**3GPP TSG-WG SA2 Meeting #170S2-2507573**

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| *CR-Form-v12.3* |
| **CHANGE REQUEST** |
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|  | **23.228** | **CR** | **1636** | **rev** | **4** | **Current version:** | **19.3.0** |  |
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| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* |
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| ***Proposed change affects:*** | UICC apps |  | ME |  | Radio Access Network |  | Core Network | **X** |

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| ***Title:***  | Clarification on UE-Satellite-UE communication procedures |
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| ***Source to WG:*** | CATT |
| ***Source to TSG:*** | S2 |
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| ***Work item code:*** | 5GSAT\_Ph3-ARC |  | ***Date:*** | 2025-08-15 |
|  |  |  |  |  |
| ***Category:*** | F |  | ***Release:*** | Rel-19 |
|  | *Use one of the following categories:****F*** *(correction)****A*** *(mirror corresponding to a change in an earlier release)****B*** *(addition of feature),* ***C*** *(functional modification of feature)****D*** *(editorial modification)*Detailed explanations of the above categories canbe found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | *Use one of the following releases:Rel-8 (Release 8)Rel-9 (Release 9)Rel-10 (Release 10)Rel-11 (Release 11)…Rel-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)Rel-19 (Release 19) Rel-20 (Release 20)* |
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| ***Reason for change:*** | There are inconsistent descriptions on whether “UL CL” or “UL CL/BP” is used for UE-Satellite-UE communication. Considering the complexity of supporting BP for UE-Satellite-UE communication, it is proposed that only UL CL is used for UE-Satellite-UE communication.Instead of stating N5 interface between IMS and 5GC, it is more accurate to stating N5 interface between the P-CSCF and PCF.Editorial modifications are needed, e.g. to change “ULCL” to “UL CL”. |
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| ***Summary of change:*** | Change “UL CL/BP” to “UL CL” to in UE-Satellite-UE communication procedures.Modify the description of N5 interface.Editorial modifications. |
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| ***Consequences if not approved:*** | It is unclear whether BP UPF onboard the satellite can be used for UE-Satellite-UE communication. Editorial mistakes exist in the specification. |
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| ***Clauses affected:*** | AE.2.1.1, AE.5.1, AE.5.2.1 |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **X** |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** |  | **X** |  Test specifications | TS/TR ... CR ...  |
| ***(show related CRs)*** |  | **X** |  O&M Specifications | TS/TR ... CR ...  |
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| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

\* \* \* Start of Change \* \* \* \*

### AE.2.1.1 Support of IMS satellite media plane optimization with IMS-AGW deployed on satellite(s)

To support IMS satellite media plane optimization, as depicted in Figure AE.2.1.1-1, the IMS-AGW may be deployed on the satellite(s) that host the gNB and UPF (UL CL and L-PSA) of the 5GC.

NOTE 1: It is assumed that the satellite(s) can always connect to the ground with IP transport networks.



Figure AE.2.1.1-1: Reference architecture of IMS satellite media plane optimization

NOTE 2: Iq interface is over satellite transport layer links (feeder link and optionally inter-satellite links), where the lower layer protocol is out of 3GPP scope.

NOTE 3: For clarity, the connections within 5GC and IMS core are not fully depicted in the architecture diagrams. For more information on 5GC architectures refer to clause 4.2.3 of TS 23.501 [93].

The above figure depicts a reference architecture for IMS satellite media plane optimization with following assumption:

- For the IMS related PDU Session, the IP address allocated to the UE corresponds to a PSA UPF located on the ground. Thus, the IP address of the UE is not changed when serving satellite is changed.

- UE(s) register onto IMS with this IP address and don't need to reregister when there is change of serving satellite.

- The architecture deployment assumes, ISL(s) can be set-up within the same satellite constellation or across different constellations depending on satellite operator's deployments (SLA). The set of ISL(s) builds up an IP network which is out of 3GPP scope.

- The routing between Onboard AGWs across satellite via ISL is assumed to be based on IP routing and the Onboard AGWs in satellite need to have non-conflicting IP address during resource allocation. It is up to the deployment to manage IP routing across ISL links and is out of 3GPP scope.

\* \* \* Next Change \* \* \* \*

## AE.5.1 At call setup

When the originating P-CSCF receives the initial INVITE request from the originating UE using regenerative NR satellite access, it selects the IMS-AGW on ground and triggers media negotiation by sending SDP offer to the terminating side indicating that satellite access is used on the originating side. If the terminating P-CSCF activates UE-satellite-UE communication, the originating P-CSCF re-selects an IMS-AGW on satellite. See Figure AE.5.1-1 that describes the procedure. In the procedure, UE A and P-CSCF A represent originating side function or entity, UE B and P-CSCF B represent terminating side function or entity.

NOTE 1: To support the UE-satellite-UE communication, P-CSCFs (AF) need to support N5 interface for AF influence on traffic routing and user plane management event subscription/notification.



Figure AE.5.1-1: Session establishment procedure with activation of optimizing media routing

1. UE A sends a SIP INVITE request, containing an initial SDP offer, to P‑CSCF A. The access information in the SIP INVITE request indicates that the UE is accessing from NR satellites access as defined in TS 24.229 [10a].

2. After receiving the SIP INVITE request indicating NR satellite access, if UE A is not roaming and the P-CSCF A supports UE-Satellite-UE communication, the P-CSCF requests Access Network Information, which includes an indication for requesting satellite identifier information, for UE A from the PCF as described in TS 23.503 [95] via Npcf\_PolicyAuthorisation\_Create service operation. The PCF requests Access Network Information, which includes the identifier of UE A's serving satellite, from the SMF via Npcf\_SMPolicyControl\_UpdateNotify service operation. Then the PCF receives the Access Network Information via Npcf\_SMPolicyControl\_Update service operation as described in TS 23.502 [94] and TS 23.503 [95]. This satellite identifier is subsequently conveyed to the P-CSCF in the Access Network Information Notification via Npcf\_PolicyAuthorization\_Notify service operation.

3. The P-CSCF A allocates an IMS-AGWon the ground as default. P-CSCF A interacts with IMS-AGW on the ground to allocate transport resources based on the mechanism defined in TS 23.334 [74].

Steps 4-20 are performed if the UE-Satellite-UE communication is possible based on step 2 (i.e. UE A is using NR regenerative payload satellite access and is not roaming). Otherwise, procedures for IMS user plane traffic routing with IMS-AGW on ground are performed (details have been omitted from the diagram).

4. P-CSCF A updates the SIP INVITE request inserting the identifier of the satellite serving UE A and updates SDP offer with the IMS-AGW transport addresses allocated in step 3. P-CSCF A forwards the updated SIP INVITE request to the terminating side via IMS core (details have been omitted from the diagram).

5. After receiving the SIP INVITE request which contains a satellite identifier indicating that UE A is using regenerative satellite access, if UE B is not roaming and the P-CSCF B supports UE-Satellite-UE communication, the P-CSCF B requests Access Network Information, which includes an indication for requesting satellite identifier information, for UE B from PCF as described in TS 23.503 [95] via Npcf\_PolicyAuthorization\_Create service operation.. The PCF obtains Access Network Information, which may include an identifier of the satellite serving UE B, from the SMF via Npcf\_SMPolicyControl\_UpdateNotify and Npcf\_SMPolicyControl\_Update service operations as described in TS 23.502 [94] and TS 23.503 [95]. This satellite identifier, if received, is subsequently conveyed to the P-CSCF in the Access Network Information Notification via Npcf\_PolicyAuthorization\_Notify service operation.

NOTE 2: P-CSCF B can decide to include an indication for requesting satellite identifier information based on e.g. access information in the SIP REGISTER request (or other SIP messages) which indicates that UE B is accessing from NR satellites access as defined in TS 24.229 [10a].

6. Based on the Access Network Information received at step 5, if UE B is using regenerative payload satellite access and if the two satellites identified in step 4 and 5 are the same or connected with ISL(s), P-CSCF B determines to activate the UE-Satellite-UE communication in IMS.

 and If UE-Satellite-UE communications in IMS is not activated, P-CSCF B selects an IMS-AGW on ground for UE B; otherwise, P-CSCF B selects an IMS-AGW on satellite for UE B.

NOTE 3: How the terminating P-CSCF uses the satellite identifiers to derive whether the two satellites are connected with ISL(s) and are equipped with UPF and IMS-AGW is based on implementation or operators' policy e.g. by querying transport network system or based on node level information reported by the IMS-AGW deployed on the satellites.

6a-6b. Based on the decision in step 6, P-CSCF B interacts with IMS-AGW onboard the satellite or IMS-AGW on ground to allocate transport resources based on the mechanism defined in TS 23.334 [74].

Steps 7-20 are performed if the UE-Satellite-UE communication is activated. Otherwise, SIP message routing procedures with IMS-AGW on the ground should be performed after P-CSCF B selecting a ground IMS-AGW for usage (details have been omitted from the diagram).

7-9. P-CSCF B forwards the updated SIP INVITE request to UE B. UE B returns an 18X response with SDP Answer as normal SIP message routing procedures.

9a-9b. After receiving the SDP Answer, P-CSCF B interacts with the IMS-AGW onboard the satellite to allocate transport resources based on the mechanism defined in TS 23.334 [74].

10. P-CSCF B instructs the PCF to authorize the resources necessary to establish a QoS flow for media via Npcf\_PolicyAuthorization\_Update service operation. To indicate the SMF to insert a UL CL and L-PSA UPF for IMS PDU session to enable UE-Satellite-UE communication, the P-CSCF B should send following parameters via the request to PCF based on Application Function influence on traffic routing mechanism described in clause 5.6.7 of TS 23.501 [93] and clause 4.3.6 of TS 23.502 [94]:

- A flow description information which contains the IP address of the IMS-AGW onboard the satellite;

- A DNAI associated with the IMS-AGW onboard the satellite and optionally corresponding N6 traffic routing information.

NOTE 4: DNAI value can be derived from the satellite identifier as per operator policy and implementation.

10a. To be notified of satellite change and perform IMS-AGW relocation at change of satellite as described in clause AE.5.2, P-CSCF B subscribes to notification of User Plane management events (i.e. UP path change) via Npcf\_PolicyAuthorization\_Update service operation to the PCF, which in turn subscribes to the events from SMF via Npcf\_SMPolicyControl\_UpdateNotify service operation and receives the event notifications from the SMF via Nsmf\_EventExposure\_Notify service operation as specified in clause 4.3.6 of TS 23.502 [94]. The P-CSCF B inserts the following parameters in its subscription request (i.e. Npcf\_PolicyAuthorization\_Update service operation) as specified in clause 5.2.5.3.3 of TS 23.502 [94]:

- Early and late notifications about UP path management events.

NOTE 5: If Rx is used by P-CSCF, implicit subscription is assumed as part of PCC rules setting.

11. P-CSCF B updates the 18X response to carry the identifier of the satellite serving UE B to indicate that UE-Satellite-UE communication is activated. Then, P-CSCF B returns the updated 18X response to originating side via IMS core (details have been omitted from the diagram).

12. Based on the identifier of the satellite serving UE B in step 11, P-CSCF A determines to perform UE-satellite-UE communication and select an IMS-AGW onboard the satellite.

12a-12c. P-CSCF A interacts with IMS-AGW onboard the satellite to allocate transport resources for both IMS access and IMS Core network sides. P-CSCF A also releases the IMS-AGW on ground.

13. P-CSCF A instructs the PCF to authorize the resources necessary to establish a QoS flow for media via Npcf\_PolicyAuthorization\_Update service operation. To indicate to the SMF to insert a UL CL and L-PSA UPF for the IMS PDU session to enable UE-Satellite-UE communication in IMS, P-CSCF B should send following parameters via the request to PCF based on Application Function influence on traffic routing mechanism described in clause 5.6.7 of TS 23.501 [93] and clause 4.3.6 of TS 23.502 [94]:

- A flow description information which contains the IP address of the IMS-AGW onboard satellite;

- A DNAI associated with the IMS-AGW onboard satellite and optionally corresponding N6 traffic routing information.

NOTE 6: DNAI value can be derived from the satellite identifier as per operator policy and implementation.

13a. To be notified of satellite change and perform IMS-AGW relocation at change of satellite as described in clause AE.5.2, P-CSCF A subscribes to notification of user plane management events (i.e. UP path change) via Npcf\_PolicyAuthorization\_Update service operation to the PCF, which in turn subscribes to the events from SMF via Npcf\_SMPolicyControl\_UpdateNotify service operation and receives the event notifications from the SMF via Nsmf\_EventExposure\_Notify service operation as specified in clause 4.3.6 of TS 23.502 [94]. The P-CSCF A inserts the following parameters in its subscription request (i.e. Npcf\_PolicyAuthorization\_Update service operation) as specified in clause 5.2.5.3.3 of TS 23.502 [94]:

- Early and late notifications about UP path management events.

NOTE 7: If Rx is used by P-CSCF, implicit subscription is assumed as part of PCC rules setting.

14. P-CSCF A updates the SDP answer in the 18X response with the IMS-AGW transport addresses allocated in step 12 and forwards the updated 18X response to UE A.

15. UE A acknowledges the 18X Response and sends the Response Confirmation to P-CSCF A.

16-17. P-CSCF A forwards the Response Confirmation to P-CSCF B. The Response Confirmation includes SDP offer modified/generated by P-CSCF A which contains the IMS-AGW transport address obtained in step 12. Upon receiving the SDP offer, P-CSCF B updates the allocated IMS-AGW on the satellite for UE B with the transport address in the SDP offer.

18. P-CSCF B sends the Response Confirmation to UE B.

19. Procedure continues to setup the call as defined in clauses 5.6 and 5.7.

\* \* \* Next Change \* \* \* \*

### AE.5.2.1 Continued optimized media routing procedure

Figure AE.5.2.1-1 depicts a signalling flow diagram for continuation of optimized media routing after change of satellites that serve a UE. The procedure is written in such a way that change of satellites occurs in the originating network for the purpose of the explanation, while change of satellites can occur in the terminating network as well.

NOTE 1: IMS entities not relevant for the procedure are omitted below for brevity of the description.

NOTE 2: In this Release of the specification, the originating network and the terminating network are the same PLMN.

Use of the N5 interface between the P-CSCF and PCF is assumed.

Based on the procedure described in clause AE.5.1, P-CSCF is expected to subscribe from 5GC for the early and the late notification of the satellite user plane management events associated with UE-Satellite-UE communication media traffic as specified in clause 5.6.7 of TS 23.501 [93] and clause 4.3.6.3 of TS 23.502 [94].



Figure AE.5.2.1-1: Continued optimized media routing procedure

The steps in the call flow are as follows:

1. A media path in both directions is established between UEs. IMS AGWs on satellite forward voice/video media via UL CL and L-PSA on satellite between the UEs.

2. P-CSCF receives the early notification of the satellite user plane management events associated with UE-Satellite-UE communication media traffic from PCF as defined in clause 4.3.6.3 of TS 23.502 [94]. This early notification contains satellite ID of a target satellite that has gNB to which the UE gets connected and an indication being set "EARLY", indicating that 5GC is prepared to change the user plane path for optimized media routing to the one through this target satellite.

3. P-CSCF determines that optimized media routing continues to be possible based on the satellite ID received in step 2 for the originating network and the satellite ID stored for the terminating network. P-CSCF determines to continue activating optimized media routing.

NOTE 3: How P-CSCF uses the satellite IDs to determine whether the two satellites are connected and whether optimized media routing is possible is up to implementation.

 If P-CSCF determines that optimized media routing cannot continue, P-CSCF follows the ground fallback procedure as defined in clause AE.5.2.2 for subsequent steps.

4. P-CSCF requests IMS AGW on the target satellite to configure the IP address allocated in UE, which P-CSCF has stored, to be used by the IMS AGW on the target satellite as the destination of media traffic towards the UE and to reserve an IP address in the IMS AGW on the target satellite to be used by the UE as the destination of media traffic. In addition, the P-CSCF requests the IMS AGW on the target satellite to configure context information other than IP addresses of the connection point towards the UE based on the corresponding context in the IMS AGW on the source satellite. This step 4 is performed according to clause 8.2 of TS 23.334 [74].

5. P-CSCF requests IMS AGW on the target satellite to configure the IP address allocated in IMS AGW on the remote satellite in the terminating network, which P-CSCF has stored, to be used by the IMS AGW on the target satellite as the destination of media traffic towards the terminating network and to reserve an IP address in the IMS AGW on the target satellite to be used by the IMS AGW on the remote satellite in the terminating network as the destination of media traffic towards the originating network. In addition, the P-CSCF requests the IMS AGW on the target satellite to configure context information other than IP addresses of the connection point towards the terminating network based on the corresponding context in the IMS AGW on the source satellite. This step 5 is performed according to clause 8.2 of TS 23.334 [74].

NOTE 4: It is assumed in general that the newly selected IMS AGW (i.e. IMS AGW on the target satellite) allows voice/video media to flow immediately after the reservation and configuration are completed (e.g. without waiting for the response from the remote end if the reservation and configuration are made triggered by SIP re-INVITE).

6. P-CSCF replies to PCF by invoking Npcf\_PolicyAuthorization\_Update service operation as defined in clause 4.3.6.3 of TS 23.502 [94] to the early notification received in step 2. The Npcf\_PolicyAuthorization\_Update request is a positive response indicating that the change of the user plane paths for optimized media routing to the one through the target satellite should be performed. This request also includes the IP address allocated in IMS AGW on the target satellite to be used by UE as the destination of media traffic and optional N6 traffic routing information associated with target DNAI. SMF in 5GC establishes UL CL and L-PSA on the target satellite, with the UL CL configured with traffic filters containing this IP address to route the IMS media towards the L-PSA, according to clause 4.3.5.7 of TS 23.502 [94]. If N6 traffic routing information associated with target DNAI is received, SMF also configures the N6 traffic routing information on the L-PSA.

7. P-CSCF updates via PCF the packet filter list of the QoS rule in UE for media traffic to additionally contain the IP address allocated in IMS AGW on the target satellite to be used by UE as the destination of media traffic according to clause 4.3.3.2 of TS 23.502 [94].

8. P-CSCF receives the late notification of the satellite user plane management events associated with UE-Satellite-UE communication media traffic from PCF as defined in clause 4.3.6.3 of TS 23.502 [94]. This late notification contains an indication being set "LATE" that indicates that 5GC has established the user plane path for optimized media routing through the target satellite.

NOTE 5: The UL CL and L-PSA on the source satellite are retained as long as active traffic exists over the N9 forwarding tunnel as described in clause 4.3.5.7 of TS 23.502 [94].

9. P-CSCF sends a SIP MESSAGE to IMS AS to request it to send SIP re-INVITE to the terminating network (i.e. Step 10) and then towards the UE in the originating network after receiving the SDP answer from the terminating network (i.e. Step 16). This SIP message contains the IP address allocated in IMS AGW on the target satellite to be used by the terminating network as the destination of media traffic. This SIP message also contains the satellite ID of the target satellite.

10. IMS AS sends SIP re-INVITE to the terminating network. This SIP re-INVITE contains an SDP offer that has the IP address allocated in IMS AGW on the target satellite to be used by the terminating network as the destination of media traffic. This SIP re-INVITE also contains a SIP header for conveying the satellite ID of the target satellite.

The following steps 11-15 are performed in the terminating network.

11. P-CSCF requests IMS AGW on satellite to configure the IP address received in step 10 to be used by the IMS AGW on satellite as the destination of media traffic towards the originating network. This step 11 is performed so far according to clause 8.4 of TS 23.334 [74]. In addition, P-CSCF stores the satellite ID of the target satellite in the originating network for future use.

NOTE 6: RTP/RTCP is not symmetric between step 11 and step 17.

12. The media path from the originating network to the terminating network remains the same. The media path from the terminating network to the originating network is via UL CL, L-PSA and IMS AGW on the remote satellite in the terminating network and further via IMS AGW, L-PSA and UL CL on the target satellite in the originating network.

13. P-CSCF sends SIP re-INVITE containing an SDP offer to UE.

14. UE sends SIP 200 OK containing an SDP answer to P-CSCF.

15. P-CSCF sends SIP 200 OK to the originating network. This SIP 200 OK also contains a SIP header for conveying the satellite ID of the satellite in the terminating network and an SDP answer. The satellite ID is the same as the one sent before the satellite change in the originating network.

The following steps 16-22 are performed in the originating network.

16. IMS AS sends SIP re-INVITE to P-CSCF. This SIP re-INVITE also contains a SIP header for conveying the satellite ID of the satellite in the terminating network and an SDP offer.

17. P-CSCF sends SIP re-INVITE to UE. This SIP re-INVITE contains an SDP offer that has the IP address allocated in IMS AGW on the target satellite to be used by UE as the destination of media traffic.

18. The media path in both directions is via UL CL, L-PSA and IMS AGW on the target satellite in the originating network and UL CL, L-PSA and IMS AGW on the remote satellite in the terminating network.

19. UE sends SIP 200 OK containing an SDP answer to P-CSCF.

20. P-CSCF sends SIP 200 OK containing an SDP answer to IMS AS.

21. SMF in 5GC releases UL CL and L-PSA on the source satellite according to steps 11 and 12 in clause 4.3.5.7 of TS 23.502 [94].

NOTE 7: The SMF releases the UL CL and L-PSA on satellite after detecting no active traffic over the N9 forwarding tunnel as described in step 10 of clause 4.3.5.7 of TS 23.502 [94].

22. P-CSCF releases IMS AGW on the source satellite sometime after receiving SIP 200 OK in step 19. This step 22 is performed according to clause 8.5 of TS 23.334 [74].

\* \* \* End of Changes \* \* \* \*