ISG - Connectivity / Voice over LTE (VoLTE) for IoT

v1.2

Introduction

This document summarizes IoT technical requirements available in 3GPP™ and in GSM Association specifications document, as well as lessons learned from IoT and consumer commercial deployments of Voice over LTE (VoLTE) over DTAG network. All requirements including the words "SHALL" or "SHALL NOT" in their descriptions are essential for VoLTE and are mandatory to follow. All statements containing the terms "SHOULD" or "SHOULD NOT" are recommended to be implemented as such.

This document is divided into several sections, categorizing the features that IoT Device and component manufacturers are required to implement to provide for feature interoperability with Deutsche Telekom networks.

Table of Contents

I. Definitions

IoT Service Application

Business application logic of the IoT Service which processes the data collected from assets. The IoT Service Provider hosts their IoT Service Application on a server or Cloud Platform provided by Deutsche Telekom or another third party.

Automotive Emergency Calls (eCall)

eCall is a European initiative intended to bring rapid assistance to motorists involved in a collision anywhere in the European Union. The aim is for all new cars to incorporate a system that automatically contacts the emergency services in the event of a serious accident, sending location and sensor information. eCall was made mandatory in all new cars sold within the EU from April 2018.

EPS Session Management (ESM)

The ESM (EPS Session Management) and EMM (EPS Mobility Management) entity is a control plane function which supports all aspects of signalling for PDN (Packet Data Network) session management, such as EPS Bearer Activation and Modification.

IP-Multimedia Subsystem (IMS)

The IP Multimedia Subsystem or IP Multimedia Core Network Subsystem (IMS) is an architectural framework for delivering IP multimedia services. Historically, mobile phones have provided voice call services over a circuit-switched-style network, rather than strictly over an IP packet-switched network.

Single Radio Voice Call Continuity (SRVCC)

Single Radio Voice Call Continuity (SRVCC) provides a solution for handing over VoLTE (Voice over LTE) to 2G/3G networks.

Unstructured Supplementary Service Data (USSD)

Unstructured Supplementary Service Data (USSD), sometimes referred to as "quick codes" or "feature codes", is a communications protocol used by GSM cellular telephones to communicate with the mobile network operator's computers. USSD can be used for WAP browsing, prepaid callback service, mobile-money services, location-based content services, menu-based information services, and as part of configuring the phone on the network.

Voice over LTE (VoLTE)

VoLTE stands for 'Voice over Long Term Evolution'. Utilizing IMS technology, it is a digital packet voice service delivered over IP via an LTE access network. Voice calls over LTE are recognized as the industry-agreed progression of voice services across mobile networks, deploying LTE radio access technology.

Video over LTE (ViLTE)

ViLTE stands for video over LTE. It's an extension of VoLTE, which enhances voice services with a high-quality video channel.

II. Deutsche Telekom M2M VoLTE platform description

Deutsche Telekom has deployed a VoLTE platform for its B2B M2M / Internet of Things (IoT) business, directly connected to the dedicated M2M packet core network. As a result, a separate system and handling is implemented which diverges from the parallel consumer VoLTE platform and service. The M2M VoLTE platform only supports outbound roaming of Deutsche Telekom customers to other networks.

The M2M VoLTE platform enables three types of SIM cards:

- Deutsche Telekom Global-SIM: MCC 901, MNC 40
- Telekom Germany SIM: MCC 262, MNC 01
- Magenta Austria SIM: MCC 232, MNC 03

The Global-SIM and Magenta Austria SIM cards are permanently roaming, even inside of the Deutsche Telekom footprint. The only domestic scenario that may occur would be when a Telekom Germany SIM card is used on the Telekom Germany network inside of Germany.

Supported Procedures

The following scenarios are catered to by Deutsche Telekom's M2M VoLTE platform:

- LTE Attach using Internet APN and IMS APN,
- IMS registration,
- Mobile-originated VoLTE calls,
- Mobile-originated Short Message Service (SMS) over IP,
- Mobile-terminated VoLTE calls,
- Mobile-terminated Short Message Service (SMS) over IP.

The following features are not supported by Deutsche Telekom's M2M VoLTE platform:

- SRVCC, i.e. a handover from VoLTE to circuit-switched (CS) call,
- Supplementary Service configuration via XCAP/Ut,
- VoLTE emergency calls (routed to the visited core network, i.e. within the Deutsche Telekom footprint, M2M VoLTE emergency calls are processed by the consumer core network),
- Rejection of local emergency calls (e.g. 113 in Norway) with a SIP 380 (Alternative Service) response is currently not supported,
- Video over LTE (ViLTE) as defined in GSMA PRD IR.94,
- Unstructured Supplementary Service Data (USSD) over IMS (USSI, i.e. dial strings),
- Local short codes,
- Inbound VoLTE traffic, originated from customers using SIM cards issued by Deutsche Telekom's roaming partners, is not catered to on the Deutsche Telekom M2M / IoT network.

APN Usage

For M2M VoLTE, the Attach procedure can be divided into two steps:

1. When initially attaching to LTE, the M2M/IoT device SHALL indicate a "Data APN" or "Default APN" to be used, and the ESM flag is set to 1. This APN must match was is defined in the corresponding SIM card

profile within Deutsche Telekom's HSS. For automotive customers this generally corresponds to the "Telemetry APN" used by customers, e.g. internet.m2mportal.de.

2. Afterwards, the M2M/IoT device SHALL initiate a PDN connection to the standard "IMS APN" to perform a VoLTE registration. This APN must also be present within the same HSS profile.

Please note that the "Data APN" must be different from the "IMS APN" in the HSS profile.

Handling of Emergency Calls

There are several emergency call types recognized from an M2M point of view:

- Public emergency calls (112 or 911),
- Public eCalls (designed for automotive customers),
- Local emergency calls (a country-specific emergency number),
- Private emergency calls (a normal VoLTE call to a third-party emergency service).

The predominant use of emergency calls on Deutsche Telekom's M2M VoLTE platform is for private emergency calls.

Local emergency numbers are currently not supported by the M2M VoLTE platform (including rejection of undetected emergency calls with a SIP 380 (Alternative Service) response). The implementation of this feature is currently ongoing.

Public emergency calls and eCalls are not supported by the M2M VoLTE platform. They are routed to Deutsche Telekom's consumer core network, while the devices are on-footprint. They can both happen in either circuit-switched (CS) or VoLTE domains. M2M/IoT devices supporting both can detect from a specific indication of the network which one should be used.

III. Network Access

The following requirements summarize capabilities required to establish a secondary IMS APN for VoLTE service. It is the obligation of both IoT Device manufacturers and Service Providers who deploy said IoT Devices to confirm that VoLTE-enabled IoT Devices placed on the Deutsche Telekom network can properly access VoLTE services.

VoLTE APN Concept

Telekom's APN concept SHALL be supported. When the IoT Device attaches to LTE, the Attach procedure SHALL work as follows:

- The LTE Attach APN is stored in the IoT Device's internal APN configuration (e.g. SIM profile);
- During the initial LTE Attach, the IoT Device requests the LTE Attach APN as stored in the internal APN configuration;
- The IoT Device then establishes a secondary PDN connection to the IMS APN, as described in [IR.92], whenever this IMS APN is not the same as the LTE Attach APN. The IMS APN defined by IR.92 currently is "ims".

Blank APN Name

The IoT Device SHALL request the initial default PDN with a blank APN name (i.e. APN = "") when there is no APN marked as LTE Attach APN in the internal APN configuration.

Use of IMS APN for SIP Signaling

The IoT Device SHALL use the IMS well-known APN for SIP signaling, as defined in IR.92, Section 4.3.1 and IR.51, Section 4.6 and IR.88. This APN is currently defined by IR.91 as "ims".

PDN Connection Handling

If the PDN connection established during the initial Attach is to an APN other than the IMS well-known APN, the IoT Device SHALL establish a secondary PDN connection to the IMS well-known APN, as described in IR.92, Section 4.3.1. The IoT Device SHALL use for this connection PDN type IPv4v6, as described in IR.92, Section 5.1.

EPS Bearer Configuration

The EPS bearers for VoLTE SHALL be managed in the following way, as described in IR.92, Section 4.3:

- The default bearer with QCI 5 is used for SIP signaling;
- The dedicated bearer with QCI 1 is used for voice;
- The bearer setup is initiated by the network.

P-CSCF Discovery & Handling

The IoT Device SHALL support P-CSCF discovery via the "PCO IE" EPS procedure, as defined in IR.92, Section 4.4. The IoT Device shall indicate "P-CSCF IPv6 Address Request" and "P-CSCF IPv4 Address Request" when requesting for default connectivity, if applicable, also when requesting for PDN connection to the IMS APN. In case a P-CSCF address is received twice, the latter one applies. If the IoT Device receives no P-CSCF address after requesting PDN connectivity for IMS-APN, it SHALL NOT try to register to IMS (to any P-CSCF) and it does not re-attempt an Attach to discover the P-CSCF.

Device Configuration for Access Domain Selection

The IoT Device SHALL be configured to perform additional procedures to support terminating access domain selection in the network, whereby "Mobility_Management_IMS_Voice_Termination" is enabled, as defined in 3GPP™ TS 24.167, Section 5.31.

SIP Attach Configuration

When requesting PDN Connectivity for VoLTE, the IoT Device SHALL indicate to the network, that the Attach is for SIP signaling by setting the IM CN Subsystem Signaling Flag, as described in TS 24.229 Annex L.2.2.1.

IV. SIP Registration & Attach

The following requirements summarize capabilities required to register and Attach to VoLTE services. It is the obligation of both IoT Device manufacturers and Service Providers who deploy said IoT Devices to confirm that VoLTE-enabled IoT Devices placed on the Deutsche Telekom network can properly perform these procedures.

IMS Profile for Voice and SMS

The IoT Device SHALL comply with the relevant parts of 3GPP™ TS 24.229 (Release 10) and the relevant parts of GSMA PRD IR.92: "IMS Profile for Voice and SMS" Version 11.0.

TCP Maximum Segment Size

The TCP maximum segment size (MSS) SHALL be set to less than 1340 bytes in the IoT Device for all IMS services. This ensures that a maximum transmission unit (MTU) size of 1500 Bytes is not exceeded.

IoT Device applications communicating with the IoT Service Application over a 3GPP™ LTE-M access bearer, SHALL have the TCP MSS set to a value 90% lower than the supplier-confirmed MTU size.

SIP Registration to IMS

The IoT Device SHALL register to IMS for VoLTE (i.e. with MMTEL ICSI) if the response to the network Attach provides IMS VoIP support indication from the networks described in IR.92, Section 2.2.1. The IoT Device SHALL NOT use signaling compression when the initial IMS registration is performed.

The IoT Device SHALL start the initial registration procedure, in case of state attribute set to "terminated" and event attribute set to "deactivated" within the Notify, which initiates the de-registration, as described in 3GPP™ 24.229, Section 5.1.1.7.

The parameter “expires” in SIP REGISTER SHALL not be smaller than 7200 seconds.

Contents of Registration Request

The REGISTER request SHALL contain:

- The MMTel IMS Communication Service Identifier (ICSI), i.e. urn:urn-7:3gpp-service.ims.icsi.mmtel, as described in IR.92, Section 2.2.1;
- The "+sip.instance" header field parameter (Instance ID) of the Contact address includes the IMEI URN, as described in IR.92, Section 2.2.1.

Note: In other circumstances, and if no other services need registration, the IoT Device SHALL NOT initiate any IMS registration at all. Registrations for other services might occur if applicable.

User Agent Header

The IoT Device SHALL support a User-Agent header which contains a unique User-Agent-Name, consisting of Device Name, Software-ID. Operator-variant-ID SHOULD be included.

Registration Features

The IoT Device SHALL support the following features:

- Subscription to registration event package, as described in IR.92, Section 2.2.1;
- Network initiated de-registration, as described in IR.92, Section 2.2.1;
- P-Access-Network-Info header according to [24.229] including access type and he cell id (user provided; CGI for GERAN/UTRAN, ECGI for EUTRAN).

Handling of an “Interval Too Brief” Response to an Initial Registration Request

On receiving a SIP 423 (Interval Too Brief) response to the REGISTER request, the IoT Device SHALL send another REGISTER request populating the registration expiration interval value with an expiration timer of at least the value received in the Min-Expires header field of the SIP 423 (Interval Too Brief) response.

Handling of "Service Unavailable" or "Retry-After" Responses to an Initial Registration Request

If the IoT Device receives a SIP 503 (Service Unavailable) or any other SIP 4xx, 5xx or 6xx message with "Retry-After" header in response to an initial REGISTER request, the IoT Device SHALL automatically re-attempt the initial registration via the same IP-CAN and the same P-CSCF after the amount of time indicated in the "Retry-After" header field expires.

Support for SIP Re-registration

The IoT Device SHALL perform IMS re-registration before the registration expires or one of the services triggers re-registration (e.g. to de-register one service and maintain the rest).

When performing re-registration, the IoT Device SHALL check the IMS VoIP support indication in the network and only registers for VoLTE if supported by the network.

Re-registration if PDN Connection Lost

If PDN connection is lost, the IoT Device SHALL check the IMS VoIP support indication in the network and only try to maintain VoLTE service if it is supported, as described in IR.92, Section 2.4.2.1. If this is successful, the IoT Device SHALL only re-registers to IMS if the IP address changes or the registration has expired.

SIP de-Registration Procedures

The IoT Device SHALL perform IMS deregistration when the last IMS service triggers de-registration or when the underlying access technology changes (e.g. from LTE to HSPA).

Procedures for IMS Restoration

As described in 3GPP™ TS 24.229, the IoT Device SHOULD initiate a new initial registration using another P-CSCF address, if it receives no response to the initial registration (i.e. timer F fires), re-registration, or de-registration with the first P-CSCF address.

Handling of "Unauthorized" Challenge

As described in 3GPP™ TS 24.229, the IoT Device SHALL handle a SIP 401 (Unauthorized) challenge to re-registration or de-registration similarly as it handles the challenge for initial registration.

Handling of "Server Time-Out" Response

As described in 3GPP™ TS 24.229, the IoT Device SHALL initiate a new initial registration, if it receives a SIP 504 (Server Time-Out) response to any non-REGISTER request (i.e. INVITE).

Handling of "Modify EPS Bearer Context Request" Message

As described in Section L.2.2.1C of 3GPP™ TS 24.229 Release 9 and IR.92, Section 4.4, the IoT Device SHALL initiate a new initial registration if it receives a "Modify EPS Bearer Context Request" message containing a list of P-CSCF addresses that does not include the address of the currently used P-CSCF. If the IoT Device receives a "Modify EPS Bearer Context Request" message during an ongoing call, it SHALL NOT initiate a new initial registration immediately but instead waits until the call finishes.

V. Call Functionality & Features

The following requirements summarize capabilities required to perform VoLTE calls once registered. It is the obligation of both IoT Device manufacturers and Service Providers who deploy said IoT Devices to confirm that VoLTE-enabled IoT Devices placed on the Deutsche Telekom network can properly perform these procedures.

IP Versions

The IoT Device SHALL support IPv4 and IPv6 for all IMS protocols.

Authentication

The IoT Device SHALL support IMS-AKA with USIM, as described in IR.92, Section 2.2.2.

Encryption Algorithms

The IoT Device SHALL supports Sec-Agree and IPSec. The list of offered IPSec encryption algorithms SHALL always contain the "null"-Algorithm, because Deutsche Telekom networks choose null encryption in case of debugging.

MSISDN-based IMPU

The IoT Device SHALL support a Mobile Subscriber ISDN Number (MSISDN)-based IMPU, which means a tel-URIs with an associated SIP-URI; for example:

tel: +491234567890

SIP:+491234567890@example.com; user=phone

Both number types are correctly routed by DTAG network.

IMS Profile for Voice and SMS

Except Annex B and A.3 all chapters of GSMA PRD IR.92: "IMS Profile for Voice and SMS" Version 11.0 SHALL be supported.

Indication of Send/Recy Media

In the SDP offer of the initial INVITE, the IoT Device SHALL indicate that the media is Send/Recv either by including the "a=sendrecv" attribute or by omitting the direction attribute, as described in IR.92, Section 2.2.4.

SIP Preconditions

The IoT Device SHALL support the SIP precondition framework and use these preconditions during call set-up in an appropriate way, as specified in IR.92, Section 2.4.1 and 3GPP™ TR 24.229 and described in the signaling flows in 3GPP™ TR 24.930. If preconditions are used, for the outgoing INVITE, the IoT Device SHALL indicate preconditions support in the “Supported” header and not “Require” header. The IoT Device SHALL NOT rely on precondition usage of the remote IoT Device, as described in IR.92, Section 2.4.1.

Invitation Requests without Preconditions

As described in IR.92, Section 2.4.1, when receiving an INVITE request without preconditions, the IoT Device SHALL send a SIP 183 (Session Progress) response with PANI and SDP body. The user is alerted, and the SIP 180 (Ringing) response is sent once the local resources at the terminated side are reserved.

Identification Presentation and Restriction

The IoT Device SHALL support: Originating Identification Presentation (OIP), Terminating Identification Presentation (TIP), Originating Identification Restriction (OIR) and Terminating Identification Restriction (TIR) as specified in IR.92.

Displaying Caller Identity

If present, the "P-Asserted-identity" header SHALL be used by the IoT Device to display the caller identity and the "From"-header field will be ignored. If a "P-Asserted-Identity" header is not present to indicate the caller identity, the IoT Device SHALL display the content of the "From"-header.

Playing Ring-back Tone

The IoT Device SHALL support P-Early-Media header, as described in IR.92, RFC 5009 and 3GPP™ TS 24.229. The IoT Device SHALL play media (i.e. ring-back tone) that is received during the call establishment. The IoT Device SHALL play a local ring-back tone if no early media is received from the network. The local ring-back tone is triggered by the SIP 180 (Ringing) response.

Please note: Deutsche Telekom implements network-based solutions for ring-back tone and announcements during call-setup, by using standardized IoT Device procedures for early media. Deutsche Telekom's network solution makes use of the "P-Early-Media" header, i.e. when the header is present and indicates that the IoT Device will receive early media, the IoT Device SHALL play the early media from the network; otherwise, it offers a local ring-back tone.

Ringing / Ring-back Timer

If a terminal-based ringing/ring-back timer exists in the IoT Device, then it's value SHALL be higher than the network-based timer. The value is 120 seconds in the Deutsche Telekom network.

Please note: Deutsche Telekom recommends that a value of 130 seconds is used for the terminal-based timer (if such is implemented). Higher values can be selected.

Invitation and Re-invitation Requests

The IoT Device SHALL accept INVITE and re-INVITE requests containing unsupported media types by putting the port of corresponding media lines to zero in the generated SDP answer. If the IoT Device receives a re-INVITE without SDP offer, it SHALL generate an offer in the next reliable response (e.g. 200 OK) according to SIP RFC 3261.

Please note: Deutsche Telekom's VoLTE service uses a re-INVITE without SDP offer for 3rd party call control purposes, e.g. during call hold for announcements and RTCP.

Remote end Updating of Media

The IoT Device SHALL support remote end updating of media with a re-INVITE/UPDATE (e.g. changing the remote IP address). A possible use case would be the creation of an Ad-Hoc Multi Party Conference, where the network may change the media path.

"Busy Here" Response

As described in IR.92, when the IoT Device is not able or willing to answer an incoming call, the IoT Device SHALL send the following responses:

- SIP 486 (Busy Here) is sent when the user is engaged in another call;
- SIP 486 (Busy Here) is sent when the user rejects the call.

When receiving SIP 486 (Busy Here) or 603 (Decline) responses, the IoT Device SHOULD play appropriate local tone.

Loss of Dedicated Media Bearer for Voice

The IoT Device SHALL locally terminate the SIP session if it loses the dedicated media bearer for voice, as described in IR.92.

"Bye" Handling

If the IoT Device ends a call session with a SIP BYE, it SHOULD append an appropriate Reason Header Field, thereby satisfying RFC 3326.

Session Description Protocol Capability Negotiation

The IoT Device SHALL NOT use Session Description Protocol Capability Negotiation (SDPcapNeg), but it SHALL be able to ignore the attributes if remote end uses them, as described in IR.92.

Voice Codecs

The IoT Device SHALL support Adaptive Multi-Rate (AMR) narrow band codec including all codec modes and Adaptive Multi-Rate Wide Band (AMR-WB) codec including all codec modes, as described in IR.92.

Acoustic Characteristics

The IoT Device SHALL conform with the minimum performance requirements for jitter buffer management and for acoustics characteristics, as described in IR.92.

Enhanced Voice Service (EVS) Modes

The IoT Device SHOULD support EVS (Enhanced Voice Services) according to IR.92:

- EVS modes NB-SWB (Narrowband to Super-wideband) up to bitrates 24.4 kbps SHOULD be supported.
- EVS AMR-WB IO Mode (interoperability with AMR-WB) SHOULD be supported, including payload format (according to 3GPP™ TS 26.445) and frame interworking (according to RFC 4867).
- Channel aware mode at 13.2 kbps for both Wideband and Super-wideband audio bandwidths SHOULD be supported, as per 3GPP™ 26.445 and 3GPP™ 26.114.

EVS Audio Bandwidth

Audio bandwidth for EVS Primary mode in SDP SHOULD include "bw" value as defined in 3GPP™ 26.445 from Narrowband to Super-wideband. The default value as defined in IR.92, Section C.3 applies.

EVS RTP Payload Format

The EVS RTP Payload Format shall include a Compact format and a Header-Full format SHOULD supported according to 3GPP™ 26.445.

RTCP Handling

The IoT Device SHALL be able to receive all types of RTCP packets. RTCP transmission SHALL be used during early media, active session and when the session is on hold, as described in GSMA IR.92 (since Version 10).

RTP Handling

The IoT Device SHALL use same port number for sending and receiving RTP and it SHALL use same port number for sending and receiving RTCP. The IoT Device SHALL NOT rely on remote end doing the same.

DTMF Handling

The IoT Device SHALL support sending and receiving DTMF events, as described in IR.92.

Circuit-Switched Fallback due to Call Set-up Failure

In the case of IoT Device applications supporting a 3GPP™ 2G (GSM) and/or 3G (UMTS) access bearer, whenever an IMS call fails because of no response to an INVITE during the session setup, the IoT Device SHALL NOT wait until timer A or B (3GPP™ TS 24.229 table 7.8) expires, but instead retries the call within 5 seconds via circuit-switched (CS) bearer over 2G and/or 3G, as described in 3GPP™ TS 24.173 V14.0.0. After the call that is performed in CS because of no response to the INVITE, the IoT Device SHOULD return to 4G (LTE) and trigger an initial registration.

For more information on circuit-switched procedures and requirements, please refer to Chapter VII.

No Configuration via OMA DM

IoT Device SHALL NOT require configuration via OMA DM. It SHALL implement the default configuration for parameters in the IMS Management Object, as defined in the standards (3GPP™ TS 24.167 and TS 24.229, as well as IR.92, IR.51).

VI. Short Message Service over IP

The following requirements summarize capabilities required to implement short message service (SMS) procedures over an IP bearer. If SMS over IP is needed, it is the obligation of both IoT Device manufacturers and Service Providers who deploy said IoT Devices to confirm that SMS over IP is properly configured and operating on the relevant VoLTE-enabled IoT Devices placed on the Deutsche Telekom network.

SMS over IP

The IoT Device SHALL support SMS over IP as sender and receiver, as described in IR.92, Section 2.5 and 3GPP™ TS 24.341. The REGISTER request SHALL contain the “tag +g.3gpp.smsip” SMS feature, as described in IR.92, Section 2.2.1. The IoT Device SHALL register to IMS for SMS exactly when it registers for MMTel service.

Please note: If the parameter "SMSoIP_usage_policy " (defined in Table C3 of IR.92) is supported by the terminal, it SHALL be set to the value “0 -Only with voice."

SMS Handling Rules

If a SMS is received via IP/IMS then the delivery report SHOULD be sent out also via IP/IMS. This applies even if the IoT Device roams in a domain for which it is configured to send SMS-MO via CS.

Domain Preference for IoT Device-originated SMS

The domain preference for IoT Device-originated SMS is IMS, whereby the “SMS_Over_IP_Networks_Indication” parameter defined in 3GPP™ TS 24.167, Section 5.28 SHALL be configured to a default value of 1, as per in IR.92, Section C.3.

VII. Circuit-Switched Service and Fallback

The following requirements summarize capabilities required to implement circuit-switched (CS) procedures and fallback to circuit-switched bearers (CSFB). It is the obligation of both IoT Device manufacturers and Service Providers who deploy said IoT Devices to confirm that CS and CSFB are properly configured and operating on any VoLTE-enabled IoT Devices placed on the Deutsche Telekom network.

The Deutsche Telekom network may reject the Attach for IoT Devices without a VoLTE subscription. It steers the retry rate of Attach attempts of VoLTE-capable IoT Devices with the adequate error codes from the network to prevent network overload.

Request Rejection if Speech Media Not Supported

The IoT Device SHALL reject incoming requests if it is unable to support speech media on current PS access, as described in IR.92, Section A.2.

Handling of Voice Calls with no VoLTE Subscription Available

If a VoLTE-capable IoT Device does not have VoLTE subscription, the connection request to the IMS well-known APN will fail in Deutsche Telekom network. In such cases, the IoT Device SHALL use CS(FB) for voice calls.

Handling of Voice Calls with no VoLTE Subscription Available

If the IoT Device is not IMS-registered (for example, because the IMS registration or re-registration has failed), the IoT Device SHOULD place voice calls over the CS(FB) domain if possible. The IMS standards describe specific behaviors for specific error codes – e.g. SIP 500 (Server Internal Error) or SIP 503 (Service Unavailable) responses with "Retry-After" header, or P-CSCF restoration procedures; these SHALL be supported regardless of using the CS domain.

Initiation of CS Call whenever IMS Call Fails

As requested by IR.92 v11 Annex A.2, the IoT Device SHOULD initiate a CS retry whenever an IMS Call fails and the IoT Device receives a SIP 500 (Server Internal Error) response including:

- "Reason"-header field with a protocol value set to "FAILURE_CAUSE";
- "Cause"-header field parameter value set to "1";
- "Response-Source"-header field with a "fe" header field parameter set to "<urn:3gpp:fe:p-cscf.orig>" (as defined in Section 5.1.3.1 and Annex L.5 of 3GPP™ Release 14 TS 24.229).

Initiation of CS Call whenever IMS Call Fails

If the IoT Device changes from PS to CS domain during call session setup for any reason and if it has already received a provisional response to the initial Invite and if neither bSRVCC nor aSRVCC has been triggered, then it SHALL cancel the ongoing IMS based call session setup before initiating a CS retry.

IMS Voice and CS Co-existence

A VoLTE-enabled IoT Device SHALL support both IMS-based voice and CS voice. The service experience is implemented in a seamless manner.

Device Configuration as "Voice centric"

The IoT Device usage setting SHALL be configured "Voice centric," as described in 3GPP™ TS 23.221. The voice domain preference in LTE "Voice_Domain_Preference_E_UTRAN," as defined in 3GPP™ TS 24.167, Section 5.27, SHALL be configured "IMS PS Voice preferred, CS Voice as secondary," as described in TS 23.221.

Return to IMS after Fallback to CS Domain

If the IoT Device falls back to use voice calls via CS domain, the IoT Device SHOULD always try to return to IMS, for example, on the return to LTE or on the next power cycle. After having used CS(FB) due to any temporary outage of Deutsche Telekom's IMS network, the IoT Device SHOULD return to IMS.

Support for Idle Mode Signaling Reduction (ISR)

If the IoT Device supports Idle Mode Signaling Reduction (ISR), its implementation conforms to 3GPP™ Rel-9. ISR allows the IoT Device to be registered in the UTRAN/GERAN at the same time it is registered in the E-UTRAN, thereby allowing for reselection between LTE and 2G/3G without the need to perform regular TAU and RAU procedures. The IoT Device SHALL disable ISR for the purpose of T-ADS, as described in IR.92, Section A.2, 3GPP™ TS 23.401, and 3GPP™ TS 24.301.

Circuit Switched Fallback (CSFB) Configuration

The IoT Device SHALL be configured to use CSFB, performing a combined EPS/IMSI Attach when attaching to LTE.

As an implementation optimization, if the first Attach results in a non-optimal procedure (either EPS Attach or combined EPS/IMSI Attach), the IoT Device may store this result and use the other Attach type when attaching to this network, until the result changes. For example, if the IoT Device started with combined EPS/IMSI Attach, but the network rejects this IMSI Attach, because CSFB is not supported, the IoT Device can still use VoLTE, but on the next Attach it will optimally start directly with an EPS Attach.

VIII. Emergency Calls

The following requirements summarize capabilities required for implementing the emergency call regulatory feature over VoLTE. It is the obligation of both IoT Device manufacturers and Service Providers who deploy said IoT Devices to confirm that emergency calls are properly configured and operating on any VoLTE-enabled IoT Devices placed the Deutsche Telekom network.

Pre-configured Emergency Numbers List

The IoT Device SHALL support a list of emergency numbers pre-configured on the SIM, as described in IR.92, Section 5.2.1.

Updating Emergency Numbers List

The IoT Device SHALL support Mobility Management procedures for updating the list of emergency numbers, as described in IR.92, Section 5.2.1.

Domain Selection & Placement of Emergency Call

As described in IR.92, Section A.5, the IoT Device SHALL be able to detect if the network supports VoLTE emergency calls and it SHALL support domain selection for emergency calls, and re-attempt in another domain if an emergency call in one domain fails. In case that a VoLTE emergency call is initiated, the IoT Device SHALL establish a connection to the emergency PDN, perform an emergency IMS registration, and set-up the emergency session on this emergency registration, including the IMEI, as described in IR.92, Section 5.2.1.3.

Sending of Geolocation during an Emergency Session

When initiating an IMS emergency session, the IoT Device SHALL conform to the requirement to convey its location, using the "Geolocation" header and the PIDF location object in the initial INVITE request, as specified in Section 5.1.6.8.2 and Section 5.1.6.8.3 of 3GPP™ TS 24.229.

Emergency Registration Timer

In case of emergency registration time-out, the IoT Device SHOULD NOT wait until timer B or F (3GPP™ TS 24.229 table 7.8) expires, and thereafter establish an anonymous emergency call within 3 seconds.

Emergency Registration Failure Handling

If the emergency registration fails with an error response or time-out (for example, due to an inbound roamer with valid roaming agreement being registered to the home IMS, but the emergency registration to the local IMS fails), the IoT Device SHALL establish an anonymous emergency call, as described in 3GPP™ TS 23.167 and in IR.92.

Behavior when an IMS Emergency Registration is not Possible

An IoT Device that is not capable of authenticating with the IMS network (for example, inbound roaming devices without a roaming agreement in place) SHALL NOT initiate an IMS emergency registration, but instead immediately initiate an emergency session as defined in 3GPP™ TS 23.167.

Emergency Call Set-up Timer

With sending out the emergency "INVITE," the IoT Device SHALL start a timer which is stopped by "18x" response. When this timer expires, the IoT Device SHALL retry the emergency call via CS bearer. The timer SHALL be configured to a default value of 10 seconds.

Emergency Call Failure Handling

If the IMS emergency call fails with an error response or time-out, the IoT Device SHALL initiate a CS emergency call.

When the IoT Device receives a SIP 380 (Alternative Service) response without emergency service information for an undetected emergency call (for example, dialed number 110 in Germany), and the Domain Selection selects a re-try in CS domain, the IoT Device SHALL initiate a normal CS call and not an emergency CS call.

IX. VoLTE Roaming

The following requirements summarize capabilities required for implementing roaming procedures over VoLTE. It is the obligation of both IoT Device manufacturers and the Service Providers who deploy said IoT Devices to confirm that roaming is properly configured and operating on VoLTE-enabled IoT Devices visiting the Deutsche Telekom network.

VoLTE Roaming

VoLTE roaming SHALL be supported. While roaming, if the VPMN sends the IoT Device a VoPS indication during an Attach, then the IoT Device tries to establish a PDN connection to the well-known IMS APN.

Please note: The visited MME resolves the APN based on the user profile received from the HPMN HSS. The user profile indicates whether the APN is to be routed home (S8HR) or locally, in the visited network (LBO). Deutsche Telekom uses S8HR.

VoLTE Emergency Calls in Roaming

VoLTE emergency calls SHALL be supported in roaming scenarios, whereby the emergency call is established in the visited network (LBO). The IoT Device performs domain selection for emergency calls based on the emergency service support indicator received during Attach from the visited network.

The usage of VoLTE emergency calls in roaming scenario SHALL be configurable (can be enabled and disabled) in the IoT Device via a software update.

X. IoT Device LTE Feature Group Indicator (FGI) Bits for VoLTE

The following table summarizes the required Feature Group Indicator (FGI) bit configuration for VoLTE service to properly work on the **Deutsche Telekom radio access networks** (Austria, Croatia, Czechia, Germany, Greece, Hungary, Macedonia, Montenegro, The Netherlands, Poland, Romania, Slovakia). Please note, only those settings common for all Deutsche Telekom networks are shown below. All settings below SHALL be implemented, unless marked as recommended, with SHOULD.

Index (Bit Number)	Setting Name	FDD - Setting	TDD - Setting
3	5-bit RLC UM SN	VoLTE IoT Devices: ON	
	7-bit PDCP SN	Other LTE IoT Devices: SHOULD be OFF	
6	Prioritized bit rate	VoLTE IoT Devices: ON	
		Other LTE IoT Devices: SHOULD be OFF	
7	RLC UM	VoLTE IoT Devices: ON	
		Other LTE IoT Devices: SHOULD be OFF	
9	EUTRA RRC_CONNECTED to GERAN GSM_Dedicated handover	VoLTE IoT Devices: ON	VoLTE IoT Devices: ON
		Other LTE IoT Devices: SHOULD be OFF	Other LTE IoT Devices: SHOULD be OFF
23	GERAN measurements, reporting and measurement reporting event B2 in E-UTRA connected mode	VoLTE IoT Devices: ON	VoLTE IoT Devices: ON
		Other LTE IoT Devices: SHOULD be ON	Other LTE IoT Devices: SHOULD be ON
27	EUTRA RRC_CONNECTED to UTRA CELL_DCH CS handover	VoLTE IoT Devices: ON	VoLTE IoT Devices: ON
		Other LTE IoT Devices: SHOULD be OFF	Other LTE IoT Devices: SHOULD be OFF

28	TTI bundling	VoLTE IoT Devices: ON	VoLTE IoT Devices: ON
		Other LTE IoT Devices: SHOULD be OFF	Other LTE IoT Devices: SHOULD be OFF
29	Semi-persistent scheduling	VoLTE IoT Devices: ON	VoLTE IoT Devices: ON
		Other LTE IoT Devices: SHOULD be OFF	Other LTE IoT Devices: SHOULD be OFF

XI. IoT Device VoLTE Settings

The following table summarizes the required configuration of VoLTE general setting in order for the service to properly work on the **Deutsche Telekom networks** (Austria, Croatia, Czechia, Germany, Greece, Hungary, Macedonia, Montenegro, The Netherlands, Poland, Romania, Slovakia). Please note, only those settings common for all Deutsche Telekom networks are shown below. All settings below SHALL be implemented, unless marked as recommended, with SHOULD.

Setting Name	Setting Value	Comments
Packet Core Network-related		
VoLTE APN	IMS	
PDN type	IPv4v6	During packet-switched Attach for VoLTE, the IoT Device requests the PDN type IPv4v6, as described in IR.92, Section 5.1
ESM Information Transfer Flag in LTE Attach Request	Dependent on Attach APN	Deutsche Telekom plans to deploy VoLTE based on IPv6; short-term, IPv4 deployments are possible in some affiliates
Combined EPS/IMSI Attach	Enabled	
APN name for Emergency Call,	Assigned by network during emergency connectivity request; IP Type = IPv4v6	The IoT Device is configured to use CSFB (i.e. to perform combined EPS/IMSI Attach when attaching to LTE)
VoLTE Voice Domain Preferences		
Voice Domain Preference for E-UTRAN	'00' - CS Voice only	Other LTE IoT Devices
	'11' - IMS PS voice preferred, CS	VoLTE IoT Devices

	Voice as secondary	
Voice Domain Preference for UTRAN	1 = CS Voice only	VoLTE IoT Devices
Mobility Management IMS Voice Termination	1 = Mobility Management for IMS Voice Termination enabled	VoLTE IoT Devices
VoLTE Features		
IMS Video Telephony	Disabled	"Media_type_restriction_policy" (Voice and/or Video over LTE allowed), as per parameter in IR.92, Section C.3
IR.94 Version compliancy (e.g. IR.94v10.0; IR.94v11.0)	Not applicable	
ViLTE Codecs (e.g. H.264 CBP Level 1.2; H.264 CHP Level 3.1; H.265 (HEVC) Main Profile, Main Tier, Level 3.1)	Not applicable	
Upgrade from Voice to Video	Not applicable	
Downgrade from Video to Voice	Not applicable	
IMS Voice via HSPA	Disabled	If supported, it can be enabled or disabled as part of the device customization by the vendor; by default, the feature is disabled and the voice domain preference in HSPA, i.e. "Voice_Domain_Preference_UTRAN" defined in 3GPP™ TS 24.167, Section 5.30, shall be configured "CS Voice only"
SMSoSG Support	Enabled	Please note: SMS domain preference is defined in the affiliate's specific voice configuration; please contact Deutsche Telekom to learn more about the per-country configuration
When to use SMSoIP	SMSoIP only	Please note: Use only if IMS voice supported
IoT Device use of VoLTE Emergency Service	Enabled	
IoT Device use of Emergency Service via VoWifi	Disabled	Please note: VoWIFI service is not expected in the Automotive environment
SRVCC to 2G	Disabled	SRVCC is currently not supported in M2M/Automotive VoLTE environment
SRVCC to 3G	Disabled	SRVCC is currently not supported in M2M/Automotive VoLTE environment

SRVCC for Emergency Session	Enabled	Used only if VPLMN supports SRVCC. IMS emergency call is handled by visited network.
SRVCC in Alerting Phase	Disabled	SRVCC is currently not supported in M2M/Automotive VoLTE environment
bSRVCC	Disabled	SRVCC is currently not supported in M2M/Automotive VoLTE environment
MSC Server Assisted Mid-call Feature during Access Transfer	Disabled	
vSRVCC	Disabled	
rSRVCC	Disabled	
Early Media Support	Enabled	
DTMF Support	Enabled	According to IR.92v10
ViLTE Roaming	Disabled	Parameter name in IR.92, Section C.3 = "Media_type_restriction_policy" (Voice and/or Video over LTE allowed while roaming)
Supplementary Services		
Supported Supplementary Services	HOLD; CB; CDIV; OIP/OIR; TIP/TIR	Subscription of services is present but there is no interface to change parameters (i.e. XCAP not supported) in the M2M/Automotive environment
Procedures for Consultative Transfer (ECT), as defined in IR.92v10, Section 2.3.11	Disabled	
Originator Information Restriction	Not applicable	Not applicable in the Automotive environment
FromPreferred	0	0 – Indicates that the "From"-header field is not used for determination of the originating party identity in OIP service
Security		
IMS Authentication Method	IMS-AKA with USIM	The IoT Device supports IMS-AKA with USIM as described in IR.92, Section 2.2.2; please note, ISIM support is not planned in the Deutsche Telekom network
Ut Authentication Method	GBA	
GBA BSF Server URL	Derived from the IMPI or IMSI, according to 3GPP™ TS 23.003	The GBA module calculates the BSF address from the IMSI parameters MCC (Mobile Country Code) and MNC (Mobile Network Code); the FQDN to contact is of the format: bsf.mncXXX.mccYYY.pub.3gppnetwork.org

GBA Access Protocol and Port	Ub/HTTP -:80 and 8080 Ut/HTTP - :80 and 8080 Ut/HTTPS - :443	
IPSEC	Enabled	The device supports IPSec as described in IR.92, Section 2.2.2
IPSec Integrity Algorithms	HMAC_SHA2-256-128; HMAC_SHA1-96; HMAC_MD5-96	List to be offered within "sec agree"
IPSec Encryption Algorithms (ESP)	AES-CBC-256, 3DES-CBC; AES-CBC; NULL	List to be offered within "sec agree"
Mobility		
Cell Reselection Idle, LTE to 2G	Enabled	
Cell Reselection Idle, 2G to LTE	Enabled	
Cell Reselection Connected, 2G to LTE	Enabled	
Packet Handover Connected, LTE to 2G	Disabled	
Packet Handover Connected, 2G to LTE	Disabled	
Cell Reselection Idle, LTE to 3G	Enabled	
Cell Reselection Idle, 3G to LTE	Enabled	
Cell Reselection Connected, 3G to LTE	Disabled	
Packet Handover Connected, LTE to 3G	Enabled	
Packet Handover Connected, 3G to LTE	Disabled	
Configuration and Addressing		
P-CSCF Configuration and Discovery Method (e.g. PCO or SIM based)	Enabled	The IoT Device supports P-CSCF discovery via EPS procedures
FQDN Support	Disabled	No FQDN support for P-CSCF discovery

Generic		
IR.92 Version Compliancy (e.g. IR.92v10.0; IR.92v11.0)	IR.92v11	
Device Management Method (e.g. OTA, Auto configuration, SIM, manually, ...)	Not applicable	Deutsche Telekom offers no device management system for VoLTE
GRUU Support	Disabled	
SIP Instance Support	Enabled, according to IR.92, Section 2.2.1	
RegRetryBaseTime	30 seconds	
RegRetryMaxTime	1800 seconds	
Support of TEL URI / SIP URI	Both enabled	
Phone-context URI	According to IR.92v10	
Policy_on_local_numbers	1 = home-local	Local number type for voice and video calls
Precondition_disabling_policy	Enabled	SIP Preconditions used
Sigcomp (SIP Message Compression) support	Disabled	
SIP Timers T1, TA, TF, TB (3GPP™ 24.229, Table 7.7.1)	Default values of IR.92, Annex C3	
SIP Timers T2 (3GPP™ 24.229, Table 7.7.1)	Default values of IR.92, Annex C3	
SIP Timers T4, (3GPP™ 24.229, Table 7.7.1)	Default values of IR.92, Annex C3	
SIP Timers TA, TF, TB (3GPP™ 24.229, Table 7.7.1)	Default values of 3GPP™ 24.229 Table 7.7.1	
Registration, Ringing, and Ringback Timers (3GPP™ 24.229, Table 7.7.1)	Registration Timer = Standard; Ringing timer >= 130 seconds	
Session Expires Refresher Preference (UAS / UAC)	According to IR.92v10, Section 2.2.8	
Session Expires - Refresher Method (Invite / update)	Update	
Reliable 18x policy; Sending SIP 18x (other than SIP 183 Response) Reliably	0	Parameter name in IR.92, Section C.3 = Reliable 18x policy

		Section 5.53 of 3GPP™ Release 14 TS 24.167 Values: 0, 1 0 – Indicates that the SIP 18x responses (other than SIP 183 response) are to be sent unreliably 1 – Indicates that the SIP 18x responses (other than SIP 183 response) are to be sent reliably
Default_EPS_bearer_context_usage_restriction_policy (Media on Default (QCI=5) Bearer)	voice:Prohibit video:Prohibit	Whether the IoT Device is allowed (or not allowed) to send voice/video media over default bearer of PDN connection used by IoT Device to access IM CN subsystem (globally or per IMS communication service)
Media		
RTCP	Enabled	RTCP transmission is used during active session and when the session is on hold
Supported Codecs	AMR, WB-AMR, EVS	
octet-align	Excluded	Permissible values are 0 and 1
RateSet for AMR	Excluded	If 1, octet-aligned operation is used
RateSet for AMR-WB	Excluded	If 0 or if not present, bandwidth-efficient operation is employed
EVS/Br	5.9-24.4	"Parametername in IR.92, Section C.3 = RateSet for AMR
EVS/Bw	nb-swb	If not present, all codec modes are allowed for the payload type"
ICM/INIT_PARTIAL_REDUNDANCY_OFFSET_RECV	0	"Parametername in IR.92, Section C.3 = RateSet for AMR-WB
mode-change-period	Excluded	If not present, all codec modes are allowed for the payload type"
mode-change-neighbor	Excluded	Parametername in IR.92, Section C.3 = EVS/Br
Maxptime	240	Parametername in IR.92, Section C.3 = EVS/Bw
Crc	Excluded	
Interleaving	Excluded	
Ptime	20	
Channels	1	
max-red	0 (redundancy not used)	This is the maximum duration in milliseconds that elapses between the primary (first) transmission of a frame and any redundant transmission that the sender

		will use, allowing a receiver to have a bounded delay when redundancy is used; allowed values are between 0 (no redundancy will be used) and 65535; Please note: the parameter is omitted, no limitation on the use of redundancy is present
Direction Attribute in Initial INVITE	a=sendrecv	The IoT Device indicates in the SDP offer in the initial INVITE that the media is sendrecv either by including the "a=sendrecv" attribute or by omitting the direction attribute

XII. References

Reference	Name	Version
IR.92	IMS Profile for Voice and SMS	15.0

XIII. Release History

Publication Date	Version	Author	Reviewer
12.11.2020	1.0	Grzegorz Nowak (ITS-IVA)	Miguel Rodriguez (ITS-IVA)
16.02.2021	1.1	Grzegorz Nowak (ITS-IVA)	Miguel Rodriguez (ITS-IVA)
29.11.2021	1.2	Andreas Utrap (VTI-IOT)	Miguel Rodriguez (VTI-IOT)