503 (Service Unavailable) response without a Retry-After header field, the SIP 503 (Service Unavailable) response MUST be treated as a SIP 500 (Server Internal Error) response (as stated in IETF RFC 3261 [10]) and the 5G-RG MUST initiate a new initial registration as described in section 5.1.1.4.1 of 3GPP TS 24.229 [4]. For this new initial registration, the 5G-RG MUST select a different P-CSCF from the P-CSCF list received previously during the P-CSCF discovery, as mentioned in R-2 above, (if not all of them have been attempted), otherwise the 5G-RG MUST re-establish a new PDU session to the IMS well-known APN/DNN and get a new list of P-CSCFs (as stated in section 4.2.1.2 of this document) and choose from one of these P-CSCFs, as specified in section 5.1.1.4.1 of 3GPP TS 24.229 [4].

[R-20] If the 5G-RG receives a SIP 503 (Service Unavailable) response or any other SIP 4xx, 5xx or 6xx response with a Retry-After header as a response to an initial SIP REGISTER request, then the 5G-RG MUST re-attempt an initial registration via the same P-CSCF, after the amount of time indicated in the Retry-After header field has expired, or it MUST immediately re-attempt an initial registration (as described above) when another P-CSCF is used.

Note 4: The above condition assumes that the 5G-RG has IP connectivity when the 5G-RG re-attempts an initial registration.

4.2.1.7 Capability Discovery

[R-21] In registering with the IMS, the 5G-RG MUST include the IMS Communication Service Identifier (ICSI) value used to indicate the IMS Multimedia Telephony service, that being urn: urn-7: 3gpp-service.ims.icsi.mmtel per 3GPP TS 24.173 [17], using the procedures defined in section 5.1.1.2.1 of 3GPP TS 24.229 [4], and MUST also include the “audio” media feature tag, as defined in IETF RFC 3840 [11], in the Contact header field of the SIP REGISTER request, using the procedures defined in 3GPP TS 24.229 [4].

4.2.2 Authentication

4.2.2.1 SIP Authentication via IMS-AKA

[R-22] If the 5G-RG supports SIP authentication via IMS-AKA, it MUST follow the procedures defined in 3GPP TS 24.229 [4] and 3GPP TS 33.203 [56] for authentication with IMS Authentication and Key Agreement (IMS-AKA), Sec-Agree and IPsec. Support of integrity protection is mandatory for both 5G-RG and network. Support of confidentiality protection is optional in the network, considering that lower layer security is available.

[R-23] The IMS core network MUST support the procedures defined for IM Services Identity Module (ISIM) based authentication. Support for ISIM based authentication in the 5G-RG is mandatory.

4.2.2.2 SIP Authentication via Digest

[R-24] If the 5G-RG supports SIP authentication via Digest, it MUST follow the procedures for SIP Digest Authentication for registration as specified in section 2.12.1 of GSMA PRD RCC.07 [18]. The digest credentials

are retrieved by the 5G-RG via remote client configuration as described in section 2.12.1 of GSMA PRD RCC.07 [18].

4.2.3 Addressing

4.2.3.1 Public User Identities

[R-25] The 5G-RG and IMS core network MUST support Public User Identities as defined in section 13.4 of 3GPP TS 23.003 [5], which includes all of the following types of addresses:

- Alphanumeric SIP-URIs :
  Example: sip:voicemail@example.com
- MSISDN represented as a SIP URI:
  Example: sip:+447700900123@example.com;user=phone
- MSISDN represented as a tel URI:
  Example: tel:+447700900123

4.2.3.2 Local numbers

[R-26] The 5G-RG and IMS core network MUST support local numbers as defined in Alternative 2 in sections 5.1.2A.1.3 and 5.1.2A.1.5 of 3GPP TS 24.229 [4]. That is, the 5G-RG MUST set the dial string containing the local number to the user part of SIP URI in the Request URI, and set the "user=phone" parameter, with the “phone-context” tel URI parameter to the user part.

[R-27] The 5G-RG MUST set the “phone-context” parameter to the home domain name, as it is used to address the SIP REGISTER request. Example of phone-context for home-local number: if the home network domain used in SIP REGISTER R-URI is “ims.mnc026.mcc567.3gppnetwork.org” then the “phone context” parameter is set to the same string.

4.2.3.3 Other addressing related SIP header fields

[R-28] The 5G-RG and IMS core network MUST support the P-Called-Party-ID header field; the network MUST use this header field as defined in 3GPP TS 24.229 [4].

The support of Globally Routable User agent URIs (GRUUs) by 5G-RG or network, is not required.

4.2.4 Call establishment and termination

4.2.4.1 General

[R-29] The 5G-RG and the IMS core network MUST follow 3GPP TS 24.229 [4] for establishment and termination of a call.

[R-30] The 5G-RG and the IMS core network MUST support reliable provisional responses as defined in IETF RFC 3262 [57]. The 5G-RG MUST support reliable SIP 18x policy and procedures as specified in section 5.1.4.2 of 3GPP TS 24.229 [4].

The operator can configure the 5G-RG with Timer_T1, Timer_T2 and Timer_T4 parameter.

[R-31] For the purpose of indicating an IMS communication service to the network, the 5G-RG MUST use an ICSI value in accordance with 3GPP TS 24.173 [17] section 5.1.

[R-32] If the 5G-RG receives an incoming SIP request for a service that is not supported over the used IMS registration, the 5G-RG MUST reject that request with a 488 “Not Acceptable Here” error response.

The usage of preconditions is discussed in section 4.2.5 of this document.

[R-33] If the user rejects an incoming call by invoking User Determined User Busy (UDUB) as described in 3GPP TS 22.030 [12], then the 5G-RG MUST send a SIP 486 (Busy here) response to the network.

Note: The appropriate SIP response to reject a call on all devices for a multiple-device scenario and operator and vendor specific services are out-of-scope of this document.

[R-34] When the 5G-RG sends a CANCEL or a BYE request, the 5G-RG MUST include a Reason header field with a protocol value set to "RELEASE_CAUSE" and follow the procedures specified in sections 5.1.3.1 and 5.1.5 of 3GPP TS 24.229 [4].

[R-35] If information is available, the 5G-RG MAY insert the P-Access-Network-Info header field into the ACK request acknowledging a 2XX response to the INVITE request, as specified in section 5.1.2A.1.1 of 3GPP TS 24.229 [4].

4.2.5 SIP preconditions

[R-36] For MMTEL Voice/Conversational Video sessions, the 5G-RG MUST support the preconditions mechanism as specified in sections 5.1.3.1 and 5.1.4.1 of 3GPP TS 24.229 [4]. If the precondition mechanism is enabled by the Precondition_disabling_policy node in Annex C.3 of GSMA NG.114 [3], the 5G-RG MUST use the precondition mechanism. If preconditions are used, and the originating 5G-RG receives the selected codec in the SDP of a SIP 18x response, then the 5G-RG MUST include only the same codec with its selected configuration parameters in the SDP of the SIP UPDATE request, used for precondition status update.

[R-37] The network MAY disable the use of preconditions in the network by removing both the “precondition” option-tag from the SIP Supported header and the related SDP media attributes.

[R-38] The terminating 5G-RG implementation MUST not rely on the use of preconditions by the originating 5G-RG.

[R-39] Upon receiving an INVITE request, if the use of preconditions is disabled by the home operator using the Precondition_disabling_policy parameter as specified in Annex C.3 of GSMA NG.114 [3] or if preconditions are not supported in the received INVITE request, and the local resources required at the terminating 5G-RG are not available, then the terminating 5G-RG according to TS 23.228 [9], MUST act as specified in 3GPP TS 24.229 [4] section U.3.1.4.

4.2.6 Early media and announcements

[R-40] The 5G-RG MUST behave as specified in section 4.7.2.1 of 3GPP TS 24.628 [13]. The 5G-RG MUST support reception of voice media associated with one (1) early dialogue.

[R-41] In addition, the 5G-RG MUST support the P-Early-Media header field as defined in IETF RFC 5009 [14] and MUST include a P-Early-Media header field with the “supported” parameter to initial INVITE requests it originates as specified in section 5.1.3.1 of 3GPP TS 24.229 [4].

[R-42] The 5G-RG MUST also maintain an early media authorization state per dialog as described in IETF RFC 5009 [14].

[R-43] As stated in 3GPP TS 24.628 [13], the 5G-RG MUST render locally generated communication progress information, if:

1. An early dialog exists where a SIP 180 response to the SIP INVITE request was

received;

2. No early dialog exists where the last received P-Early-Media header field as described in IETF RFC 5009 [14] contained "sendrecv" or "sendonly"; and
3. In-band information is not received from the network.

[R-44] For SIP response 181 and 182 to the SIP INVITE, the 5G-RG MUST NOT locally render tones to indicate diversion or queueing of calls.

[R-45] The 5G-RG MUST evaluate the above rules again after each subsequent request or response received from the remote party, and when in-band information starts, and when the 5G-RG determines the in-band media to have stopped.

Note 1: A SIP request or response received without a P-Early-Media header does not change the early media authorization state for the early dialog in which it was received.

Note 2: In-band information arriving at the 5G-RG, will always override locally generated communication progress information as defined in section 4.7.2.1 of 3GPP TS 24.628 [13].

4.2.7 Forking

[R-46] Forking in the network is outside the scope of the present document. However, for inter-operability and forward-compatibility reasons, the 5G-RG MUST be ready to receive responses generated due to a forked request and behave according to the procedures specified in IETF RFC 3261 [10], section 4.2.7.3 of 3GPP TS 23.228 [9], 3GPP TS 24.229 [4] and section 4.7.2.1 of 3GPP TS 24.628 [13]. Furthermore, the 5G-RG SHOULD be able to maintain at least forty (40) parallel early dialogs until receiving the final response on one of them and the 5G-RG MUST support receiving media on one of these early dialogs.

[R-47] If the originating 5G-RG needs to release an early dialog, the 5G-RG MUST send a BYE request within the early dialog to be released, in accordance with section 15 of IETF RFC 3261 [10], e.g., when the 5G-RG receives the first response that would create an early dialog it cannot maintain, the 5G-RG sends a BYE request on that early dialog without saving dialog data.

[R-48] It is also possible that the network or the terminating 5G-RG will need to release an early dialog using the 199 (Early Dialog Terminated) response defined in IETF RFC 6228 [15]. To support this, the originating 5G-RG MUST include the "199" option tag in the Supported header field in the initial INVITE request and MUST understand a 199 (Early Dialog Terminated) response code and act as specified in section 5.1.3.1 of 3GPP TS 24.229 [4].

Note 1: An early dialog that is maintained is one where a SIP 18x response has been received and the early dialogue has not been terminated (e.g., by receipt of a SIP 199 response) prior to receiving a SIP 2xx response.

Note 2: Multiple early dialogs can occur as a result of forking or for other reasons such as announcements or services.

[R-49] The IMS core network can support sending and the 5G-RG MUST support receiving a SIP CANCEL request including a Reason header field with values of:

1. SIP; cause=200; text="Call completed elsewhere"
2. SIP; cause=603; text="Declined"
3. SIP; cause=600; text=” Busy Everywhere”

for forked calls as defined in 3GPP TS 24.229 [4].

4.2.8 Signaling compression

[R-50] The 5G-RG MUST NOT use Signaling Compression.

4.2.9 SIP session timer

[R-51] The 5G-RG MUST support and use IETF RFC 4028 [16] as follows:

1. For an initial SIP INVITE request, the 5G-RG MUST include a Supported header with the option tag “timer” and MUST either insert Session-Expires header field with the delta-seconds portion set to 1800, or MUST NOT include the Session-Expires header field in the initial SIP INVITE request;
2. If the 5G-RG receives a SIP 422 response to an INVITE request, the 5G-RG MUST follow the procedures of section 7.4 of IETF RFC 4028 [16];
3. It is recommended that the 5G-RG does not include the "refresher" parameter in the Session-Expires header field of the SIP INVITE request. If the 5G-RG includes the "refresher" parameter in the Session-Expires header field of the SIP INVITE request, the 5G-RG MUST set the "refresher" parameter to “uac”;
4. If a received SIP INVITE request indicates support of the "timer" option tag, and does not contain the Session-Expires header field, the 5G-RG MUST include a Session-Expires header field with the delta-seconds portion set to the greater of 1800 or the value contained in the Min-SE header (if present in the received INVITE) and the "refresher" parameter with the value "uac" in SIP 2xx response to the SIP INVITE request; and
5. If a received SIP INVITE request indicates support of the "timer" option tag, and contains the Session-Expires header field without "refresher" parameter, the 5G-RG MUST include the "refresher" parameter with the value "uac" in the Session-Expires header field of the SIP 2xx response to the SIP INVITE request, and MUST set the delta-seconds portion of the Session-Expires header field of the SIP 2xx response to the SIP INVITE request to the value indicated in the delta-seconds portion of the Session-Expires header field of the SIP INVITE request.

Note: The network can choose to influence the session timer negotiation by modifying any of the related header fields or header field parameters within the constraints of IETF RFC 4028 [16].

4.2.10 User Agent and Server header fields

[R-52] A 5G-RG that is registered with an IMS network MUST indicate its capability to support MMTel Voice by including the IMS Communication Service Identifier (ICSI) value of “urn:urn-7:3gpp-service.ims.icsi.mmtel”, as defined in 3GPP TS 24.173 [17], in a Contact header field when it sends a SIP OPTIONS request or sends a 200 OK response to an incoming SIP OPTIONS request.

4.2.11 User Agent and Server Headers

[R-53] The 5G-RG MUST include the User-Agent header in all SIP requests and the Server header in all SIP responses. The headers MUST be compiled as defined in section C.4.1 of GSMA PRD RCC.07 [18] including the following amendment:

```
product-list =/ enabler *(LWS enabler
                    [LWS terminal]
                    [LWS device-type]
                    [LWS mno-customisation]
                    *(LWS list-extension)
```


The rule "enabler" is defined in section C.4.1 of GSMA PRD RCC.07 [18] and is extended as follows:

```
enabler =/ BBF-TR
BBF-TR = "BBF-" TR-code SLASH major-version-number
TR-code = "TR-494" / token
major-version-number = 1*DIGIT ; the major version number of the BBF-TR
```

The rule "terminal" is defined in section C.4.1 of GSMA PRD RCC.07 [18].

The rules "mno-customization" and "device-type" are defined as an extension to section C.4.1 of GSMA PRD RCC.07 [18] as follows:

```
list-extension =/ device-type / mno-customisation
device-type = "device-type" SLASH device-classification
device-classification = token ; token taken from the
                  ; device classification registry defined in IETF RFC 7852
mno-customisation = "mno-custom" SLASH customisation
customisation = open-market / customised
open-market = "none”
customised = MCC-MNC / free-text
MCC-MNC = MCC MNC
MCC = 3DIGIT ; the E.212 Mobile Country code assigned to the operator country
MNC = 3DIGIT ; the E.212 Mobile Network Code assigned to the operator,
; a two digit MNC is padded out to 3 digits by inserting a 0 at the beginning
free-text = token ; a human readable string to identify the customisation
```

It is recommended that the 5G-RG uses the token “fixed” for device-classification, as per RFC 7852 [53].

Examples of User-Agent header constructed according to the rules above:

```
User-Agent: BBF-TR-494/1 term-Vendor1/Model1-XXXX device-type/fixed mno-
custom/none
User-Agent: BBF-TR-494/2 term-Vendor2/Model2-YYYY device-type/fixed mno-
custom/ex.telekom
```

Note 1: The User-Agent and Server headers are meant to assist persons in analysing the network behaviour. It is not intended that their presence, content or syntax, influence the network behaviour.

Note 2: Within a trust domain, network(s) are expected not to add, remove or modify User-Agent and Server headers. This applies whether a given network element functions as a SIP proxy or Back to Back User Agent (B2BUA).

4.3 Supplementary services for multimedia telephony calls

[R-54] The 5G-RG and the network MUST support the MMTEL supplementary services defined in section 4.3.1 that are managed as defined in section 4.3.2 and further detailed in their respective subsections of this section.

4.3.1 Supplementary services overview

[R-55] Supplementary services MUST be supported as defined in 3GPP TS 24.173 [17], with the constraints described in this section. The 5G-RG and the Telephony Application Server (TAS) MUST support the supplementary services listed in Table 4-1. The provisioning of these supplementary services for a subscriber is optional and is an operator decision.

Supplementary Service
Originating Identification Presentation 3GPP TS 24.607 [19]
Terminating Identification Presentation 3GPP TS 24.608 [20]
Originating Identification Restriction 3GPP TS 24.607 [19]
Terminating Identification Restriction 3GPP TS 24.608 [20]
Communication Forwarding Unconditional 3GPP TS 24.604 [21]
Communication Forwarding on not Logged in 3GPP TS 24.604 [21]
Communication Forwarding on Busy 3GPP TS 24.604 [21]
Communication Forwarding on No Reply 3GPP TS 24.604 [21]
Barring of All Incoming Calls / Anonymous Call Rejection 3GPP TS 24.611 [22]
Barring of All Outgoing Calls 3GPP TS 24.611 [22]
Barring of Outgoing International Calls 3GPP TS 24.611 [22]
Communication Hold 3GPP TS 24.610 [23]
Message Waiting Indication 3GPP TS 24.606 [24]
Communication Waiting 3GPP TS 24.615 [25]
Ad-Hoc Multi Party Conference 3GPP TS 24.605 [26]
Explicit Communication Transfer - Consultative 3GPP TS 24.629 [27]

Table 4-1 Supplementary Services

For most of the services listed above, recommended options are described in subsequent subsections of section 4.3.

[R-56] The 5G-RG MUST support local generation of dial tone and call waiting tone.

4.3.2 Supplementary service configuration

[R-57] For MMTEL supplementary service configuration, the 5G-RG and the IMS core network MUST support SIP-based user configuration, as defined in 3GPP TS 24.238 [28], for supplementary services that are implemented in the network.

As stated in TS 24.238 [28], The precise digit sequences within the Request-URI that comprise the effective dialstrings for user configuration are defined by the IM CN subsystem service provider and are not subject to standardization.

4.3.3 Ad-Hoc Multi Party Conference

[R-58] The 5G-RG and the IMS core network MUST support the procedures defined in 3GPP TS 24.605 [26] and section 5.3.1.3.2 of 3GPP TS 24.147 [29], with the clarifications defined in this sub section. Conference calls for more than 3 participants are not required.

Note 1: As per section 4.2 of 3GPP TS 24.605 [26], the invocation and operation for conferencing is described in 3GPP TS 24.147 [29].

[R-59] For conference creation, the 5G-RG and the IMS core network MUST support Three Way Session creation as described in section 5.3.1.3.3 of 3GPP TS 24.147 [29]. The 5G-RG MUST apply option 2b) when inviting the remote user to the conference. If the 5G-RG has not been configured with Conf_Factory_URI parameter as specified in Annex C.3 [3], then the 5G-RG MUST construct the "Default Conference Factory URI for MMTel" as specified in section 13.10 of 3GPP TS 23.003 [5].

Note 2: Other mechanisms for providing 3-party calls such as local mixing in the 5G-RG are out of scope of this specification.

4.3.4 Communication Waiting

[R-60] The 5G-RG and the IMS core network MUST support the terminal-based service, as described in 3GPP TS 24.615 [25]. The network-based service is not required. The Communication Waiting (CW) indication as defined in section 4.4.1 of 3GPP TS 24.615 [25] is not required. The 5G-RG is required to support Alert-Info, with values as specified in 3GPP TS 24.615 [25].

4.3.5 Message Waiting Indication

[R-61] The 5G-RG MUST, and the IMS core network can support the Message Waiting Indication (MWI) event package, as defined in 3GPP TS 24.606 [24] and IETF RFC 3842 [30].

4.3.6 Originating Identification Restriction

[R-62] The 5G-RG and the IMS core network MUST support the SIP procedures in 3GPP TS 24.607 [19]. Service configuration as described in section 4.10 of 3GPP TS 24.607 [19], is not required.

The user controls the presentation of Originating Identification by means of feature activation codes dialed on the analog handset. These codes are not standardized and need to be configured via digit mapping on the 5G-RG to suit local practice.

[R-63] The 5G-RG MUST follow the procedures defined in section 4.5.2.1 of 3GPP TS 24.607 [19] in accordance with the privacy setting requested for any given originating call by the user via feature activation codes.

4.3.7 Terminating Identification Restriction

[R-64] The 5G-RG and the IMS core network MUST support the SIP procedures in 3GPP TS 24.608 [20]. Service configuration (XCAP), as described in section 4.9 of 3GPP TS 24.608 [20], is not required.

4.3.8 Communication Diversion

[R-65] The IMS core network MUST support the SIP procedures described in 3GPP TS 24.604 [21] for Communication Diversion (CDIV), with certain exceptions and modifications as noted here.

[R-66] For CDIV service activation and deactivation, the IMS core network MUST support the XML rules for Call Forwarding Unconditional and the conditions, actions and elements listed in Table 4-2.

Type	Parameter
Rule containing condition	busy
Rule containing condition	no-answer
Rule containing condition	not-registered
Action	Target
Element	NoReplyTimer

Table 4-2 Supported Conditions, Actions, and Elements in CDIV

[R-67] The IMS core network MUST support the XML rules as described in section 4.9.1 of 3GPP TS 24.604 [21]. However, the operator decides which rules are included in the XML document, e.g., depending on the subscription.

For service configuration, the Ut interface is not required. Instead, user configuration for CDIV is supported via SIP as defined in 3GPP TS 24.238 [28] are used.

[R-68] The IMS network MUST support SIP-based user configuration of Call Forwarding Unconditional, whereby the user dials a feature activation code followed by the destination number to which calls should be forwarded. The codes for activation and deactivation of CFU are not subject to standardization and should be configured by the operator to suit local needs.

The operator can support user-controlled activation and deactivation of Call Forwarding Busy and Call Forwarding No Answer using SIP-based user configuration of activation status for these supplementary services.

[R-69] The 5G-RG MUST support the History-Info header for identification of diverting parties at the terminating side and for identification of diverted-to parties at the originating side. At the terminating side, a History-Info entry MUST be used for the identification of the diverting party and that the call has been diverted only if another History-Info entry exists that has assigned the next index in sequence and includes a cause value in a cause-param SIP URI parameter as described in section 4.5.2.6.2 of 3GPP TS 24.604 [21].

[R-70] At the originating side only History-Info entries including a cause value MUST be used for presentation of the diverted-to party.

Note 1: The 5G-RG can deduce that the received call is a diverted call based on the cause-param values.

Note 2: Support of subscription options and other conditions and actions are out of scope of the document.

4.3.9 Communication Barring

Operators can offer users outgoing call barring services, for example enabling users to block call attempts to International numbers or to premium rate lines.

Note: Barring of premium rate numbers is in 3GPP specified as operator determined barring in 3GPP TS 24.315 [58].

[R-71] Outgoing communication barring services MUST be implemented in accordance with the procedures defined in 3GPP TS 24.611 [22], with control of the services being provided by SIP-based user configuration as defined in 3GPP TS 24.238 [28].

[R-72] For incoming communication barring, Anonymous Communication Rejection (ACR) MUST be supported. If the 5G-RG supports terminal-based ACR, the operator should leverage this capability to support the ACR service. Otherwise, ACR May be implemented in the network as defined in 3GPP TS 24.611 [22] section 4.5.2.6.2.

4.3.10 Communication Hold

[R-73] The 5G-RG MUST support the Communication Hold service as defined in 3GPP TS24.610 [23].

4.3.11 Explicit Communication Transfer – Consultative

[R-74] The 5G-RG MUST, and the IMS core network can support the procedures for the consultative transfer defined in 3GPP TS 24.629 [27], with the clarifications defined in this sub section.

[R-75] The 5G-RG as a Transferee MUST support the procedures with 3rd Party Call Control (3PCC) as defined in 3GPP TS 24.628 [13]. The 5G-RG procedure without 3PCC is not required.

[R-76] The 5G-RG and the IMS core network MUST support audio media for the transferred session.

4.3.12 Originating Identification Presentation

[R-77] The 5G-RG and IMS core network MUST support the SIP procedures in 3GPP TS 24.607 [19].

[R-78] The 5G-RG MUST support the presentation of the originating user identity both from the identity within the P-Asserted-Identity header field and the identity within the From header field.

[R-79] The 5G-RG MUST support the operator's originating party identity determination policy as defined in section 4.5.2.12 of 3GPP TS 24.607 [19] also the 5G-RG MUST support being configured according to the "FromPreferred" parameter as specified in Annex C.3 [3].

Note: As, by default, the identity in the From header field need not be network asserted, it is the responsibility of the network to ensure that the From header field contains a reliable identity of the originating user when it is sent to the 5G-RG.

5 Media

5.1 General

This section endorses a set of media capabilities specified in 3GPP TS 26.114 [31]. The section describes the needed SDP support in 5G-RGs and in the IMS core network and it describes the necessary media capabilities both for 5G-RGs and for entities in the IMS core network that terminate the user plane. Examples of entities in the IMS core network that terminate the user plane are the Media Resource Function Processor (MRFP) and the Media Gateway (MGW).

5.2 Audio

5.2.1 Codecs

[R-80] The 5G-RG MUST support and offer all speech codecs mandated for MTSI clients in terminal, including mandatory parts of the detailed per-codec requirements, as described in sections 5.2.1 and 7.5.2.1 of 3GPP TS 26.114 [31].

[R-81] In particular, the 5G-RG MUST support the EVS codec as described in 3GPP TS 26.114 [31], 3GPP TS 26.441 [32], 3GPP TS 26.445 [33], 3GPP TS 26.446 [34], 3GPP TS 26.447 [35], 3GPP TS 26.449 [36], 3GPP TS 26.450 [37], 3GPP TS 26.451 [38] and either 3GPP TS 26.442 [39] or 3GPP TS 26.443 [40] or 3GPP Release 16 TS 26.452 [41].

[R-82] The 5G-RG MUST support the handling of CMR within RTP payload as specified in section 7.5.2.1.2.2 of 3GPP TS 26.114 [31].

[R-83] Entities in the IMS core network that terminate the user plane supporting speech communication and supporting TFO and/or TrFO MUST support all speech codecs mandated for MTSI media gateways, including mandatory parts of the detailed per-codec requirements as described in clause 12.3.1 of 3GPP TS 26.114 [31].

[R-84] Entities in the IMS core network that terminate the user plane supporting super-wideband speech communication MUST support:

- EVS speech codec as described in 3GPP TS 26.441 [32], 3GPP TS 26.445 [33], 3GPP TS 26.447 [35], 3GPP TS 26.449 [36], 3GPP TS 26.450 [37] and 3GPP TS 26.451 [38] and either 3GPP TS 26.442 [39], 3GPP TS 26.443 [40], or 3GPP Release 16 TS 26.452 [41].

[R-85] Entities in the IMS network that provide transcoding-free interworking to the legacy network MUST be capable of requesting the 5G-RG to restrict codec mode changes to be aligned to every other frame border and also be capable of requesting the UE to restrict codec mode changes to neighboring codec modes within the negotiated codec mode set.

Note: Restrictions in codec mode changes are required only for transcoder-free interworking with a legacy device.

5.2.2 Speech Media: SDP Considerations

5.2.2.1 General

[R-86] The SDP offer/answer for voice media MUST be formatted as specified in section 6.2.2 of 3GPP TS 26.114 [31], with the restrictions included in the present document.

[R-87] The 5G RG MUST include at least the following codecs in the initial SDP offer in the following preference order.

1. [a, b, c] as per sections 5.2.1.5 and 5.2.1.6 of 3GPP TS 26.114 [31].

    a) One EVS payload type (as the preferred option) with one of the configurations supporting super-wideband speech as defined in section 3.2.2.3 of this document.

    b) One AMR-WB payload type with no mode-set specified as defined in table 6.1 of 3GPP TS 26.114 [31].

c) One AMR payload type with no mode-set specified as defined in table 6.1 of 3GPP TS 26.114 [31].

2. At least one wireline codec (to be compatible with wired POTS terminals/FN-RG to reduce transcoding requirements and support the related call flows)

a) To be chosen by the service operator

b) G.711 (default) [54]

[R-88] The offering of the codecs and the priority order in the SDP Offer SHOULD be configurable.

[R-89] A codec change during a running call SHOULD be feasible i.e., in case the access changes from wireline to wireless and vice versa.

Note 1: See also chapter 9.1 5G-RG recommended Voice Codecs in TR-493 [55].

Note 2: The originating and terminating networks can modify the SDP offer for voice media.

5.2.2.2 AMR and AMR-WB

[R-90] The UE MUST set the b=AS to match the highest codec mode for the offer (maximum codec bit rate if no mode set is included).

[R-91] The UE, upon receiving an initial SDP offer containing a payload description for AMR with no mode-set included and accepting the payload description with no mode-set, MUST include into the SDP answer the value assigned to the RateSet parameter for AMR as specified in Annex C.3 [3]. It is recommended to set the RateSet parameter for AMR to 0,2,4,7 (i.e., mode set=0,2,4,7 included in the SDP answer).

[R-92] The UE, upon receiving an initial SDP offer containing a payload description for AMR-WB with no mode-set included and accepting the payload description with no mode-set, MUST include into the SDP answer the value assigned to the RateSet parameter for AMR-WB as specified in Annex C.3 [3]. It is recommended to set the RateSet parameter for AMR-WB to "undefined" (i.e., no mode-set included). A UE that intends to use AMR-WB 12.65 as highest mode MUST have the RateSet parameter set to "0,1,2" and include mode-set=0,1,2 in the SDP answer.

[R-93] The SDP answer for AMR with no mode-set included, MUST be interpreted by the UE as all eight AMR modes can be used.

[R-94] The SDP answer for AMR-WB with no mode-set included MUST be interpreted by the UE as all nine AMR-WB modes can be used.

[R-95] The UE MUST set the b=AS to match the highest codec mode for the answer (maximum codec bit rate if no mode set is included).

5.2.2.3 EVS

[R-96] The UE that sends the SDP offer for voice media MUST include in this SDP offer at least one EVS payload type with one of the following EVS configurations:

1. EVS Configuration A1: br=5.9-13.2; bw=nb-swb.
2. EVS Configuration A2: br=5.9-24.4; bw=nb-swb.
3. EVS Configuration B0: br=13.2; bw=swb.
4. EVS Configuration B1: br=9.6-13.2; bw=swb.
5. EVS Configuration B2: br=9.6-24.4; bw=swb.

[R-97] The UE MAY also include in this SDP offer, ch-aw-recv=x with x set to a value out of the set {-1,0,2,3,5,7}. The UE MUST support being configured according to the "ICM/INIT_PARTIAL_REDUNDANCY_OFFSET_RECV" parameter as specified in Annex C.3 [3]. If the "ICM/INIT_PARTIAL_REDUNDANCY_OFFSET_RECV" parameter is undefined, then the UE MUST not include ch-aw-recv into the SDP offer. SDP parameters other than br, bw, max-red and ch-aw-recv MUST not be included in a media format description associated with the EVS codec within the initial SDP offer (for a list of SDP parameters see table 6.2a in 3GPP TS 26.114 [31]).

Note 1: If ch-aw-recv is not included in the SDP, this is identical to include ch-aw-recv=0, as specified in 3GPP TS 26.445 [33].

[R-98] The configuration of the EVS payload type to be included first in the initial SDP offer for EVS is defined by the EVS/Br and EVS/Bw parameters as specified in Annex C.3 [3], which MUST be configured to one of the five above EVS Configurations.

[R-99] The UE that sends the initial SDP offer SHOULD also include in this initial SDP offer one EVS payload type with audio bandwidth range up to super-wideband and with no restrictions on bitrate range and no restriction on mode-set (Open Offer, OO). If this EVS payload type is not included, then:

1. an initial SDP offer with EVS configuration B0 or B1 listed first MUST also include a second payload type with EVS configuration A1; and
2. an initial SDP offer with EVS configuration B2 listed first MUST also include a second payload type with EVS configuration A2.

Note 2: An initial SDP offer with multiple EVS configurations does not need to include subsequent EVS configurations that are subsets of the previously listed ones. For example, including B0 or B1 after A1, or including B2 after A2 is allowed but does not provide any additional information.

[R-100] The UE MUST support all SDP parameters applicable to EVS that can be received in an SDP offer as specified in 3GPP TS 26.114 [31] and 3GPP TS 26.445 [33].

A payload type in the received SDP offer is considered to match the EVS configuration ‘X’ if the values that the payload type indicates for the ‘br’ and ‘bw’ parameters are exactly as specified above for configuration ‘X’. The inclusion of additional parameters and the values to which those parameters are set, has no bearing on whether this inclusion matches the standard configuration ‘X’.

[R-101] A UE MUST answer according to both the received SDP offer and the UE's EVS configuration (i.e., EVS/Br and EVS/Bw parameters as specified in see Annex C.3 [3] as described in Table 5-1 below:

	EVS configuration (preferred payload type) of the UE that received the SDP Offer				
Received SDP Offer for EVS (preferred payload type listed first, and other, if any)	**A1**	**A2**	**B0**	**B1**	**B2**
A1 and optionally OO	A1 (from A1)	A1 (from A1)	A1 (from A1)	A1 (from A1)	A1 (from A1)
A2 and optionally OO	A1 (from A2)	A2 (from A2)	A1 (from A2)	A1 (from A2)	A2 (from A2)
B0 and (A1 and/or OO)	B0 (from B0)	B0 (from B0)	B0 (from B0)	B0 (from B0)	B0 (from B0)
B1 and (A1 and/or OO)	A1 (from A1 or OO)	A1 (from A1 or OO)	B1 (from B1)	B1 (from B1)	B1 (from B1)
B2 and (A2 and/or OO)	A1 (from A2 or OO)	A2 (from A2 or OO)	B1 (from B2)	B1 (from B2)	B2 (from B2)

Table 5-1 SDP content to be included in an SDP answer for a super-wideband call

Note 3: This table applies only to received SDP offers compliant with this specification, e.g., including A1, if B0 or B1 are listed first and including A2, if B2 is listed first.

If the offer is not compliant with this specification, the SDP offer/answer rules in 3GPP TS 26.445 [33] still apply.

[R-102] The SDP answerer SHOULD use the same payload type number in the SDP answer as was used by the payload type selected from the SDP offer. This applies both, when the SDP offer and the SDP answer contain the same EVS configuration, and if the SDP answer contains a subset of the chosen configuration from the SDP offer.

[R-103] The SDP offerer MUST be able to handle an SDP answer with a different payload type number than the one used in the offer and use this payload type number in its sent RTP packets when the payload type number in the SDP answer can be unambiguously associated with one of the payload types in the offer.

[R-104] If the SDP offerer cannot unambiguously associate the received payload type number in the SDP answer with an offered EVS configuration, the SDP offerer SHOULD re-issue the SDP offer at most once, with the following modifications:

1. If the ambiguous EVS payload type number from the SDP answer was not used for another codec in the initial SDP offer, the SDP offerer SHOULD add the same EVS configuration and payload type number than the one used by the SDP answer as most preferred payload type number in the re-offer.
2. If the ambiguous EVS payload type number from the SDP answer was used for another codec in the initial SDP offer, the SDP offerer SHOULD include the EVS configuration from the SDP answer with a single payload type number not previously used in the SDP offer.

Note 4: An answer with a different payload type number can happen e.g., when the network nodes, perform third party call control. If the re-issue of the SDP offers results in an ambiguous SDP answer, the SDP offerer can end the call attempt.

Note 5: This means that the same payload type number will in most cases be used in both directions. Table 5-1 contains information on which payload type from the SDP offer to use in the SDP answer when a subset of the configuration from the SDP offer is needed ("from …"), and when there can be an ambiguity in which payload type number from the SDP offer that is chosen.

[R-105] If the selected EVS configuration is A1, B0, or B1 then "mode set = 0,1,2" MUST be included in the SDP answer.

[R-106] The UE MUST add only SDP parameters that are applicable to EVS in the SDP answer that are already present in the corresponding received and accepted SDP offer. If SDP parameters applicable to EVS, are included in the accepted SDP offer, then the UE MUST handle these parameters as specified in 3GPP TS 26.445 [33].

[R-107] If the SDP parameter ch-aw-recv is present in the corresponding received and accepted SDP offer, then the SDP parameter ch-aw-recv MUST be included in the SDP answer with the same value as received.

Default values as specified in 3GPP TS 26.445 [33] apply for all other SDP parameters applicable to EVS that are not included in the SDP answer.

5.2.2.4 G.711

G.711 is the prevalent audio codec in the legacy devices like POTS and is detailed in [G.711: Pulse code modulation (PCM) of voice frequencies https://www.itu.int/rec/T-REC-G.711-198811-I/en] [54].

5.3 DTMF events

[R-108] The UE and the IMS core network MUST support DTMF events as defined in Annex G of 3GPP TS 26.114 [31].

[R-109] If the UE receives an SDP offer with no telephone-event codec included, then the UE MUST not reject the SDP offer for this reason and the UE MUST not send DTMF events using the telephone-event codec for the negotiated session.

Note: Transport of DTMF events from the UE using the telephone-event codec during a session is impossible unless the telephone-event payload type has been negotiated.

6 Common Functionalities

6.1 Emergency service

This section describes the requirement regarding emergency call and emergency services for 5G-RG.

[R-1] The 5G-RG MUST support the IMS emergency services as specified in 3GPP TS 24.229 [4] and Annex H of 3GPP TS 23.167 [44].

[R-2] Emergency call MUST be free of charge for the user.

[R-3] Emergency calls shall be routed to the emergency services in accordance with national regulations where the subscriber is located.

[R-4] Emergency call shall be established by dialing specific emergency numbers identified by the network (and not by the 5G-RG).

[R-5] Emergency local numbers MUST be provisioned on the 5G-RG in the SIM/eSIM

[R-6] If the number is not provisioned, then the network SHOULD provision the emergency local number during the initial attach.

[R-7] Depending on the regulatory conditions the following emergency call options MUST be supported:

Option A: Emergency call MUST be supported by 5G-RG without a Subscriber identity module/ Universal Subscriber Identity Module (SIM/USIM/ISIM) being present.

Option B: Emergency call MUST be supported by 5G-RG only if a Subscriber identity module/ Universal Subscriber Identity Module (SIM/USIM/ISIM) is being present.

[R-8] 5G-RG MUST support 5G-NR cell id in the SIP PANI Header (P-Access-Network-Info Header)

Note: Details on the emergency architecture and the call flows can be found in [55].

6.2 Voice Band Data

[R-110] The 5G-RG MUST support ITU-T V.152 Procedures for supporting voice-band data over IP networks, V.152 [51].

[R-111] The 5G-RG MUST support ITU-T Rec V.152 Implementors Guide for ITU-T V.152 Procedures for supporting voice-band data over IP networks, V.Imp152 [52].

End of Broadband Forum Technical Report TR-494