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Technical Report

**3rd Generation Partnership Project;
Technical Specification Group Services and System Aspects;
Feasibility Study of Single Radio Video Call Continuity
(vSRVCC);
Stage 2
(Release 10)**



Keywords

3GPP, Architecture, SAES, SRVCC, Video

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Foreword

This Technical Report has been produced by the 3rd Generation Partnership Project (3GPP).

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1 Scope

The objective of the feasibility study is to investigate a solution for supporting single radio the video call continuity from E-UTRAN/HSPA to UTRAN-CS based on the Rel-8/9 Single Radio Voice Call Continuity (SRVCC) architecture as specified in TS 23.216 [2] and TS 23.237 [3], and study the mechanisms to resolve the key issues. It is not expected that the SRVCC architecture will be modified unless any of the key issues cannot be resolved with the current architecture.

The study will be performed to the scenarios where IMS session using bidirectional voice and synchronised video such as defined in TS 22.173 [4], originated in E-UTRAN/HSPA and the UE moves to UTRAN and continues the service over UTRAN in the CS domain.

The video call continuity from E-UTRAN/HSPA to GERAN is not supported.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

- [1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".
- [2] 3GPP TS 23.216: "Single Radio Voice Call Continuity (SRVCC): Stage 2".
- [3] 3GPP TS 23.237: "IP Multimedia Subsystem (IMS) Service Continuity; Stage 2".
- [4] 3GPP TS 22.173: "IP Multimedia Core Network Subsystem (IMS) Multimedia Telephony Service and supplementary services; Stage 1".
- [5] 3GPP TS 22.101: "Technical Specifications and Technical Reports for a UTRAN-based 3GPP system".
- [6] 3GPP TS 22.278: "Service requirements for the Evolved Packet System (EPS)".
- [7] 3GPP TS 26.114: "IP Multimedia Subsystem (IMS); Multimedia Telephony, Media handling and interaction".
- [8] 3GPP TS 26.111: "Codec for circuit switched multimedia telephony service; Modifications to H.324".
- [9] ITU-T Recommendation H.324, Annex K: "Media oriented negotiation acceleration procedure" and associated changes to Annex J".
- [10] ITU-T Recommendation H.245: "Control protocol for multimedia communications".
- [11] 3GPP TS 23.401: "GPRS Enhancements for E-UTRAN Access".
- [12] 3GPP TS 23.172: "Technical realization of Circuit Switched (CS) multimedia service; UDI/RDI fallback and service modification; Stage 2".
- [13] 3GPP TS 23.203: "Policy and charging control architecture".
- [14] 3GPP TR 26.911: "Codec(s) for Circuit-Switched (CS) multimedia telephony service; Terminal implementer's guide".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [1].

Video Call: For IMS over E-UTRAN/HSPA, it represents the session using bidirectional voice and synchronised real time video as specified in TS 22.173 [4]. For UTRAN-CS, it represents the Circuit Switched (CS) multimedia calls as specified in TS 22.101 [5].

Single Radio Video Call Continuity: Video call continuity from IMS over E-UTRAN/HSPA access to UTRAN access for calls that are anchored in IMS when the UE is capable of transmitting/receiving on only one of those access networks at a given time. The definition of SRVCC as specified in TS 23.216 [2] could mean the process of continuing a voice (or video) call as a user moves from IMS over E-UTRAN/HSPA access to UTRAN access. However, the usage of the term SRVCC in 3GPP specifications will keep its original meaning, i.e. voice call continuity. In this technical report, the term vSRVCC is introduced for single radio video call continuity to differentiate it from single radio voice call continuity (SRVCC).

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1].

SRVCC	Single Radio Voice Call Continuity
vSRVCC	Single Radio Video Call Continuity

4 Assumptions and requirements

4.1 Assumptions

Followings are the assumptions of the vSRVCC from E-UTRAN/HSPA to UTRAN-CS handover:

- The video call by IMS over E-UTRAN/HSPA is the MMTEL with video which uses separate EPS bearers for video and voice components, respectively.

4.2 Architectural requirements

Followings are the requirements for the vSRVCC from E-UTRAN/HSPA to UTRAN-CS from an architectural perspective.

- The solution shall not require UE with multiple RATs capability to simultaneously signal on two different RATs.
- Impact on user service quality experience, e.g. QoS, call drop, interruption time, should be minimized.
- Overall duration of the vSRVCC handover from E-UTRAN/HSPA to UTRAN-CS procedure shall be minimized.
- It shall be possible to restrict RAT/domain selection change to access systems and subscribers depending on operator policies, and capabilities of the network and the UE, and these shall be network initiated and under network control.
- In roaming cases, the VPLMN shall be able to control the RAT/domain selection change while taking into account any related HPLMN policies for MMTEL video call.

- The signalling to the HPLMN for inter-domain continuity from E-UTRAN/HSPA to UTRAN-CS in the VPLMN should be minimized.
- Rel-8/9 SRVCC architecture, as specified in TS 23.216 [2], shall not be modified unless any of the key issues cannot be resolved.
- For PS bearer(s) other than the ones for voice and video, PS continuity from E-UTRAN/HSPA to UTRAN-CS and from E-UTRAN to UTRAN/HSPA as specified in TS 23.401 [11] shall not be impacted.
- It shall be possible to fallback to Rel-8/9 SRVCC and maintain the voice component of MMTEL session if the Rel-10 vSRVCC cannot be completed due to, for instance, resource shortage in UTRAN-CS.

4.3 Performance requirements

- In the RAT change procedure executed to enable vSRVCC, the audio component of the MMTEL session shall be subject to interruption times equivalent to Rel-8/9 SRVCC performance, i.e. target interruption time is not higher than 300 ms for voice as defined in TS 22.278 [6].
- In the RAT change procedure executed to enable vSRVCC, the time of the additional transfer of the video component(s) of the MMTEL session should be equivalent to the time it takes to complete the H.245 codec negotiation [10], as defined in TS 23.237 [3], in order to minimize the perceivable video disruption for the user.

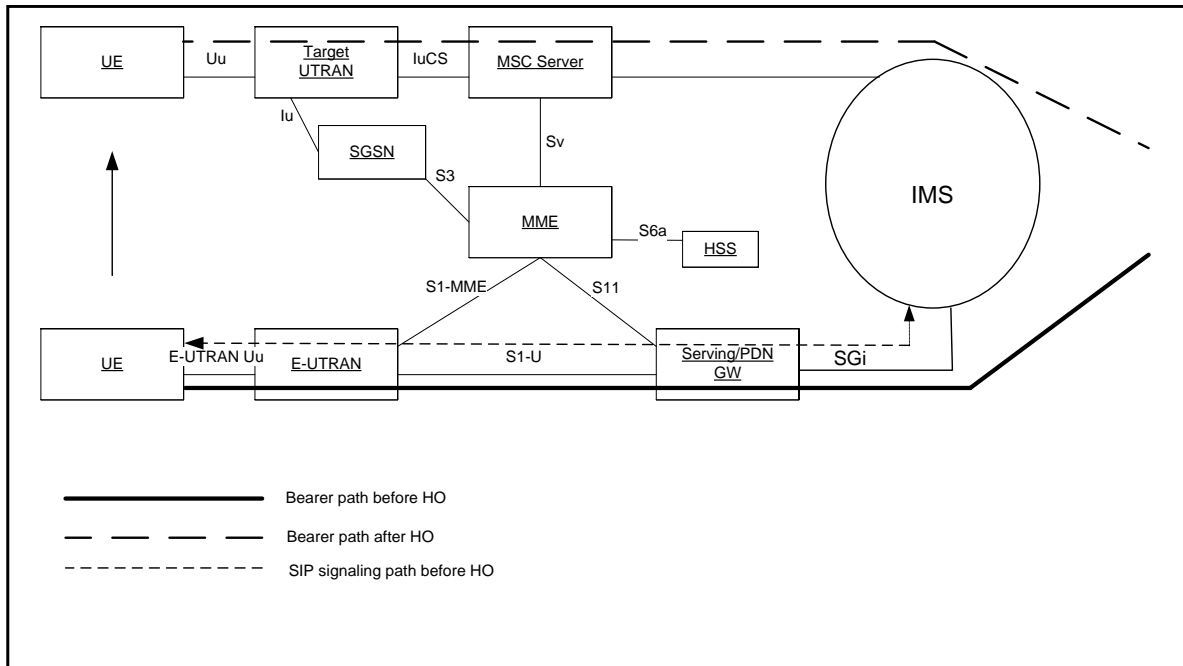
5 Architecture model and reference points

5.1 General

5.2 Reference architecture

The architecture is similar to the one provided in TS 23.216 [2].

5.2.1 Proposed 3GPP E-UTRAN/HSPA to 3GPP UTRAN SRVCC for video-calls architecture



- NOTE 1: The following figure only shows the necessary components related to MSC Server enhanced for vSRVCC
- NOTE 2: MSC Server shown in the figure is enhanced for vSRVCC.
- NOTE 3: This architecture also applies to roaming scenario (i.e., S8, S6a are not impacted due to vSRVCC).
- NOTE 4: The MSC server enhanced with vSRVCC may not be the final target MSC which connects to the target cell.

Figure 5.2.1-1: Video SRVCC architecture for E-UTRAN to 3GPP UTRAN

5.3 Impact on functional entities

5.3.1 UE

5.3.2 eNode-B/Node-B

5.3.3 MME/SGSN

5.3.4 MSC Server enhanced for vSRVCC

5.3.5 SCC AS

5.4 Reference points

Editor's Note: The reference point that provide video-call SRVCC support between 3GPP E-UTRAN/HSPA and 3GPP UTRAN (CS).

6 Key Issues

6.1 Key issue 1: Video Codec negotiation

6.1.1 Alternative 1- Two step approach for transferring video-call with vSRVCC

6.1.1.1 Functional description

For MTSI and 3G-324M, three video Codecs, H.263, MPEG-4, and H.264, are standardized in [7], [8]. For 3G-324M, only H.263 and MPEG-4 are typically implemented and the more complex but of a higher compression efficiency H.264 is currently not implemented in general. MTSI is expected to begin with H.264 at higher bit rates and larger image sizes than those of 3G-324M.

Call Setup Delay of 3G-324M using H.245

H.324, the parent standard of 3G-324M, includes the following steps for call setup:

- H.223 Multiplexer level detection
- Terminal Capability Exchange
- Master Slave determination
- Open Logical Channels
- Multiplexer Table Entries Exchange

The procedure typically takes 5 ~ 8 seconds. If link quality deteriorates or media configurations between UEs are not well-matched, this delay may increase even further. The delay can be suppressed to as low as a few seconds in the limited cases when the acceleration techniques, such as MONA [9], are supported by both UEs and little data is lost during the period. However, the call set up procedure of 3G-324M, outlined above, is likely to occur at cell edges under the SRVCC situations where radio link is unstable.

Given that the period of the current SRVCC handover with voice only is significantly smaller (e.g. in the area of 300-500ms) if we aim for simultaneous transfer of voice and video when handing over from PS-to-CS with vSRVCC given that we aim for the establishment of a 64kbps bearer on the UTRAN side and the increased call setup delay of 3G-324M from the negotiation between UEs using H.245 signalling procedures, the interruption time might be significantly large, during which a message might be displayed to ask for patience from the user or recently-played video clips might be replayed until newly-decoded scenes become available.

6.1.1.2 Information flows

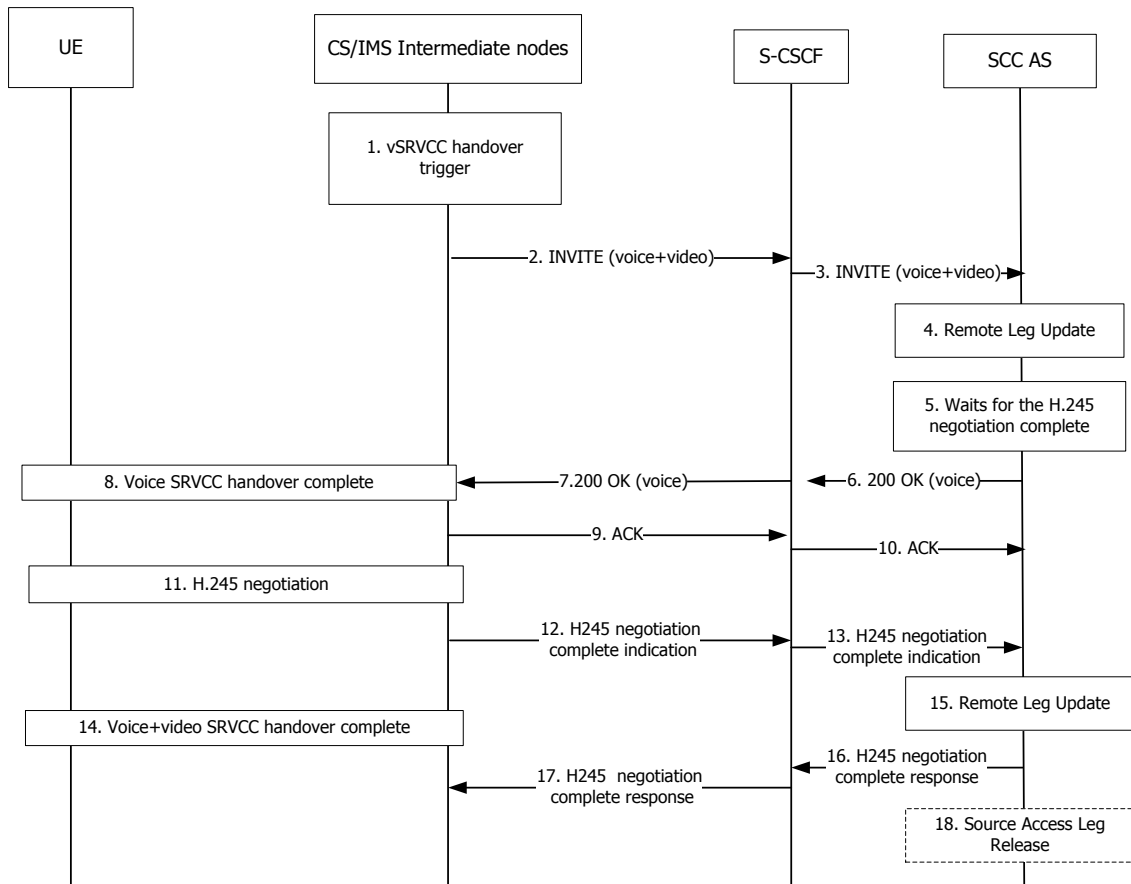


Figure 6.1.1.2-1: Two-step approach of transferring video-call with vSRVCC

NOTE: The upgrade from voice to video is performed using SCUDIF as defined in TS 23.237 [3]. Both UE and network must therefore support SCUDIF.

Given the long period without any media flow is not acceptable but the voice component of the call needs to be relayed anyway, one alternative approach might be the following step-wise procedure in which the transfer is performed in two steps:

- a) the initial session transfer from the MSC-S to the SCC AS only transfers the voice component (step 2 to 10 in Figure 6.1.1.2-1).
- b) in a second stage and when the H.245 negotiation using SCUDIF completes the 3G-324M replaces the CS voice (step 11 to 17 in Figure 6.1.1.2-1).

6.1.1.3 Evaluation of the alternative

This alternative uses SCUDIF procedures from the network for the upgrade of the voice call to video during the vSRVCC handover procedure. According to the SCUDIF procedure for establishment of multimedia call which can support in call modification the SETUP message needs to include Repeat Indicator (RI) set to support of service change and fallback, a multimedia BC-IE, a speech BC-IE. The bearer capability elements are indicated by BC1 (first bearer capability in a message -preferred service) and BC2 (second bearer capability in a message- less preferred service). A terminal may request a call to be set with the capability to fallback to either a speech only, a multimedia only call or to use service change later during the active state of the call (the first BC-IE indicates the preferred service). Also, if the terminal supports Network-initiated service upgrade to multimedia, then it shall also indicate this in the SETUP message with the "Enhanced Network-initiated ICM" (ENICM) Capability.

As the UE itself can not send the SETUP request, these elements need to be made available to the MSC server. The problem is that these parameters especially the bearer capability elements are UE and radio access network specific and

can not be generated by any other entity except the UE. This would require significant changes in the SCUDIF procedures.

This solution has significant impacts on the legacy CS infrastructure and is deemed inappropriate for further study as part of the TR 23.886.

6.1.2 Alternative 2: 3G-324M pre-negotiation scheme for vSRVCC domain transfer

6.1.2.1 Functional description

Assuming UE and the network have the capability of combined TA and LA update, which eventually enables LTE located UE to know corresponding T-MSC. Using this functionality, this scheme performs necessary 3G-324M negotiation, to prepare future needs of 3G-324M in CS domain, with T-MSC via MSC-S/MGW while the process to locate UE in the PS domain during PS session is on-going. Therefore, all necessary 3G-324M related information has been negotiated prior to the actual SRVCC sequence. This is shown in the pre 3G-324M negotiation part of the sequence and this scheme is called the 3G-324M pre-negotiation procedure.

6.1.2.2 Information flows

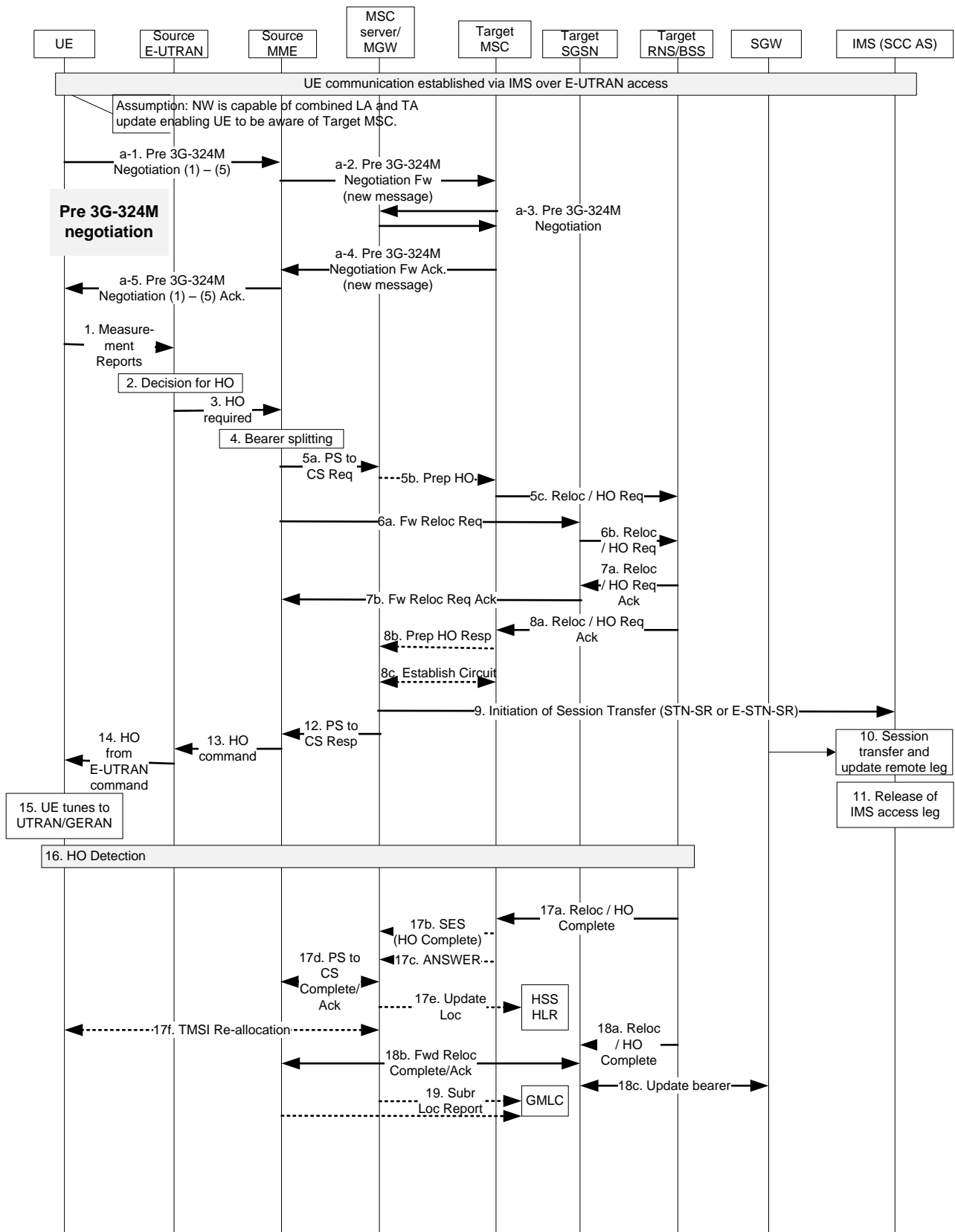


Figure 6.1.2.2-1: 3G-324M pre-negotiation scheme for vSRVCC domain transfer

It is assumed that prior to the start of the pre-3G-324M negotiation sequence, the UE and the network have the capability of TA and LA combined location update mechanism. Hence, the UE located by the PS domain knows the T-MS-C via TA information.

a-1: UE sends the pre 3G-324M negotiation message to the Source MME in Uplink generic NAS transport message (TS 24.301 [11], clause 8.2.32) using Generic message container IE (TS 24.301 [11], clause 9.9.3.42). This message includes all the necessary information for 3G-324M negotiation which includes:

- (1) H.223 Multiplexer level detection,
- (2) Terminal Capability Exchange,
- (3) Master Slave determination,
- (4) Open Logical Channels, and
- (5) Multiplexer Table Entries Exchange.

The timing of this message sent is right after the original Audio and Visual (A/V) communication in PS domain has been established.

a-2: The message is forwarded to Target MSC from MME via S-GsAP-UPLINK-UNITDATA message (TS 29.118, clause 8.22). NAS message container Information Element (IE) can be used.

a-3: The Target MSC forwards the 3G-324M related information to MSC-S/MGW where codec exchange function is located. Encapsulated Application Information of Mobile Service Transport (TS 29.205 Annex-B) in BICC is used for this message. The MSC-S/MGW performs transcoding, if necessary.

a-4: is an acknowledgement of a-2 message. S-GsAP-DOWNLINK-UNITDATA message is used for this message (TS 29.118, clause 8.4). NAS message container Information Element (IE) can be used for this purpose.

a-5: is an acknowledgement of a-1 message. Downlink generic NAS transport message (TS 24.301 [11], clause 8.2.31) using Generic message container IE (TS 24.301 [11], clause 9.9.3.43) is used for this purpose.

This ends the pre 3G-324M negotiation process. The UE and the network are now prepared for the 3G-324M call handover when the UE moves to the CS domain.

Steps 1-9 of the SRVCC procedure, as specified in TS 23.216 [2] clause 6.2.2.2 (SRVCC from E-UTRAN to UTRAN or GERAN with DTM HO support) are executed.

Editor's Note: When the pre-3G-H324M codec negotiation is triggered needs to be clarified.

6.1.2.3 Evaluation of the alternative

The pre-3G-324M negotiation procedure is initiated by the UE when the UE establishes a multimedia call in the PS domain. This prepares the target MSC to receive the multimedia call in case handover to CS domain is required. This alternative adds messaging overhead between the UE, MSC server, and target MSC prior to the start of the HO procedure. Moreover, the pre-negotiation could be triggered every time UE changes the RAN, which can generate additional signalling in the network. The impacts of these aspects could not be fully analyzed.

Hence, this alternative is not recommended for selection in the current release.

6.1.3 Alternative 3: Two step procedure with UE initiated multimedia call establishment (without need of SCUDIF)

6.1.3.1 Functional description

In this method is proposed the voice component is transferred first and after reaching the target CS side the UE may initiate a new CS video call based on user interaction and implementation specific triggers. Then a local transfer happens at the UE using session continuity procedures and the earlier call is deactivated.

6.1.3.2 Information flows

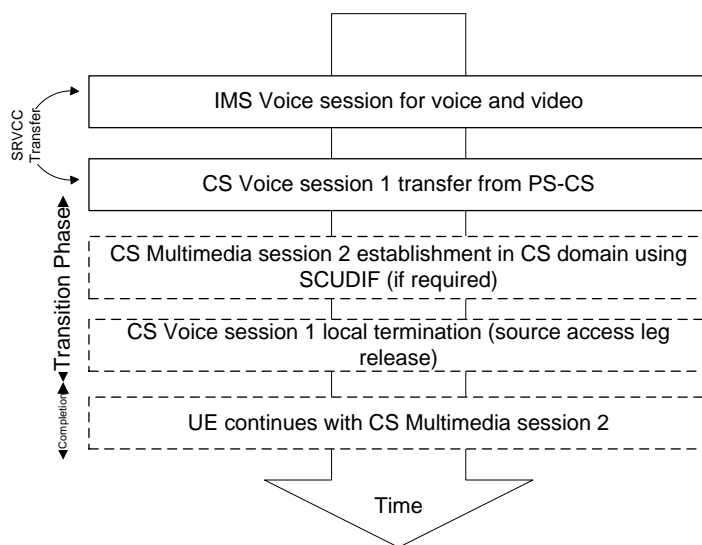


Figure 6.1.3.2-1: Phases of two step video call SRVCC handover procedure using UE initiated additional multimedia call

The phases of the procedure are explained in more detail as follows:

1. The UE is in PS domain and has an ongoing IMS session with bidirectional voice and synchronised video media.
2. SRVCC handover is triggered for video but only the voice component is initially transferred to the CS domain by the MSC server. After the completion of the handover the UE maintains a CS voice session and the interruption times that apply are same as the ones currently experienced in SRVCC handover for voice only (i.e. 300 ms). At this stage the current SRVCC handover for voice is executed.
3. The UE after it connects to the CS domain it establishes a new CS multimedia call; if SCUDIF is supported procedures as described in TS 23.172 [12] are used. Otherwise, the UE/MSC can establish a "normal" multimedia call. It is strongly recommended that the UE/MSC uses MONA [9] in order to accelerate the multimedia call establishment and minimise the interruption. In this case the "original" voice-only session is put on hold and the SCC AS correlates the two sessions.
4. The UE/SCC AS terminates the initial voice session using procedures similar to those of source access leg release defined in TS 23.237 [3].
5. The UE/SCC AS continues with the new multimedia session and performs SCUDIF procedures if used and required.

Steps 3,4 and 5 can be considered optional and implementation dependent. It may be possible that the user/UE implementation chooses to pursue with the CS voice call and not attempt to re-establish the video call when it moves to the CS target. It is strongly recommended that the UE/MSC uses MONA [9] in order to accelerate the multimedia call establishment and minimise the interruption.

The procedures in more detail are described in following figure 6.1.3.2-2:

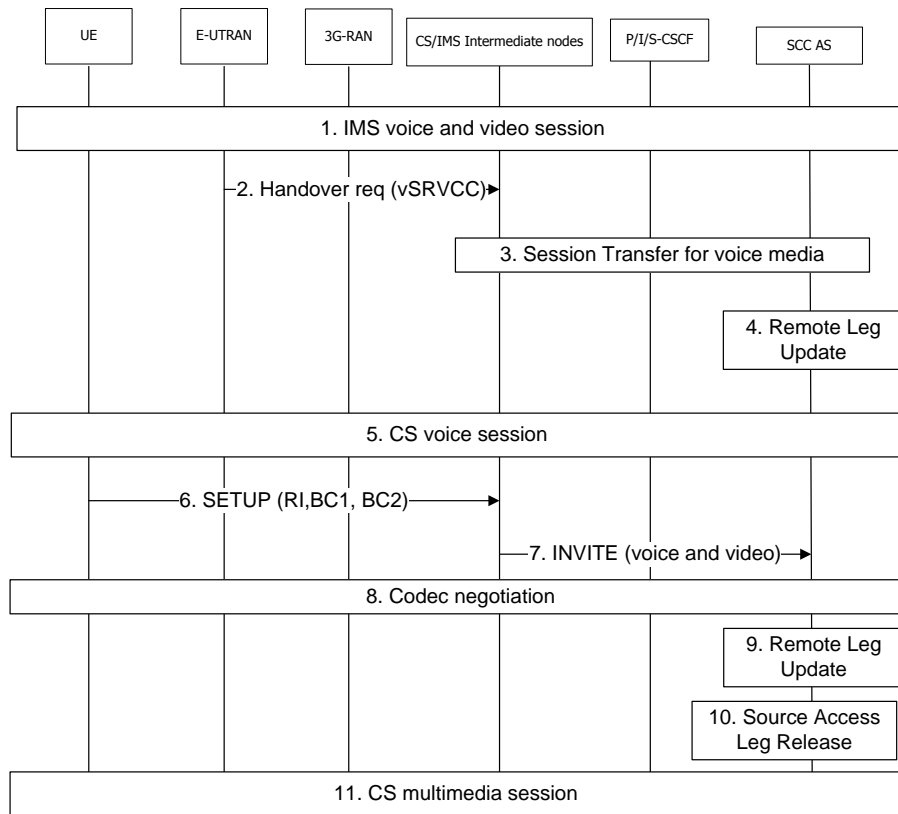


Figure 6.1.3.2-2: Detailed procedure for two-step approach of transferring video-call using UE initiated multimedia call

1. The UE is engaged in an ongoing IMS session with bidirectional voice and synchronised video media (to be called video-call for then on).
2. The criteria are met for this session to be transferred to CS domain. The E-UTRAN identifies the existence of the video-call and initiates a SRVCC handover.

NOTE: Even though the voice component is transferred only the indication of vSRVCC handover is required in the MME in order to perform the appropriate bearer splitting as indicated in section 6.2.

3. The MME sends vSRVCC indication in PS_to_CS request to the MSC server which initiates a session transfer procedure only for the voice component (i.e. using SDP for bidirectional speech in the SIP INVITE of the session transfer as it is currently described in TS 23.237 [3]).
4. The SCC AS updates the remote party and updates the session to voice-only.
5. At this stage the UE has an ongoing CS voice call with the remote party.
6. The UE may trigger the setup of a new CS multimedia session depending on user interaction or implementation specific triggers and sends SETUP to the MSC using the STN when it detects the SRVCC for voice only is completed (sends Handover Complete message). If the UE supports SCUDIF, the UE indicates SCUDIF support and provides two bearer capabilities (voice and multimedia) with multimedia preferred when initiating the transfer. Otherwise it sets up the multimedia call as normal using the STN. At this stage the CS voice call that is transferred in step 5 is put on hold by the MSC server. It is strongly recommended that the UE uses MONA [9] in order to accelerate the multimedia call establishment and minimise the interruption.
7. If the MSC/MGCF supports SCUDIF, the MSC/MGCF sends SIP INVITE towards the SCC AS including voice and video in the SDP. The STN and STN-SR are configured to point to the same SCC AS. The SCC AS correlates the existing (ongoing) session with the session transfer request received in step 3 and the C-MSISDN.
8. The video codec negotiation takes place at this stage.
9. The SCC AS updates the remote party and updates the session to voice and video.

10. The UE/SCC AS terminates the ongoing voice session of the UE and performs procedures similar to the "source access leg release" described in TS 23.237 [3].
11. At this stage the UE has an ongoing CS voice and video call with the remote party.

6.1.3.3 Evaluation of the alternative

This procedure presents minimal impacts on the existing rel.9/10 SRVCC and ISC procedures. Namely the additional impacts on the various entities are the following:

In the UE:

- may initiate the multimedia call on the CS domain using the STN after the vSRVCC handover is completed based on user interaction or implementation specific triggers.
- it is strongly recommended that the UE uses MONA [9] in order to accelerate the multimedia call establishment and minimise the interruption.

In E-UTRAN:

- depends on resolution of key issue 2. See clause 6.2.

In MME:

- depends on resolution of key issues 2 and 3. See clauses 6.2 and 6.3.

In SCC AS:

- is required to identify the vSRVCC handover and correlate the transferred "voice-only" session with the session that is initiated later on by the UE on the CS domain (voice and video).
- update the remote party when the video component is added by the UE in the CS domain.

The advantage of this procedure is that it does not impact the legacy CS call establishment procedures and does not require SCUDIF capability of the UE/network. Since the voice component of the video-call is transferred immediately subject to the handover requirements of SRVCC (rel.9) the voice communication is not disrupted.

The transfer of the video component from UE can be driven by user interaction or implementation specific means. If the UE triggers the transfer of the video component then given that the initial voice has to be put on hold, the voice communication is also disrupted. MONA [9] is strongly recommended to be used in order to minimize this interruption.

It is proposed that this solution is not considered for Rel-10.

6.1.4 Alternative 4: Basic approach for transferring video-call with vSRVCC

6.1.4.1 Functional description

This alternative assumes the extension of the existing SRVCC handover procedure in order to execute SRVCC handover for video calls and identifies the differences in order to extend the current SRVCC handover procedure for voice (as described in TS 23.216 [2]) in order to support the video-calls.

This alternative requires the negotiation of video Codecs during the handover procedure.

6.1.4.2 Information flow

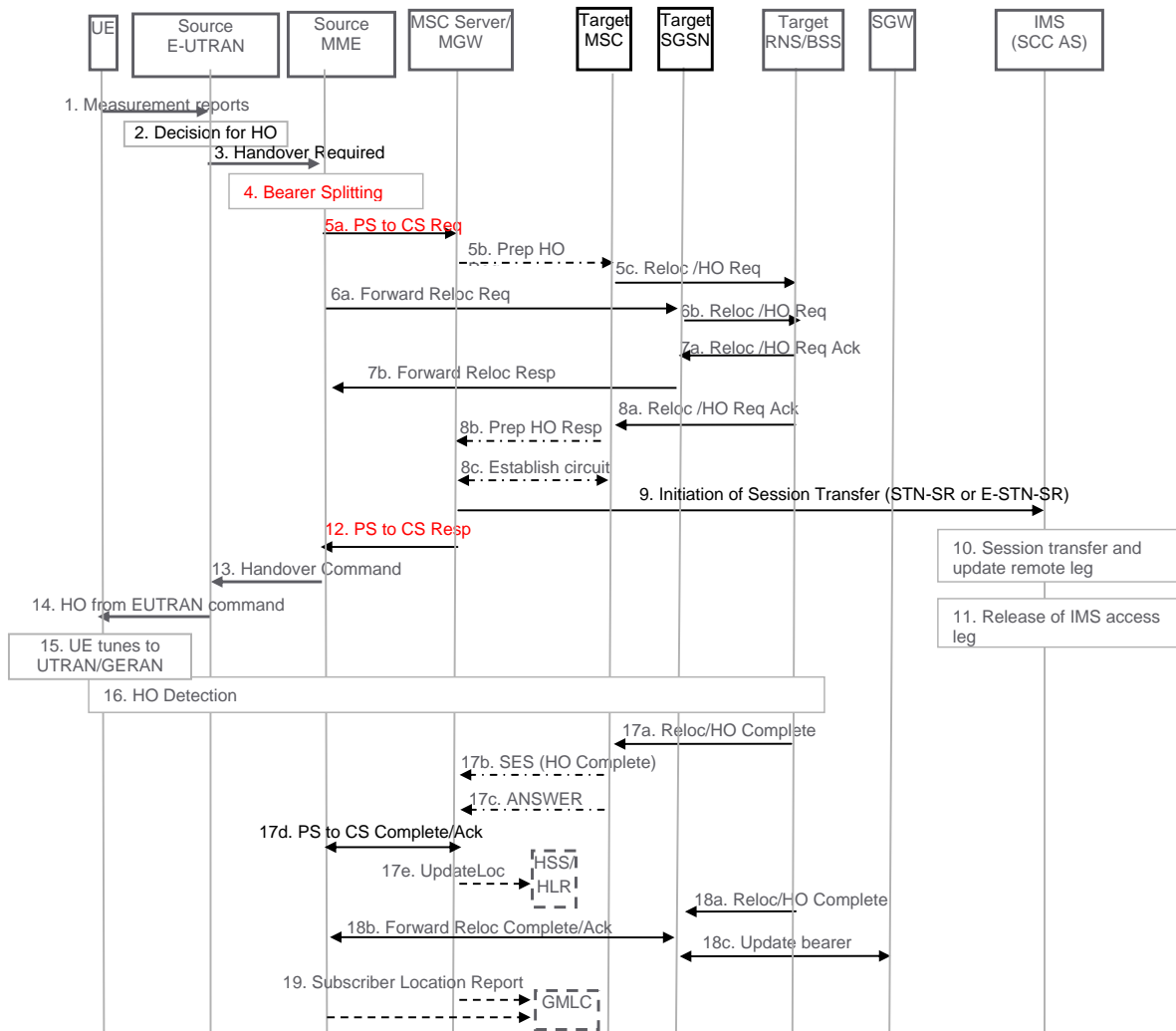


Figure 6.1.4.2-1: SRVCC handover procedure for video-call based on the current TS 23.216 [2] signalling flow

1. Same as in TS 23.216 [2].
2. Same as in TS 23.216 [2].
3. The change from the step in TS 23.216 [2] is that eNodeB should prepare the transparent container indicating that video bearer (QCI=2) as well as voice bearer (QCI=1) should be transferred to CS side and indicate this is vSRVCC handover towards the MME if "SRVCC operation possible" has been indicated for this UE.
4. The change from step in TS 23.216 [2] is that the MME performs the split based on the presence of QCI=2 and QCI=1 bearers and the vSRVCC Handover indication from the eNodeB.
- 5a) The change from the step in TS 23.216 [2] is that the MME sends an indication to the MSC server in PS to CS request to offer video SDP as well as voice.
- 5b) The change in this step from TS 23.216 [2] is that MSC server sends a reject if it receives an indication to prepare the video SDP from MME and MSC server can't support video. This should include the vSRVCC capability.
- 5c) Same as in TS 23.216 [2].
6. The difference from step in 23.216[2] is that the EPS bearer includes context for video bearer(s) also. The PS-to-CS indicator shall be set for video bearers also.

7. Same as in TS 23.216 [2].
8. Same as in TS 23.216 [2].
9. The change from step in TS 23.216 [2] is that if the MSC server receives the indication from MME to prepare video SDP also, it prepares video SDP along with voice SDP otherwise it offers SDP for voice only.
10. Same as in TS 23.216 [2].
11. Same as in TS 23.216 [2].
12. The difference from TS 23.216 [2] is that MSC server also includes an indication whether it prepared the SDP for video besides voice. This potentially requires the renegotiation of the Codecs with H.245 [10].
13. Same as in TS 23.216 [2].
14. Same as in TS 23.216 [2].
15. Same as in TS 23.216 [2].
16. Same as in TS 23.216 [2].
17. Same as in TS 23.216 [2] with extension of 3G-324M codec negotiation (refer to TR 26.911 [14] for H.245 signalling optimizations).

NOTE: 3G-324M codec negotiation starts at step 17c1 right after the UE establishes a circuit bearer to the Target MSC, i.e. after step 17c.

18. The change from step in TS 23.216 [2] is that the PS-to-CS indicator is included for video bearers.
19. Same as in TS 23.216 [2].

6.1.4.3 Evaluation of the alternative

The call setup delay of 3G-324M typically takes 5 ~ 8 seconds. The delay can be suppressed to as low as a few seconds in the limited cases when the acceleration techniques, such as MONA [9], are supported by both UEs and little data is lost during the period. However, the call set up procedure of 3G-324M, outlined above, is likely to occur at cell edges under the SRVCC situations where radio link is unstable.

The period of the current SRVCC handover with voice only is significantly shorter (e.g. in the area of 300-500ms). In this procedure transfer of voice and video handing is done simultaneously after the establishment of a 64kbps bearer on the UTRAN side. This introduces increased call setup delay of 3G-324M from the negotiation between UEs using H.245 signalling procedures, and voice interruption time might be significantly large. This alternative is not recommended for selection in the current release.

6.1.5 Alternative 5: Consolidated approach for transferring video-call with vSRVCC

6.1.5.1 Functional description

This alternative assumes the extension of the existing SRVCC handover procedure in order to execute SRVCC handover for video calls. In summary the following steps are executed:

- The UE has only one voice and one video media active, associated with QCI=1 and QCI=2 bearers in E-UTRAN for bearer identification reasons. The UE shall prevent multi session scenarios other than one active video call (consisting of voice and video media) by rejecting origination and termination session requests, if the UE misbehaves, the SCC AS will select the latest active voice and video session for the transfer.
- The MSC-Server executes a SRVCC voice session transfer first, while the MSC-Server tries to reserve resources for a BS30 bearer towards the target RAN. In case the target RAN is GERAN the subsequent handover procedure is similar to SRVCC specified in TS 23.216. In case the target RAN is UTRAN and the BS30 bearer reservation was successful, voice media only would be transported over the BS30 bearer in the first place after

the handover until the video negotiation procedure is finished. The UE selects the default voice codec for vSRVCC use only.

The session transfer procedure towards IMS for the voice media is the same as in SRVCC. When the UE receives the HO Command with the transparent container indicating the allocated resources is a TS11 or BS30 bearer, it knows whether it should start the H324M video codec negotiation or not. In case of UTRAN and BS30 resources are available, the MSC-Server sends after the finished CS H324M negotiation a new Session Transfer message to request the addition of the video media.

6.1.5.2 Information flow

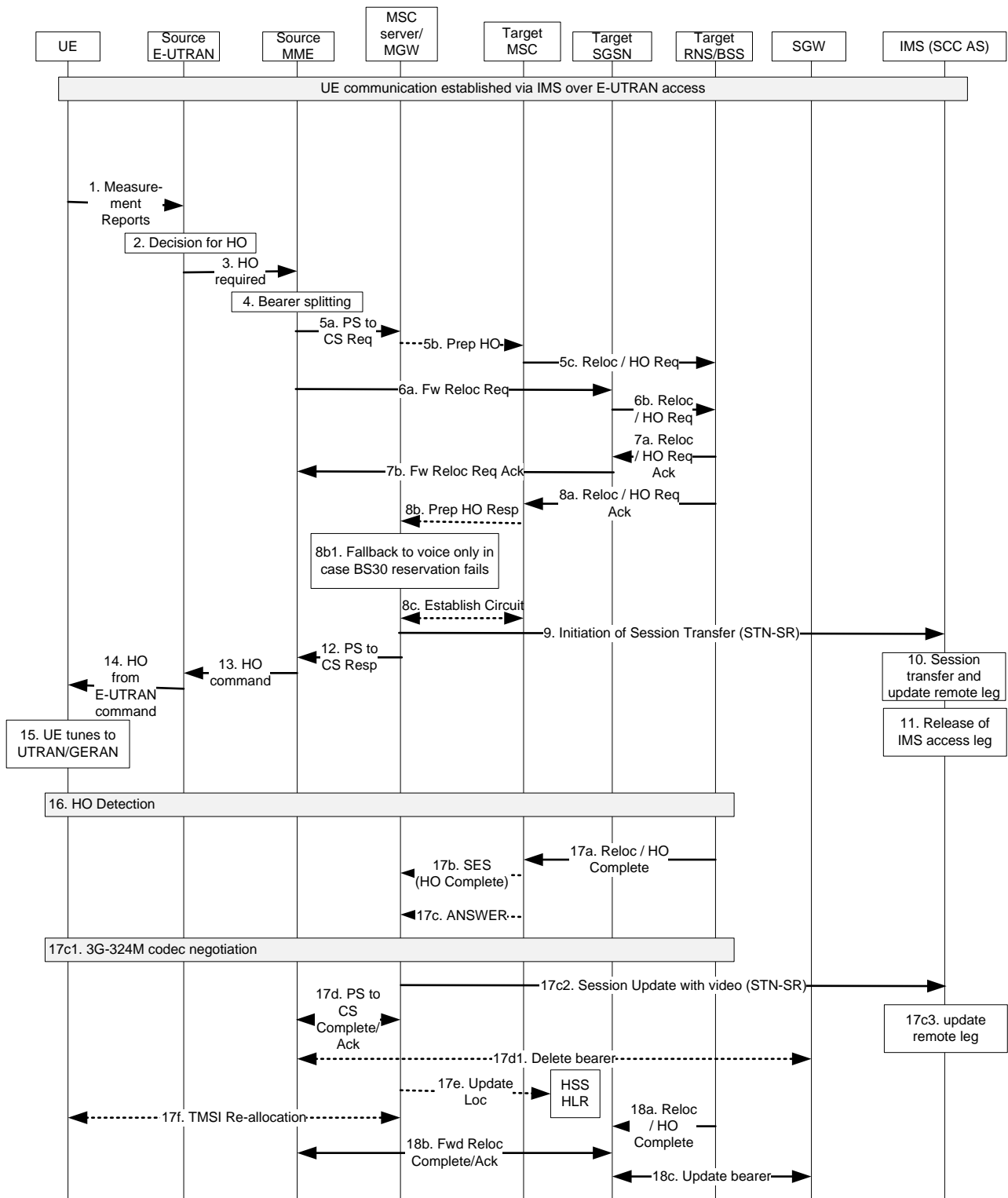


Figure 6.1.5.2-1: SRVCC handover procedure for video-call with enabling voice media first and in a subsequent step video media

1. Same as in TS 23.216 [2].

2. Same as in TS 23.216 [2].
3. Same as in TS 23.216 [2].
4. The change from step 4 in TS 23.216 [2] is that the MME performs the split based on the presence of one QCI=2 and one QCI=1 bearers, i.e. if the target SGSN uses S4 based interaction with S-GW and P-GW, the PDN Connections IE includes bearer information for all bearer(s) but the voice and video bearer(s). If the target SGSN uses Gn/Gp based interaction with GGSN the Forward Relocation Request will contain PDP Contexts, instead of PDN Connections IE, including bearer information for all bearers but the voice and video bearer(s).
- 5a) The change from the step in TS 23.216 [2] is that the MME sends an indication to the MSC server in PS to CS request to indicate a video call handover and initiates the PS-CS handover procedure for the voice bearer and the video bearer towards the MSC Server.
- 5b) The change in this step from TS 23.216 [2] is that in case the target RAN is GERAN or the MSC Server cannot support video, all following steps are similar to TS 23.216 except step 12 and the removal of the video by the SCC AS in steps 10 and 11. In case the target RAN is UTRAN, the MSC-Server tries to reserve resources for a BS30 bearer. In case the UTRAN BS30 resource reservation fails, the MSC-Server tries to reserve the resources for voice only; all following steps are then similar to TS 23.216 except step 12 and the removal of the video by the SCC AS in steps 10 and 11.
- 5c) Same as in TS 23.216 [2] with the difference that a BS30 bearer should be reserved in case the target RAN is UTRAN.
6. Same as in TS 23.216 [2]. The video bearer with QCI=2 is not forwarded to the target SGSN.
7. Same as in TS 23.216 [2].
8. The difference from TS 23.216 [2] is that in case the failed BS30 resource reservation is detected in step 8b1, then the steps starting from step 5b for a TS11 resource reservation are executed as a fallback to voice only.
9. The difference from TS 23.216 [2] is that in case target RAN is UTRAN and the resource reservation was successful then the MSC-Server includes additionally to the SDP of the voice a video SDP set to inactive.
10. The difference from TS 23.216 [2] is that the SCC AS detects based on the presence of the video SDP set to inactive that it needs to perform a vSRVCC HO and expects the session update message in step 17c2. The SCC AS performs a remote leg update with the SDP of the CS access leg for the voice session and sets the video session to inactive. In case the video SDP set to inactive is missing, the SCC AS assumes a SRVCC HO and initiates the release of the video bearer from the remote leg and the access leg.
11. The difference from TS 23.216 [2] is that the SCC AS releases only the source IMS access leg of the voice session.
12. The transparent container contains information about the CS bearer reservation. In case the target RAN is GERAN or the BS30 resource reservation failed then the MSC-Server reserved resources for voice only and indicates the failed video HO to the MME.
13. Same as in TS 23.216 [2].
14. The difference from TS 23.216 [2] is that the UE detects the vSRVCC handover and selects the default voice codec for vSRVCC.
15. Same as in TS 23.216 [2].
16. Same as in TS 23.216 [2].
17. Same as in TS 23.216 [2].
 - 17c1. Right after the UE establishes a circuit bearer to the MSC Server 3G-324M codec negotiation for the video is executed (refer to TR 26.911 [14] for H.245 signalling optimizations).
 - 17c2. After the 3G-324M codec negotiation, the MSC server prepares the video SDP and updates the Session with a request to the SCC AS, adding video to the voice.
 - 17c3. The SCC AS updates the remote end with the SDP of the CS access leg according to TS 23.237 [14]. The downlink flow of VoIP and video packets is switched towards the CS access leg at this point.

17d1). The source MME deactivates the voice and video bearer(s) towards S-GW/P-GW and sets the PS-to-CS handover indicator to Delete Bearer Command message. If dynamic PCC is deployed, the PGW may interact with PCRF as defined in TS 23.203 [13].

18. The change from step in TS 23.216 [2] is that the PS-to-CS indicator is included for video bearers.

6.1.5.3 Evaluation of the alternative

The impacts on the various entities are the following:

In the UE:

- signals its vSRVCC capability to the network
- needs to select a preconfigured default voice codec for vSRVCC usage only initiates the multimedia codec negotiation on the CS domain after the vSRVCC handover is completed.
- it is strongly recommended that the UE uses MONA [9] in order to accelerate the multimedia call establishment and minimise the interruption.
- prevents multi session scenarios other than one active video call (consisting of voice and video media) by rejecting origination and termination session requests.

In MME:

- signals the vSRVCC indication to the MSC-S and performs bearer splitting for QCI=1 and QCI=2 bearers

In MSC:

- transfers initially "voice-only" when the Sv request comes from the MSC-S (sends SIP INVITE with voice only SDP).
- initiates the handover towards the target system for BS30 when it receives the Sv request from the MME.
- needs to select a default voice codec for vSRVCC usage only.
- the MGW needs to support the vSRVCC feature.

In SCC AS:

- is required to identify the vSRVCC handover and correlate the transferred "voice-only" session with the session that is initiated later on by the UE on the CS domain (voice and video).
- update the remote party when the video component is added by the UE in the CS domain.
- selects the latest active voice and video session in case the UE has more than one voice and one video media.
- detects based on the presence of the SDP for video set to inactive from the MSC-Server in the Session Transfer Request that the UE is involved in a vSRVCC handover and releases the video session in case the vSRVCC handover was not successful, i.e. when the SDP for video set to inactive is missing.

6.1.6 Alternative 6: IMS based 3G-324M pre-negotiation scheme for vSRVCC domain transfer

6.1.6.1 Functional description

The scheme uses IMS signalling to perform 3G-324M pre-negotiation during/after IMS video call establishment with MSC Server/MGW. Therefore, all necessary 3G-324M related parameters have been negotiated in the IMS domain prior to the vSRVCC handover to CS domain.

When the vSRVCC handover occurs, the 3G-324M call can be established based on the pre-negotiation result.

The method described here in this clause is identical to that described in clause 6.1.2, except for the video codec pre negotiation steps shown in part-a of the sequence. In the method described below, the pre-negotiation steps of part-a are

carried out in IMS. This scheme does not require combined TA and LA update capability: the SCC AS is aware of the MSC Server enhanced for vSRVCC, so the SCC AS can connect to the MSC Server to do the pre-negotiation and there is no need to perform the combined TA and LA update.

6.1.6.2 Information flows

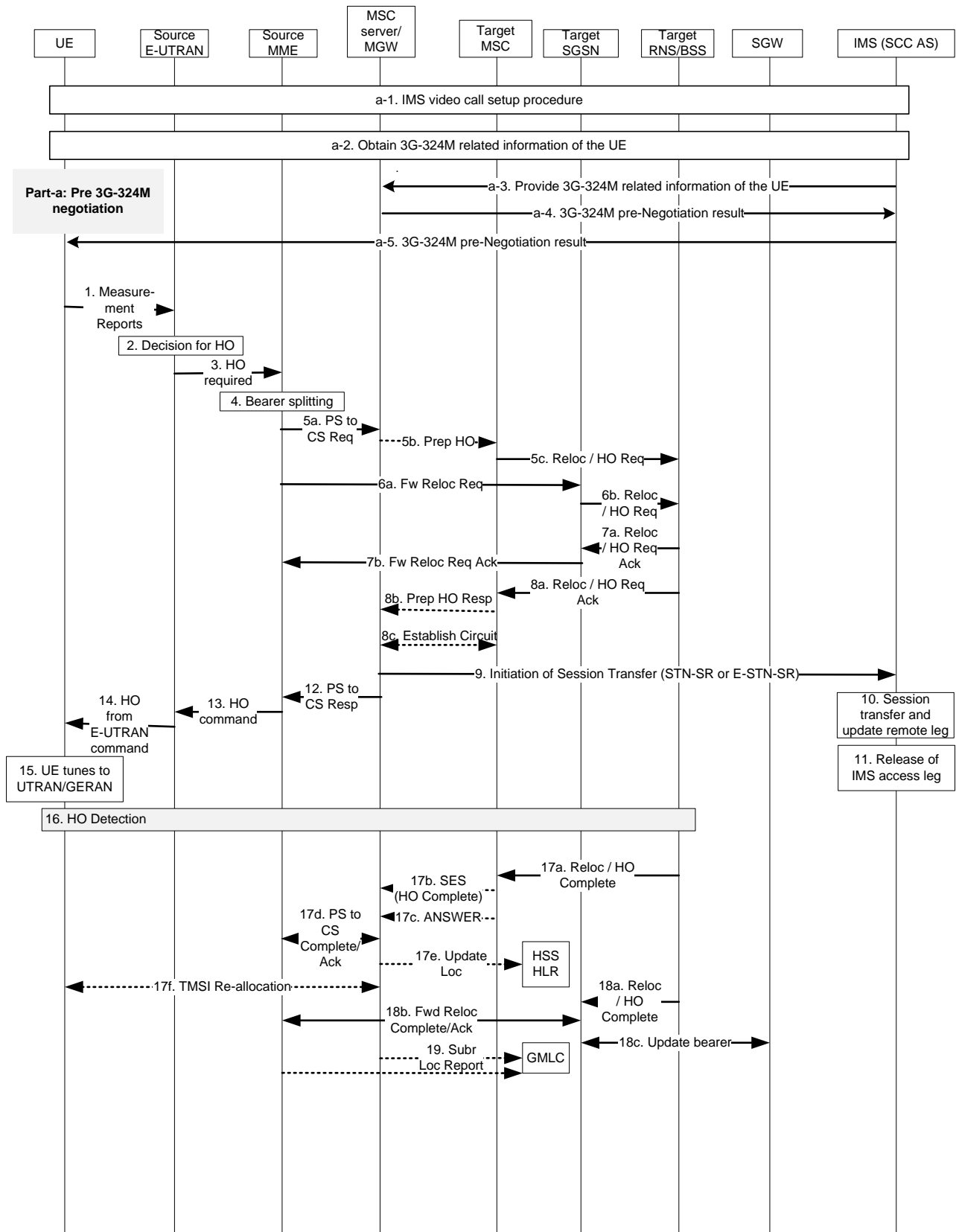


Figure 6.1.6.2-1: 3G-324M pre-negotiation scheme for vSRVCC domain transfer in IMS domain

Part-a: 3G-324M pre-negotiation in IMS domain:

- a-1: UE initiates the IMS Video Call establishment procedure by sending a SIP INVITE message to the SCC AS via the IM CN subsystem intermediate entities as specified in TS 23.237 [3].
- a-2: The SCC AS obtains from the UE all the necessary information for establishing the 3G-324M call, which includes:
- (1) H.223 Multiplexer level detection,
 - (2) Terminal Capability Exchange,
 - (3) Master Slave determination,
 - (4) Open Logical Channels, and
 - (5) Multiplexer Table Entries Exchange.

Three alternatives can be used for obtaining the information of the UE for establishing the 3G-324M call:

- the UE sends the 3G-324M pre-negotiation message to the SCC AS via the IM CN subsystem intermediate entities after the IMS Video Call has been established; or
- the SCC AS queries the UE for all the necessary information for establishing the 3G-324M call based on an indication in the SIP INVITE that indicates the UE has the capability of 3G-324M pre-negotiation for vSRVCC domain transfer, after the IMS Video Call has been established, and the UE sends the information back to the SCC AS; or
- the SCC AS has prior knowledge of 3G-324M information of the UE from the SIP INVITE request for IMS Video Call establishment or through registration procedures.

NOTE: Based on the local configuration, the SCC AS can retrieve the remote end's codec capabilities and provide to the MSC Server/MGW for the 3G-324M pre-negotiation (e.g. by sending a SIP OPTIONS to the remote end). Optionally, the MSC Server/MGW can perform transcoding if necessary when interworking 3G-324M towards the remote end, and thus the IMS based capability exchange procedures towards the remote end would be unnecessary.

- a-3: The SCC AS provides the MSC Server enhanced for vSRVCC with the 3G-324M related information of the UE received in step a-2, together with the codec capabilities of the remote end if available.

Editor's Note: It is FFS how the SCC AS selects the MSC Server for the 3G-324M pre-negotiation.

- a-4: The MSC Server/MGW gets the 3G-324M related parameters for the 3G-324M call by performing pre-negotiation based on the information received from the SCC AS and sends the pre-negotiation result to the SCC AS. When choosing the codec for 3G-324M, the MSC Server also takes account of the codec capabilities of the remote end if available. The MSC Server/MGW performs transcoding, if necessary.
- a-5: The 3G-324M pre-negotiation result is sent to the original UE. This ends the 3G-324M pre-negotiation procedure. The UE and the network are now prepared for the 3G-324M call handover when the UE moves to the CS domain.

Steps 1-15 are identical with steps 1-15 in Figure 6.1.4.2-1 (Information flow of Alternative 4).

Editor's Note: It is FFS how to ensure that the MME selects the same MSC Server as the one involved in the 3G-324M pre-negotiation.

16. The difference from TS 23.216 [2] is that after the UE sends a Handover Complete message via the target MSC to the MSC Server, the UE and the MSC Server/MGW activate the 3G-324M call based on the pre-negotiation result.

Steps 17-19 are identical with steps 1-15 in Figure 6.1.4.2-1 (Information flow of Alternative 4).

6.1.6.3 Evaluation of the alternative

This alternative requires the UE, SCC AS and MSC Server to support the 3G-324M pre-negotiation procedure, and the UE and the MSC Server to activate the 3G-324M call based on the pre-negotiation result after the UE switches to CS

domain, as described in clause 6.1.6.2. The IMS SIP signalling needed to be extended to support the 3G-324M pre-negotiation.

The advantages of this alternative are:

- 3G-324M negotiation is done before vSRVCC handover, so that the 3G-324M call can be established soon after the UE moves to CS domain and the interruption can be further minimised compared to the case of 3G-324M negotiation being done during the vSRVCC handover;
- 3G-324M negotiation is done via the IMS domain, minimising the impacts on the EPS.

This alternative is not recommended to be specified in Release 10.

6.2 Key issue 2: Bearer identification for vSRVCC handover

The IMS session with bi-directional speech and synchronised video media over E-UTRAN/HSPA as defined in TS 22.173 [4], and TS 26.114 [7] and for which separate bearers will be established for the voice and video components respectively as per the current assumption in clause 4.1. These bearers will have different QCI values: QCI =1 and for example QCI=2 for the bearer carrying the voice and the video media respectively. At any instance, there can be multiple bearers available with QCI =1 and QCI=2 because there can be multiple video/voice call applications running simultaneously. The E-UTRAN/UTRAN(HSPA) will not be able to co-relate which video and voice bearer belong to the same application and it can provide a wrong trigger for SRVCC e.g. sending Handover Required message with indication for vSRVCC whereas it should have been for voice. Similar problem occurs at the MME/SGSN which has to perform bearer splitting by separating the voice and video bearer belonging to a single video call application from others. Hence it needs to be resolved how these bearers should be identified and correlated together by the E-UTRAN/UTRAN(HSPA) and MME/SGSN to trigger the correct SRVCC operation.

6.2.1 Alternative 1: Using dedicated QCI for the video bearer associated with a video call application

6.2.1.1 Functional description

The video bearer which is associated with a video call application is assigned a dedicated QCI value. The eNodeB checks if both QCI=1 i.e. voice bearer and QCI=2 i.e. video bearer are present. The presence of both the voice and video bearer indicates that a video call application is ongoing. Hence, the eNodeB prepares the transparent containers appropriately and triggers a vSRVCC handover. The MME checks that voice and video bearers related to video call application are present (based on the QCI values) and there is vSRVCC handover indication from the eNodeB. The MME recognizes that a vSRVCC operation is desirable and splits the video call application related voice and video bearers from other non-voice PS bearers. The MME then sends a PS-to-CS request for vSRVCC towards the MSC server.

6.2.1.2 Evaluation of the alternative

At any instance of time there may be multiple active video call applications along with voice call application. Hence E-UTRAN/UTRAN(HSPA) will observe multiple bearers with QCIs corresponding to voice and video respectively and with no idea of which bearer belongs to which application. Hence the E-UTRAN/UTRAN(HSPA) cannot correctly identify whether to trigger SRVCC for video or voice.

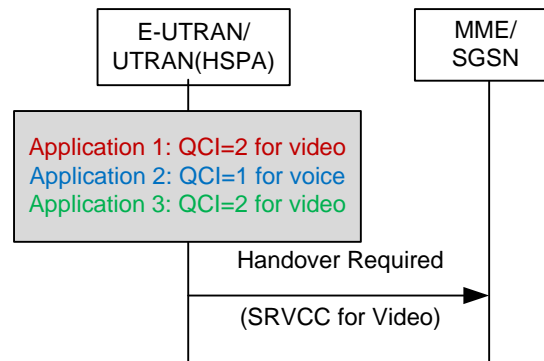


Figure 6.2.1.2-1: Incorrect trigger of SRVCC HO- scenario 1

As per the figure 6.2.1.2-1, for Applications 1 and 3, the video bearer should be transferred to the PS domain, whereas for application 2, the voice needs to be transferred to the CS domain but since E-UTRAN/UTRAN(HSPA) is not aware that these QCI=1 and QCI =2 bearers belong to different applications, it might incorrectly trigger SRVCC for video considering QCI =1 from Application 1 and QCI =2 from Application 2.

Another example of incorrect SRVCC triggering by the E-UTRAN/UTRAN(HSPA) can be as follows:

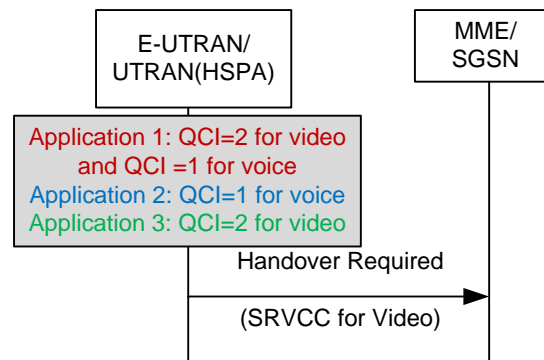


Figure 6.2.1.2-2: Incorrect SRVCC HO trigger – scenario 2

In figure 6.2.1.2-2, instead of E-UTRAN/UTRAN(HSPA) triggering vSRVCC operation with respect to application 1, it might assume that the Application 1's bearer are not co-related and will trigger SRVCC Handover for voice corresponding to application 2.

For SRVCC HO the MME/SGSN needs to perform bearer splitting i.e. separating the voice bearer from non-voice bearers. For SRVCC HO for voice application, the MME/SGSN performs bearer splitting based on the 'SRVCC HO indicator' in Handover Required message and the presence of QCI =1 bearer. But in case of vSRVCC when the MME/SGSN receives 'vSRVCC required' from the E-UTRAN/UTRAN(HSPA) it does not know clearly which QCI = 1 and QCI=2 bearer belong to the same video call application. For example in figure Y, the MME/SGSN might combine the QCI = 2 bearer from the application 1 with QCI =1 bearer from application 3 and transfer them to the CS domain. Hence this alternative for bearer identification can only work if the vSRVCC UE is allowed only one pair of QCI=1/QCI=2 bearers in place at any point in time. It is also not possible for the same UE to have in parallel voice calls (with associated QCI=1) in held status.

It is proposed that the above limitation is accepted for rel.10 and QCI=2 is selected as the allocated QCI for the video component of the Video Call and this limitation is captured in relevant specifications.

6.2.2 Alternative 2: Using bearer correlation method

6.2.2.1 Functional description

In accordance to this alternative describing co-relation of bearers, the E-UTRAN/UTRAN(HSPA) and the MME/SGSN receive a "correlation-id" from the PCRF and in turn the PDN-GW as part of dedicated EPS bearer activation process as defined in Fig. 6.2.2.2-1.

Based on "vSRVCC operation possible", existence of EPS bearers with QCI values for voice and video (QCI=1 and QCI=2 respectively) and the "correlation id", the E-UTRAN/UTRAN(HSPA) triggers vSRVCC operation. The MME/SGSN in addition splits the bearers based on vSRVCC HO indication, QCI values and the "correlation id" as described in Fig. 6.2.2.2-1.

6.2.2.2 Information flows

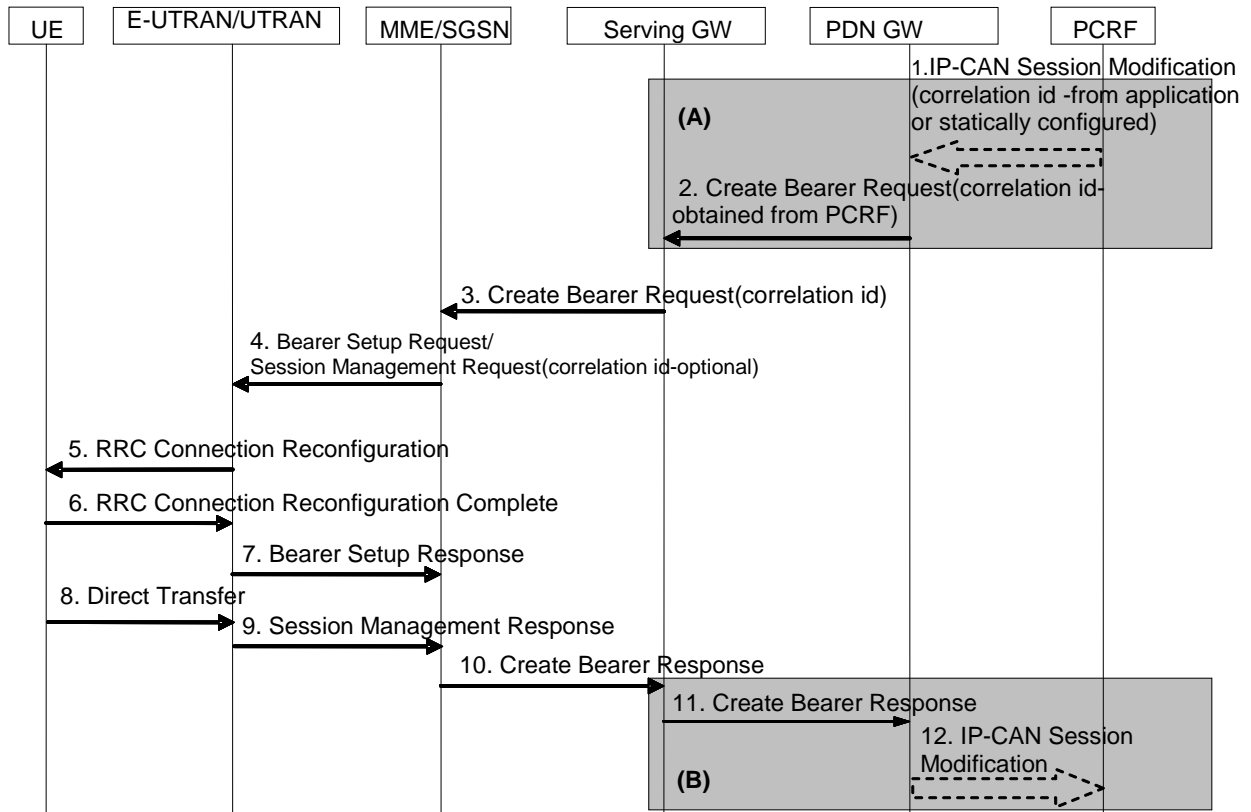


Figure 6.2.2.2- 1: Dedicated EPS bearer establishment using "correlation-id"

The changes with respect to the dedicated bearer activation procedure in TS 23.401 [11] are as follows:

1. The PCRF sends the correlation id to PDN GW/GGSN in case of dynamic PCC. PCRF can send the correlation id obtained from application or the statically assigned correlation id.
2. The PDN GW sends the correlation id to SGW along with the EPS Bearer Identity and the Linked Bearer Identity. The PDN GW stores the correlation id in the bearer context.
3. The SGW sends the correlation id to MME/SGSN along with the EPS Bearer Identity and Linked Bearer Identity. The SGW stores the correlation id in the bearer context.
4. The MME/SGSN signals the correlation id received in step 3 in the Bearer Setup Request message to the E-UTRAN/UTRAN(HSPA) only if the UE is vSRVCC capable. The MME/SGSN also stores the correlation id in the bearer context. If UE is not vSRVCC capable then the MME/SGSN doesn't send the 'vSRVCC operation possible' indication to the E-UTRAN/UTRAN(HSPA) so that the E-UTRAN/UTRAN(HSPA) doesn't trigger vSRVCC operation.
5. The E-UTRAN/UTRAN(HSPA) stores the correlation id received in step 4.
- 6~12. These steps are the same as in TS 23.401 [11].

The correlation id obtained by the MME/SGSN during the dedicated bearer activation procedure is passed as a part of bearer context during the mobility management procedures.

In the vSRVCC Handover procedure the E-UTRAN/UTRAN(HSPA) will take a decision for triggering vSRVCC handover procedure based on the 'vSRVCC operation possible' indication from the MME/SGSN, QCI values 1 and 2 for voice and video respectively and the correlation identifier. Similarly the MME/SGSN splits the bearers corresponding

to the video call application from rest of the bearers based on the 'vSRVCC HO' indication from the E-UTRAN/UTRAN(HSPA), QCI of the bearers 1 and 2 for voice and video respectively and the correlation identifier which was saved during the dedicated bearer activation procedure. Figure 6.2.2.2-2 explains the vSRVCC procedure:

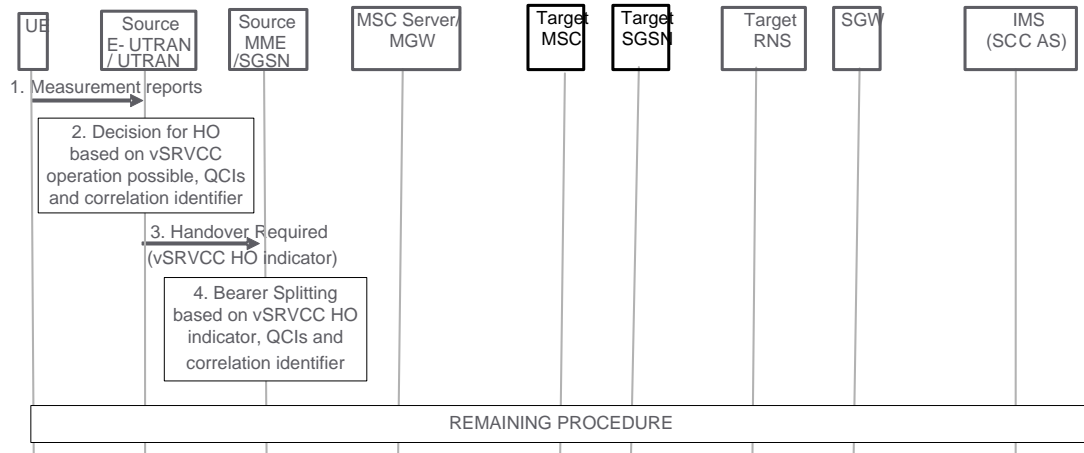


Figure 6.2.2.2- 2: Bearer splitting vSRVCC from E-UTRAN/UTRAN(HSPA) to UTRAN

The changes with respect to the current SRVCC procedure as defined in TS 23.216 [2] are as follows:

2. The E-UTRAN/UTRAN(HSPA) decides to trigger vSRVCC handover based on the vSRVCC operation possible indication from the MME/SGSN, QCI-1 and QCI-2 for voice and video respectively and the specific correlation identifier.
3. The E-UTRAN/UTRAN(HSPA) sends Handover Required message containing the 'vSRVCC HO' indication towards the MME/SGSN.
4. The MME/SGSN splits the bearers corresponding to the video call application from other bearers based on the vSRVCC HO indication from the E-UTRAN/UTRAN(HSPA), QCI- 1 and QCI-2 for voice and video respectively and the correlation identifier. These bearers are transferred to the CS domain and PS HO is triggered for the remaining bearers.

Then the remaining procedure is the same as in TS 23.216 [2] with needed updated for handling video call.

6.2.2.3 Evaluation of the alternative

This solution presents significant impacts on IMS, PCC, EPC and RAN, and may be required only for more than one set of QCI=1/QCI=2 bearers from the same UE.

6.2.3 Alternative 3: Not requiring bearer identification for vSRVCC

6.2.3.1 Functional description

It is not possible for the MME to reliably differentiate between the cases that the currently ongoing session is an IMS session only with bidirectional speech media or an IMS session with bi-directional speech and synchronised video media. Hence the MME can only indicate SRVCC for bi-directional speech media to the MSC Server.

6.2.3.2 Evaluation of the alternative

In rel.9 the MME cannot reliably identify the cases that the currently ongoing session is an IMS session only with bidirectional speech media or an IMS session with bi-directional speech and synchronised video media. Therefore if SRVCC handover is triggered towards UTRAN or GERAN with DTM the MME is unable to perform bearer splitting in the case of bi-directional speech and synchronised video media, so it will transfer the QCI-1 bearer as CS transparent container whereas the QCI corresponding to the video media as a PS transparent container.

This will lead to the Video Call application losing the synchronisation between speech and video media, since the former will be transferred to the CS domain where the latter to the PS domain. In addition if the target access is GERAN with DTM the video performance will be poor.

Overall the solution of "doing nothing" (as is the case in rel.9) is not even going to allow the appropriate continuity of the voice communication in the CS domain unless the UE drops the PS bearers corresponding to the video component when it moves to the CS access.

6.3 Key issue 3: Requirement for vSRVCC indication towards the MME and the MSC server

6.3.1 Alternative 1: vSRVCC indication towards the MME and the MSC server

6.3.1.1 Description

For SRVCC HO for voice calls the 'Handover Required' message from eNodeB to MME contains an indication. Similarly the PS-to-CS request message from the MME to MSC server indicates that SRVCC HO is to be performed. For vSRVCC HO also, a separate indication is required because the core network nodes i.e. the MSC and the MME needs to perform different actions based on whether it is voice or vSRVCC.

6.3.1.2 Functional description

For vSRVCC operation the MME splits the voice and video bearer(s) corresponding to the video call application from the other non-video call application bearers based on indication for vSRVCC in Handover Required message. The MSC server performs the vSRVCC related action i.e. initiate the voice transfer and later perform video transfer based on the vSRVCC indication in the PS-to-CS request message.

6.3.1.3 Evaluation of the alternative

Whether we need indication for vSRVCC handover will depend on the solution for key issue 1.

If Alternative 4 is chosen where the session transfer for voice and video is happening in one step, we need to identify to the MSC that the session transfer is for vSRVCC in order to include voice and video SDP media lines in the INVITE request it sends to the SCC AS.

If Alternative 3 is chosen then we can rely on the MME to perform bearer splitting (refrain from sending QCI-1 and QCI-2 PS transparent containers) when the UE has simultaneously QCI-1 and QCI-2 bearers active and we assume that we allow only one pair of QCI-1/QCI-2 bearers to exist. The MME can then use Sv procedures to trigger SRVCC as defined in rel.9 TS 23.216 [2].

If Alternative 5 is chosen then we can also rely on the MME to perform bearer splitting (refrain from sending QCI-1 and QCI-2 PS transparent containers). But the MME still needs to signal to MSC-S that this is vSRVCC or SRVCC handover in order for the MSC to decide whether to initiate TS11 or BS30 bearers towards the target system.

In conclusion if Alternative 4 or 5 is selected for Key issue 1 then we need a vSRVCC indication from the MME to MSC Server.

6.3.2 Alternative 2: No need for vSRVCC indication towards the MME and the MSC server

6.3.2.1 Functional description

Since it is not possible for the MME to reliably differentiate between the cases that the currently ongoing session is an IMS session only with bidirectional speech media or an IMS session with bi-directional speech and synchronised video media, the MME can only indicate SRVCC for bi-directional speech media to the MSC Server.

Therefore there is no need for a special vSRVCC indication towards the MME and the MSC Server.

6.3.2.2 Evaluation of the alternative

As indicated in section 6.3.1.3 this alternative can work if Alternative 3 is selected for key issue 1 and we allow only one pair of QCI-1/QCI-2 bearers to exist.

7 Assessment of the solutions

Editor's Note: This clause will include solutions assessment and will provide the chosen solution for video-call SRVCC from 3GPP E-UTRAN/HSPA to 3GPP UTRAN (CS) study.

8 Conclusion

Following are the conclusions for this TR:

1. For key issue #1 - Video codec negotiation: Alternative 5 in clause 6.1.5 (Consolidated approach for transferring video-call with vSRVCC) shall be selected for normative specification. This alternative transfers the voice component of the multimedia call first followed by the transfer of the video component after the 3G-324M video codec negotiation has been completed. With this approach the voice component is transferred with minimum delay prior to the transfer of the video component. It is assumed the UE has only one voice and one video media active, associated with QCI=1 and QCI=2 bearers in E-UTRAN for bearer identification reasons.
2. For key issue #2 - Bearer identification for vSRVCC handover: Alternative 1 in clause 6.2.1 shall be selected for normative specification, with the assumption that only one multimedia (voice+video) call is active.
3. For key issue #3 - Requirement for vSRVCC indication towards the MME and the MSC server: Alternative 1 in clause 6.3.1 shall be selected for normative specification.

Annex A: Change history

Change history							
Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment	Old	New
2010-09	SP-49	SP-100565	-	-	MCC editorial update to version 1.0.0 for presentation to TSG SA#49 for Information and Approval	0.3.1	1.0.0
2010-09	SP-49	-	-	-	MCC Update to version 10.0.0 after TSG SA Approval	1.0.0	10.0.0