VoLTE Support

Feature Summary and Revision History

Summary Data

Table 1: Summary Data

Applicable Product(s) or Functional Area	SMF
Applicable Platform(s)	SMI
Feature Default Setting	Disabled – Configuration Required
Related Changes in this Release	Not Applicable
Related Documentation	Not Applicable

Revision History

Table 2: Revision History

Revision Details	Release
First introduced.	Pre-2020.02.0

Feature Description

The SMF supports Voice over Long-Term Evolution or LTE (VoLTE). The VoLTE technology utilizes IP Multimedia Subsystem (IMS) to allow you to make cellular calls over the LTE access network.

How it Works

A 5G mobile device with LTE access requests voice services to communicate with PGW-C over S-GW and MME resulting in the establishment of a PDU session. The P-GW supports a non-GBR bearer with QCI flows as 5 for VoLTE sessions. This support allows IMS signaling along with P-CSCF, DNS IPv4, or DNS IPv6 addresses for end users. For mobile-originated (MO) or mobile-terminated (MT) calls, the Application Function (AF) provides policy authorization details to the PCF. The PCF then converts these details to GBR flows and PCC rules and sends them to PGW-C. The PGW-C then converts the GBR-flows to dedicated bearers by establishing the dedicated bearer creation procedure with UE. The PGW-C provisions the GBR with the QCI flow as 1 to UPF. By this provisioning, the UPF supports voice communication between the calling and called devices over IMS network elements.

As per the E-UTRAN Attach procedure, the MME triggers the GTPv2 Create Session Request to PGW-C over S-GW. This request includes the EPS Bearer Identity (EBI) value, ePCO options for P-CSCF and DNS IPv4 or DNS IPv6 containers, PDN-Type, and PAA options for IPv4 or IPv6 allocated address for end users. The P-GW then processes the received Create Session Request and communicates with various SBI interfaces to receive the following information:

- Subscription data from UDM by including PGW-C FQDN in the subscription request.

- Policy information from PCF by sending SM policy create request. Policy information includes details, such as PCC rules and Session-AMBR.

- Online and offline charging information from CHF by sending the charging create data request.

After communication with SBI interfaces, which are based on the local SMF profile configuration, the P-GW sends the GTPv2 Create Session Response to the end user over S-GW and MME. This response includes:

- PAA with IPv4 or IPv6 addresses that PGW-C IPAM module allocates

- ePCO option with P-CSCF

- DNS IPv4 or DNS IPv6 address based on DNN-Profile configuration

- Non-GRB with the QCI flow as 5 for IMS signaling

For an MO or MT call, if the PCF is provisioned for GBR with the QCI flow as 1 for end users, the P-GW converts these GBR flows to the dedicated bearer creation. The GBR flows include the flow information and the PCC rules in the SM Policy Update Notify Request. The dedicated bearer is created by sending GTPv2 Create Bearer Request to UE over S-GW or MME. Another S5-U tunnel is created between S-GW and P-GW to allow GBE flow packets for the voice communication between the calling and called devices.

Call Flows

This section describes the following call flows:

- VoLTE PDU Session Creation Call Flow

- VoLTE Mobile-Originated (MO) Call Creation Call Flow

- VoLTE Mobile-Terminated (MT) Call Creation Call Flow

VoLTE PDU Session Creation Call Flow

To enable the connectivity through a 5G core, the initial attach on the E-UTRAN or EPS deviates from the defined 3GPP procedures in the following ways:
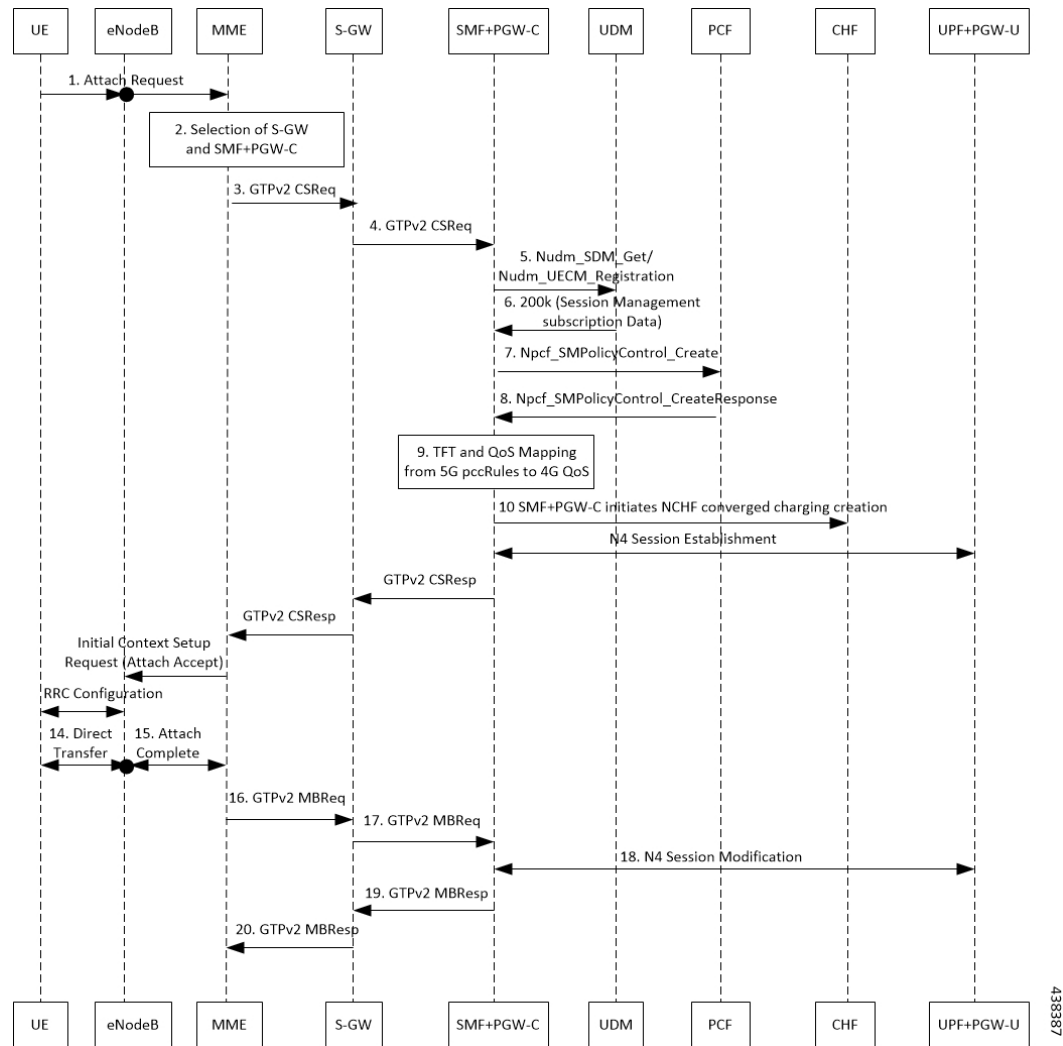
- An SMF+P-GW replaces the P-GW in the procedure.

- The SM Policy Association Establishment procedure replaces the IP-CAN Session Establishment and modification.

- The integrated charging over the NCHF interface with CHF replaces the online and offline charging functionality by using the Gy and Gz interfaces.

- Communication with the User Plane node happens over the N4 interface instead of the Sxb interface.

Note Depending on the mapped PCC rules, the SMF+PGW-C can initiate the dedicated bearer creation.

The following call flow depicts the creation of a VoLTE PDU session.

Figure 1: VoLTE PDU Session Creation Call Flow

Table 3: VoLTE PDU Session Creation Call Flow Description

Step	Description
1	UE sends the attach request to MME through eNodeB.
2	MME determines if the UE is active and subscribed for the handoff to NR. Then, MME selects a SMF+PGW-C node as the P-GW for the PDU session.
3	MME sends the create session request to the selected S-GW and includes the selected SMF+PGW-C address in the request.
4	S-GW initiates the create session request toward SMF+PGW-C by including the "P-CSCF IPv4 or IPv6 request" container identifier in the extended PCO IE options. SMF+PGW-C extracts and saves the PDU session ID that UE sends in the PCO option. Then, SMF+PGW-C performs a UDM registration and sends both the N11 and S5 or S8 interface ID to UDM. Based on the local configuration or the session management subscription data, which is received from UDM for respective DNN, SMF+PGW-C determines to support "IMS Voice over PS".
5	SMF+PGW-C sends the NPCF SM policy control creation request to PCF to initiate the SM policy association establishment procedure. In this procedure, PGW-C+SMF includes the information elements that are received in the create session request message into the Npcf_SMPolicyControl_Create service. These elements comprise the following information: • SUPI contains the IMSI. • DNN contains the APN. • PEI contains the IMEI-SV. • Session AMBR contains the APN-AMBR. • Default QoS information that contains the default EPS bearer QoS. The QCI values are mapped into 5QI values.
6	PGW-C+SMF receives the PCC rules, PDU session policy information, and 5G QoS information. The PCC rules are mapped into EPS QoS information. The SMF+PGW-C creates TFT from the SDF filters that are received in the PCC rules. Then, SMF+PGW-C associates them with the corresponding default and dedicated bearers.
7	Based on the charging policies received from the PCF, the SMF+PGW-C initiates the NCHF converged charging creation procedure toward CHF. This procedure is based on the charging rules that are received from the PCF.
8	The SMF+PGW-C starts the UPF+PGW-U selection and N4 session establishment procedure. As this session is a 4G session that connects to the SMF+PGW-C, a separate CN tunnel is created for each bearer. Also, the QoS Flow Identifier (QFI) is not sent in the QoS Enforcement Rule (QER) and Packet Detection Rule (PDR).
9	The SMF+PGW-C sends create session response to the S-GW. This response includes the bearer information and the TEID for the default bearer. The SMF+PGW-C also includes the 5G QoS parameters in PCO options 001CH (QoS rules), 001DH (Session-AMBR), 001EH (PDU session address lifetime), and 001FH (QoS flow descriptions) to the UE.

Step	Description
10	Based on the charging policies received from PCF, the SMF+PGW-C initiates NCHF converged charging creation procedure toward CHF. This procedure is based on the charging rules that are received from PCF.
11	S-GW sends create session response to MME.
12	MME sends the Initial Context Setup Request to eNodeB with the N1 Attach Accept message.
13	eNodeB and UE perform the RRC configuration.
14	UE sends the direct transfer message to eNodeB.
15	eNodeB sends the attach completion message in the Initial Context Setup Response and the TEID of eNodeB to MME.
16	MME sends a modify bearer request to S-GW with eNodeB TEID.
17	S-GW sends the modify bearer request to SMF+PGW-C with eNodeB TEID.
18	SMF+PGW-C performs the N4 session modification to update the eNodeB TEID on the data path to the UPF+PGW-U.
19	SMF+PGW-C sends the modify bearer response to the S-GW.
20	S-GW sends the modify bearer response to MME.

VoLTE Mobile-Originated (MO) Call Creation Call Flow

This section describes the VoLTE MO call creation call flow.
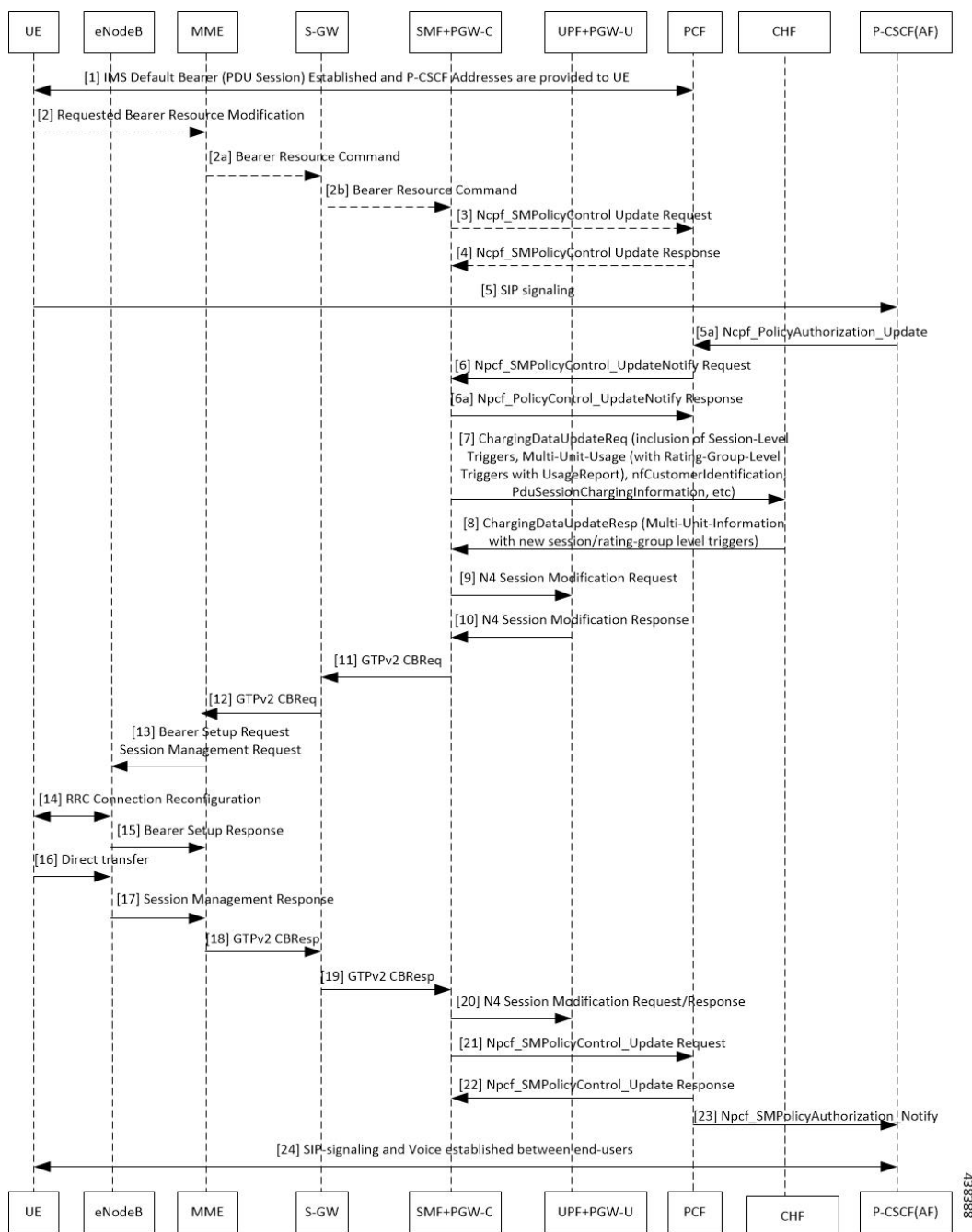
Figure 2: VoLTE MO Call Creation Call Flow

Table 4: VoLTE MO Call Creation Call Flow Description

Step	Description
1	UE requests for establishment of the IMS default bearer, PDU session, through PCF. After establishing the session, the UE receives the P-CSCF addresses from PCF.
2	UE sends the requested bearer resource modification information to MME.

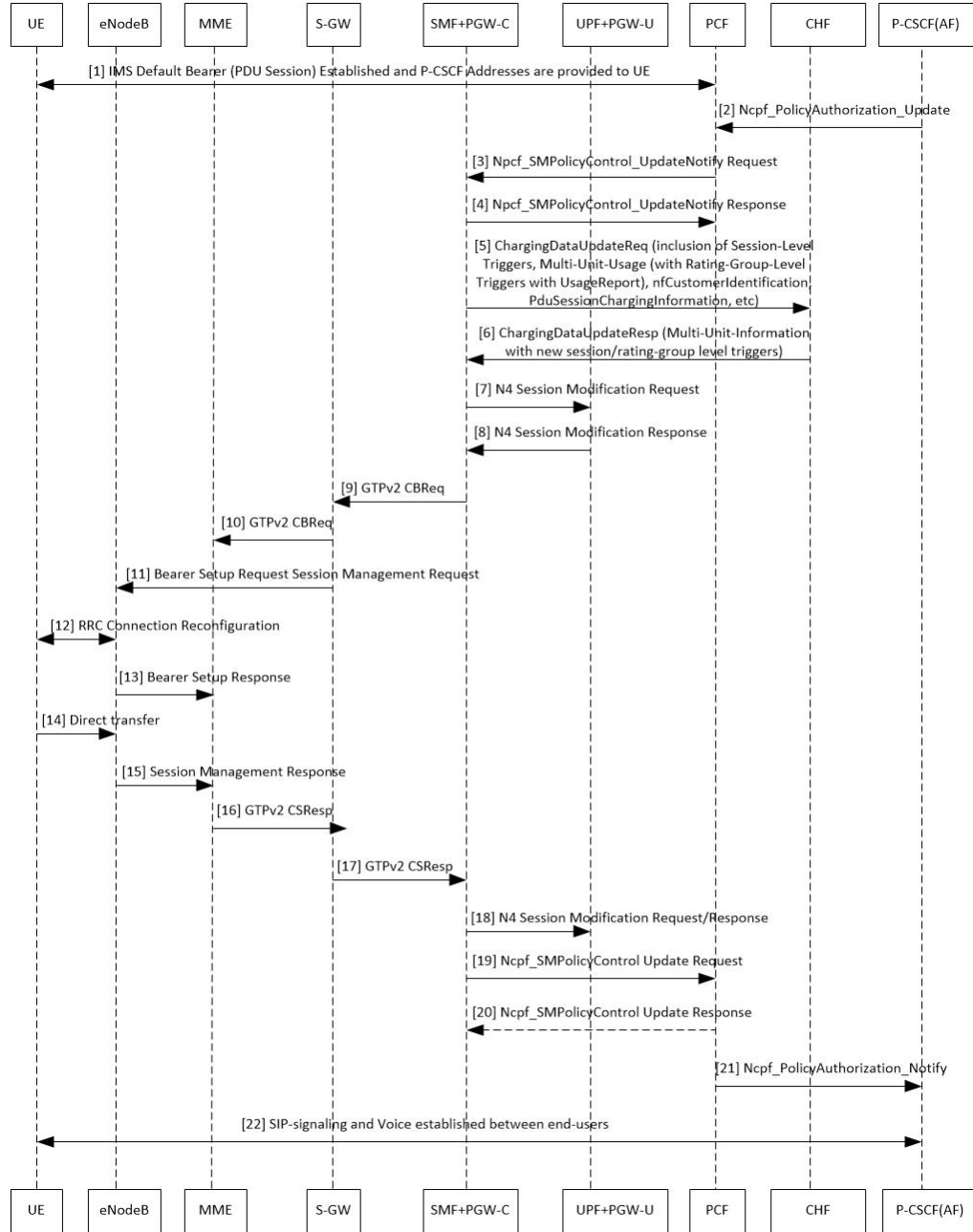| Step	Description
2a	MME sends the bearer resource command to S-GW.
2b	S-GW sends the bearer resource command to SMF+PGW-C.
3	SMF+PGW-C sends the NPCF SM policy control update request to PCF.
4	PCF sends the NPCF SM Policy control update response back to SMF+PGW-C.
5	UE initiates SIP signaling toward P-CSCF (AF).
5a	P-CSCF sends NPCF Policy Authorization Update message to PCF through CHF.
6	PCF sends the NPCF SM policy control update notify request to SMF+PGW-C.
6a	SMF+PGW-C sends the NPCF SM Policy control update notify response back to PCF.
7	SMF sends ChargingDataUpdateReq by including Multi-Unit-Usage with Rating-Group-Id that are received as part of Charging_Description of Sm_PolicyControl_UpdateNotify_Request to install PCC Rules.
8	CHF provides ChargingDataUpdateResp with Multi-Unit-Information for received Rating-Group values in requested message. CHF also provides params changes for Session-Level and Rating-Group values.
9	SMF sends N4 Session Modification Request to the UPF by including Create ULPDRs and Create ULFARs. Create ULPDRs include SDFs and QER Info which are received as part of PCC Rule Installation.
10	UPF responds back with N4 Session Modification Response to SMF by including Created ULPDR and Created ULFAR. Create ULFAR contains UL Tunnel Information of UPF for the dedicated bearer creation.
11	SMF+PGW-C sends the GTPv2 create bearer request to S-GW.
12	S-GW sends the GTPv2 create bearer request to MME.
13	MME sends the bearer setup request and session management request to eNodeB.
14	RRC connection reconfiguration starts between UE and eNodeB.
15	The eNodeB sends the bearer setup response to MME.
16	UE initiates a direct transfer toward eNodeB.
17	eNodeB sends the session management response to MME.
18	MME sends the GTPv2 create bearer response to S-GW.
19	S-GW sends the GTPv2 create bearer response to SMF+PGW-C.
20	SMF+PGW-C sends the N4 session modification request or response to UPF+PGW-U.
21	SMF+PGW-C sends the NPCF SM policy control update request to PCF.
22	PCF sends the NPCF SM policy control update response back to SMF+PGW-C.
23	PCF sends the NPCF policy authorization notify request to P-CSCF (AF).
24	Establishes SIP-signaling and voice call between end-users through UE and P-CSCF (AF).

NOTES:

- The PCC rules that the PCF provides are mapped to TFTs for the new dedicated bearer. The associated QoS is mapped to 4G QoS.

- The NCHF Converged Charging Update service procedures replace all the Gy and Gz interface messages.

- The User Plane resources for dedicated bearers are added through the N4 Session Modification procedure towards the UPF. PDRs, QERs, and FARs are added for the SDF filters for the new dedicated bearer.

- SMF+PGW-C saves the EBI for the dedicated bearer that is received in the create bearer response.

VoLTE Mobile-Terminated (MT) Call Creation Call Flow

This section describes the VoLTE MT call creation call flow.

Figure 3: VoLTE MT Call Creation Call Flow

Table 5: VoLTE MT Call Creation Call Flow Description

Step	Description
1	UE requests for establishment of the IMS default bearer, PDU session, through PCF. After establishing the session, the UE receives the P-CSCF addresses from PCF.
2	P-CSCF (AF) sends the NPCF policy authorization update to PCF.

Step	Description
3	PCF sends the NPCF SM Policy control update notify request to SMF+PGW-C.
4	SMF+PGW-C sends the NPCF SM Policy control update notify response to PCF.
5	SMF sends ChargingDataUpdateReq by including Multi-Unit-Usage with Rating-Group-Id that are received as part of Charging_Description of Sm_PolicyControl_UpdateNotify_Request to install PCC Rules.
6	CHF provides ChargingDataUpdateResp with Multi-Unit-Information for received Rating-Group values in requested message. CHF also provides params changes for Session-Level and Rating-Group values.
7	SMF sends N4 Session Modification Request to the UPF by including Create ULPDRs and Create ULFARs. Create ULPDRs include SDFs and QER Info which are received as part of PCC Rule Installation.
8	UPF responds back with N4 Session Modification Response to SMF by including Created ULPDR and Created ULFAR. Create ULFAR contains UL Tunnel Information of UPF for the dedicated bearer creation.
9	SMF+PGW-C sends the GTPv2 create bearer request to S-GW.
10	S-GW sends the GTPv2 create bearer request to MME.
11	MME sends the bearer setup request and session management request to eNodeB.
12	RRC connection reconfiguration starts between UE and eNodeB.
13	eNodeB sends the bearer setup response to MME.
14	UE initiates a direct transfer toward eNodeB.
15	eNodeB sends the session management response to MME.
16	MME sends the GTPv2 create bearer response to S-GW.
17	S-GW sends the GTPv2 create bearer response to SMF+PGW-C.
18	SMF+PGW-C sends the N4 session modification request or response to UPF+PGW-U.
19	SMF+PGW-C sends the NPCF SM policy control update request to PCF.
20	PCF sends the NPCF SM policy control update response back to SMF+PGW-C.
21	PCF sends the NPCF policy authorization notify request to P-CSCF (AF).
22	Establishes SIP-signaling and voice call between end-users through UE and P-CSCF (AF).

Standards Compliance

The VoLTE support feature complies with the following standard:

- 3GPP TS 23.502 V15.2.0 (2018-09)

Limitations

The VoLTE support feature has the following limitations:

- The UE-initiated dedicated bearer creation is not supported.

- VoLTE is not integrated with charging.

- PCF-initiated modification is not supported to change the GBR flows and PCC rules. However, the addition and deletion of GBR flows are supported.