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ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
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1 Scope

The present document defines optional Optimal Media Routing (OMR) procedures that can be applied by entities in the IP Multimedia Subsystem (IMS) that control media resources and are capable of manipulating the Session Description Protocol (SDP) as defined by IETF RFC 4566 [6].

The OMR procedures in the present specification relate to the handling of OMR-specific SDP attributes that are documented in TS 24.229 [4]. The OMR procedures use SDP offer/answer related procedures in IETF RFC 3264 [5] and in TS 24.229 [4] in a backward-compatible manner.

The 3GPP network architecture, including the configuration and network entities of the IMS, is defined in TS 23.002 [2]. The stage 2 of the IMS is defined TS 23.228 [3]. Annex Q of TS 23.228 [3] documents the architecture and call flows for OMR.

The OMR procedures in this document are applicable to the following IMS entities that perform as an IMS-ALG or UA according to TS 24.229 [4] and that control media resources:

- an IBCF acting as an IMS-ALG;
- a P-CSCF acting as IMS-ALG;
- an AS acting as B2BUA and adapting IMS-ALG procedures to control an MRF;
- an AS acting as B2BUA and adapting UA procedures to control an MRF; and
- an MGCF acting as UA.

NOTE 1: An AS acting as B2BUA to perform application functions such as conferencing or announcements will normally perform separate originating and terminating UA procedures, treating the media resource as an endpoint. An AS acting as B2BUA offering transcoding options will typically follow IMS-ALG procedures.

NOTE 2: The controlled media resource can be a TrGW, IMS-AGW, MRF, or a media function of the entity performing OMR.

The OMR procedures are not applicable for an UE.

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 23.002: "Network architecture".
- [3] 3GPP TS 23.228: "IP multimedia subsystem; Stage 2".
- [4] 3GPP TS 24.229: "IP multimedia call control protocol based on Session Initiation Protocol (SIP) and Session Description Protocol (SDP); Stage 3"
- [5] IETF RFC 3264: "An Offer/Answer Model with Session Description Protocol (SDP)".

- [6] IETF RFC 4566: "SDP: Session Description Protocol".
- [7] IETF RFC 2617: "HTTP Authentication: Basic and Digest Access Authentication".
- [8] IETF RFC 3605: "Real Time Control Protocol (RTCP) attribute in Session Description Protocol (SDP)".
- [9] 3GPP TS 29.238: "Interconnection Border Control Functions (IBCF) – Transition Gateway (TrGW) interface, Ix Interface; Stage 3".
- [10] 3GPP TS 29.334: "IMS Application Level Gateway (IMS-ALG) – IMS Access Gateway (IMS-AGW); Iq Interface; Stage 3".
- [11] IETF RFC 4240: "Basic Network Media Services with SIP".
- [12] IETF RFC 3260: "Media Control Channel Framework".
- [13] IETF RFC 6505: "A Mixer Control Package for the media Control Channel Framework".
- [14] 3GPP TS 29.332: "Media Gateway Control Function (MGCF) – IM Media Gateway Mn Interface".
- [15] 3GPP TS 23.334: "IP Multimedia Subsystem (IMS) Application Level Gateway (IMS-ALG) – IMS Access Gateway (IMS-AGW) interface: Procedures descriptions".
- [16] 3GPP TS 29.162: "Interworking between the IM CN subsystem and IP networks".
- [17] 3GPP TS 29.163: "Interworking between the IP Multimedia (IM) Core Network (CN) subsystem and Circuit Switched (CS) networks".
- [18] IETF RFC 5552: "SIP Interface to VoiceXML Media Services".
- [19] IETF RFC 4117: "Transcoding Services Invocation in the Session Initiation Protocol (SIP) Using Third Party Call Control (3pcc)".
- [20] IETF RFC 5939: "Session Description Protocol (SDP) Capability Negotiation".
- [21] IETF RFC 2234: "Augmented BNF for Syntax Specification: ABNF".

3 Definitions, symbols 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].

Codec: A media configuration for a media line in SDP that is specified by one or more formats in the format list of the m-line, by one or more preferred configurations (pcfg) associated with the media line, or by a combination of both.

Codec Change: Any modification to the media configurations for the media line in the format list or the list of preferred configurations.

Codec List: Either the format list of the m-line, or a combination of all the preferred configurations and the format list for the media line.

Connected IP realm: Compared to a reference IP realm, a connected IP realm is one identified with a different unique name where all IP endpoints in the two IP realms are mutually reachable (accessible) by means of IP routing without address translation. Interconnection between the IP realms may be via direct link, via IP tunnel through other networks, via IP routing through intermediate networks, or via any other method of internetworking as long as their IP endpoints are mutually reachable. The property of connectedness is symmetric but not necessarily transitive. In particular, two IP realms connected to a reference IP realm are not necessarily themselves connected.

Incoming termination: The termination at an MR in the direction from where an incoming SDP offer is being received at the IMS-ALG that is controlling the MR.

IP realm: A collection of IP endpoints identified by a unique name, where all IP endpoints are mutually reachable by means of IP routing without address translation.

Media resource: An IMS Network entity that provides resources to process media streams and is controlled by an entity applying OMR procedures. A TrGW, BGW, MRF, or a function internal to the entity performing OMR can be a media resource.

Outgoing termination: The termination at an MR in the direction towards where an outgoing SDP offer is being sent at the IMS-ALG that is controlling the MR.

Second SDP offer/answer: An SDP offer/answer transaction initiated by any of the involved IMS-ALGs during session establishment towards the initial SDP answerer upon reception of the initial SDP answer and MR resources are required (e.g. when an intermediate IMS-ALG performs proactive transcoding without resource reservation) or not required (e.g. when MR resources are reserved for the purpose of transcoding and transcoding is not required). The second SDP offer is not an end-to-end negotiation and is handled as the initial SDP offer.

Subsequent SDP offer/answer: An end-to-end SDP offer/answer transaction initiated after a completed initial or second SDP offer/answer transaction. The subsequent SDP offer contains no OMR specific attributes.

3.2 Symbols

For the purposes of the present document, the following symbols apply:

Ix	Reference Point between IBCF and TrGW
Iq	Reference Point between the P-CSCF and the IMS Access Gateway

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1], in TS 23.228 [3] 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] or in TS 23.228 [3].

ALG	Application Level Gateway
B2BUA	Back-to-Back User Agent
ICE	Interactive Connectivity Establishment
MR	Media Resource
OMR	Optimal Media Routing
UA	User Agent

4 General

The procedures in clause 5, clause 6, clause 7 and clause 8 shall apply separately to each media line with non-zero port value in each SDP message, and shall apply separately to each SDP offer/answer transaction. In the presence of forking of a SIP INVITE request that includes an SDP offer, the OMR procedures for handling of the SDP offer apply once for all forked dialogs, and the OMR procedures for handling of the corresponding SDP answer apply independently to each dialog. Entities supporting OMR use the OMR-specific SDP extension attributes defined in TS 24.229 [4].

OMR builds on the ALG NAT traversal model and is not consistent with ICE.

OMR does not modify the SIP signalling route path and usually does not modify the flow of SIP messages except in some cases when transcoding options are offered.

5 Common SDP Procedures

5.1 General

The IMS-ALG or UA using the OMR procedures in clause 6 or clause 7, respectively, shall additionally use the procedures in this clause when manipulating SDP.

5.2 Encapsulation of previous SDP information

5.2.1 Media level information

If an IMS-ALG forwards an SDP offer and for a given media line:

- adds or removes offered format(s);
- modifies the transport protocol;
- adds or removes other corresponding media level SDP attribute(s) than "visited-realm", "secondary-realm", "omr-codecs", "omr-m-att", "omr-s-att", "omr-m-bw", "omr-s-bw", "omr-s-cksum" or "omr-m-cksum" attributes;
- modifies the value of other corresponding media level SDP attribute(s) than "visited-realm", "secondary-realm", "omr-codecs", "omr-m-att", "omr-s-att", "omr-m-bw", "omr-s-bw", "omr-s-cksum" or "omr-m-cksum" attributes;
- adds or removes corresponding media level SDP bandwidth line(s); or
- modifies the value of corresponding media level SDP bandwidth line(s),

then the IMS-ALG shall apply the procedures below to encapsulate all media level information of the corresponding media line.

The IMS ALG shall encapsulate the received transport protocol and format list of the corresponding media line within an "omr-codecs" attribute and add this attribute as a media level attribute for the corresponding media line.

The IMS ALG shall encapsulate each received attribute of the corresponding media line within an "omr-m-att" attribute and add this attribute as a media level attribute for the corresponding media line.

The IMS ALG shall encapsulate each received bandwidth line of the corresponding media line within an "omr-m-bw" attribute and add this attribute as media level attribute for the corresponding media line.

If the IMS-ALG received any visited-realm instances in the SDP offer, the IMS-ALG shall supply the instance number one above the highest instance number in the received SDP offer as instance number within the "omr-codecs", the "omr-m-att" and "omr-m-bw" attribute(s). Otherwise the IMS-ALG shall supply the instance number 2.

5.2.2 Session level information

If an IMS-ALG forwards an SDP offer and:

- encapsulated any media level information according to the conditions in clause 5.2.1;
- adds or removes any session level SDP attribute(s);
- modifies the value of any session level SDP attribute(s);
- adds or removes session level SDP bandwidth line(s); or
- modifies the value of session level SDP bandwidth line(s).

then the IMS-ALG shall apply the procedures below to encapsulate all session level information.

The IMS ALG shall encapsulate each received session-level attribute within an "omr-s-att" attribute and add this attribute as a media level attribute for every media line.

The IMS ALG shall encapsulate each received session-level bandwidth line within an "omr-s-bw" attribute and add this attribute as a media level attribute for every media line.

If the IMS-ALG received any visited-realm instances in the SDP offer, the IMS-ALG shall supply the instance number one above the highest instance number in the received SDP offer as instance number within the "omr-s-att" and "omr-s-bw" attribute(s). Otherwise the IMS-ALG shall supply the instance number 2.

NOTE 1: The instance number 1 is reserved for the incoming SDP offer when it contains no visited-realm instance.

NOTE 2: The remaining SDP session level attributes (e.g., the "o" line) are not modified by the OMR procedures.

5.3 Determination of codec related SDP information associated to a previous realm instance

When deciding to bypass some previous MR, an IMS-ALG needs to determine the SDP information which is applicable together with the visited-realm instance or secondary-realm instance that the IMS selects for the bypass (see clause 6.1). The IMS-ALG will include that SDP information in a forwarded SDP offer or perform additional modifications on top of it, e.g., to offer transcoding at its own MR.

To determine the codec related SDP information associated to that previous realm instance for the media line, the IMS-ALG shall use the procedures below.

- 1) If any "omr-codecs", "omr-m-att", or "omr-m-bw" attributes with a higher instance number than the previous visited-realm instance or secondary-realm instance exist for a media line, the IMS-ALG shall consider the information within the set of attributes with the lowest instance number among those as follows:
 - the IMS-ALG shall replace the transport format and media formats in the media line with the transport format and media formats from the "omr-codecs" attribute with this instance number;
 - the IMS-ALG shall retain all the "visited-realm", "secondary-realm", "omr-s-cksum", "omr-m-cksum", "omr-codecs", "omr-m-att", "omr-s-att", "omr-m-bw" and "omr-s-bw" attributes for the media line and replace all other SDP a-line(s) for the media line with the attributes extracted from the "omr-m-att" attribute(s) with this instance number; and

NOTE 1: This procedure only describes update to codec related SDP information. Clauses 6 and 7 describe the corresponding modifications to the OMR related attributes.

- the IMS-ALG shall replace the SDP b-line(s) for the media line with the b-line(s) extracted from the "omr-m-bw" attributes with this instance number.

Otherwise, the IMS-ALG shall use the SDP a-lines, b-lines, transport format and list of media formats of the corresponding media line.

- 2) If any "omr-s-att" or "omr-s-bw" attributes with a higher instance number than the previous visited-realm instance or secondary-realm instance exist, the IMS-ALG shall consider the information within the set of attributes with the lowest instance number among those as follows:
 - If the same attributes are provided for each media line, the IMS ALG shall replace all session-level SDP a-lines and b-lines with the encapsulated attributes and bandwidth within the "omr-s-att" attributes and "omr-s-bw" attributes of one media line as session level attributes and bandwidth, and may apply attribute or bandwidth modifier specific logic to verify and possibly adjust the session-level information from "omr-s-att" and "omr-s-bw" attributes and media level information determined as described above;

NOTE 2: Verification helps in the possible event of splitting media lines by intermediate entities.

- otherwise the IMS-ALG shall apply attribute or bandwidth modifier specific logic to derive appropriate session-level information from "omr-s-att" and "omr-s-bw" attributes and media level information determined as described above, or delete all those encapsulated attributes and all session-level SDP a-lines and b-lines.

NOTE 3: In the possible event of merging of media lines by intermediate entities, there may be inconsistencies in the encapsulated session level a-lines and/or b-lines.

- 3) Otherwise, the IMS-ALG shall use the session-level SDP a-lines and b-lines.

For an SDP offer with several media lines, an IMS-ALG applies the OMR algorithm separately for each media line and can select different optimised paths. In such a case, the session-level attributes and bandwidth information determined by the above algorithm can differ for different optimised paths, depending on the selected visited-realm instance or secondary-realm instance for each media line. The IMS-ALG may then apply attribute or bandwidth modifier specific logic to determine the appropriate session-level information or discard conflicting information. An IMS-ALG may also apply a policy not to choose different optimised paths for different media to avoid such conflicts.

NOTE 4: Upon receiving an SDP offer and validating the OMR attributes in the SDP offer, but before making any codec changes to the SDP offer, the IMS-ALG supporting OMR can delete any unsupported attributes from the SDP offer, e.g., attributes associated with capability negotiation. The IMS-ALG supporting OMR can also delete any ignored attributes, e.g., due to lack of support of a required extension to capability negotiation, as determined by the *creq* attribute defined in IETF RFC 5939 [20].

5.4 Modifying codec related information

5.4.1 Modifying the format list

When forwarding an SDP offer, the IMS-ALG should not make changes to the attributes associated with a format remaining in the format list of the m-line that require the allocation of an MR to translate the media payload between the format described by the received SDP offer and the format described by the forwarded SDP offer.

NOTE 1: Examples include changing between AMR octet-aligned and bandwidth-efficient modes, and incompatible AMR mode-sets.

To add a codec to the format list of the m-line in the SDP offer to be forwarded, the IMS-ALG shall either:

- add a media format to the format list on the media line that is different from any format in the "omr-codecs" attributes for the media line, along with any necessary media attributes, or
- re-insert a format from an "omr-codecs" attribute for the media line that is not in the current format list, along with the corresponding attributes for the format with the same instance number in "omr-m-att" attributes.

NOTE 2: This procedure avoids the potential need to retain a media resource to perform format mapping when performing proactive transcoding, if the bypass decision is based on the SDP answer.

5.4.2 Modifying preferred configurations

When forwarding an SDP offer, the IMS-ALG supporting SDP capability negotiation shall only make a change to a preferred configuration in the incoming SDP offer without changing the configuration number if the change is backward compatible. A backward compatible change is one that, if it is selected as the actual configuration, does not require the allocation of an MR to translate the media payload between the format described by the received SDP offer and the format described by the forwarded SDP offer, and does not require modification of the actual configuration number when forwarding the SDP answer. This applies to the preferred configuration (*pcfg*) itself and any capabilities referenced in the *pcfg*.

NOTE 1: It is recommended that an IMS-ALG not make any codec list changes to an SDP offer that includes any mandatory session capabilities unless it also deletes all attributes associated with capability negotiation as if capability negotiation were not supported.

To make any of the following changes to a preferred configuration in the SDP offer:

- to change the priority of the preferred configuration with respect to others;
- to allow insertion of a new preferred configurations with higher priority;
- to allow reassignment of another preferred configuration to a higher priority; or
- to make any other changes to a preferred configuration that are not backward compatible and cannot be realized by inserting a new preferred configuration,

the IMS-ALG shall reassign the configuration number to one unused in the SDP offer or in any of the encapsulated information for the media line in the SDP offer and add any necessary capability attributes.

NOTE 2: Changing the priority of a codec or preferred configuration increases the possibility of introducing a transcoding function that is not otherwise needed. Normally new or changed preferred configurations are assigned with higher configuration numbers (of lower priority) than existing preferred configurations.

When forwarding an SDP offer, the IMS-ALG supporting SDP capability negotiation shall not change any existing SDP capneg capability attributes, but may insert additional capability attributes.

The IMS-ALG may delete a preferred configuration from the SDP offer. However, the IMS-ALG shall not delete any unreferenced capability attributes.

If the IMS-ALG desires to add a preferred configuration, it should search for an equivalent or backward compatible preferred configuration within the encapsulated codec related information. If it finds such a suitable preferred configuration, the IMS-ALG should reuse the configuration number from the encapsulated preferred configuration if the resulting priority with respect to other preferred configurations is acceptable.

To add a new preferred configuration to the media line of the SDP offer that is different from and not backward compatible with any pcfg attribute in encapsulated codec information for the media line, the IMS-ALG shall allocate a new configuration number for the new preferred configuration with a configuration number unused by any other preferred configuration within the SDP offer or within the encapsulated codec related information.

5.5 Additional handling for SDP answer with actual configuration

In clause 6.2.2 and clause 6.2.8 step 4), if the media line in the initial or second SDP answer includes an actual configuration, the IMS-ALG should perform the following procedure to determine if the codecs in the initial or second SDP answer are supported by a previous version of the received initial or second SDP offer:

The IMS-ALG should compare the actual configuration with SDP capneg preferred configurations in encapsulated codec related information to determine if previous realm instances are associated with matching codec related information. The actual configuration matches a preferred configuration:

- if the preferred configuration has the same configuration number as the actual configuration; or
- if the capabilities listed in the actual configuration match the capabilities available in the preferred configuration in the initial or second SDP offer.

NOTE: An IMS-ALG can choose not to compare the SDP capneg actual configuration with encapsulated preferred configurations, or only to compare configuration numbers, but this may lead to a failure to find opportunities to bypass previous realm instances. However, SDP capneg procedures recommend that the offerer performs a second offer/answer transaction where the actual configuration is offered in normal SDP. Missed opportunities to bypass previous realm instances could still be found during this second offer/answer transaction.

If the IMS-ALG selected a preferred configuration with a different configuration number than the actual configuration for bypassing a previous realm, the IMS-ALG shall change the capability number of the actual configuration to equal the capability number of the matching preferred configuration before forwarding the initial or second SDP answer.

5.6 Procedures specific to OMR attributes

5.6.1 General

This clause describes additional procedures specific to SDP attributes associated with OMR specified in TS 24.229 [4], clause 7.5.3.

5.6.2 instance-number

When creating a new visited-realm instance for a media line in an SDP offer, the IMS-ALG shall assign an instance-number value for the instance that is "1" higher than the highest existing instance-number value for any visited-realm attribute for any media line in the received SDP offer, starting with the value "1" if there are no such attributes in the SDP offer. If the IMS-ALG adds visited-realm instances for several media lines, the IMS-ALG shall use the same

instance-number. If the IMS-ALG adds a "secondary-realm" SDP attribute for a media line in the SDP offer the IMS-ALG shall assign the same instance-number value as assigned to the "visited-realm" SDP attribute.

A UA creating a visited-realm instance for a media line in an SDP offer shall assign an instance-number value "1" for the instance. If the UA adds a "secondary-realm" SDP attribute for a media line in the SDP offer the UA shall assign the instance-number value "1" for a secondary-realm instance.

5.6.3 Session and media checksum calculation

An IMS ALG or a UA supporting OMR shall determine a session level checksum and a media level checksum for each media line containing a "visited-realm" SDP attribute in an SDP offer.

NOTE: A session level checksum and a media level checksum calculation is not performed for an SDP answer containing media line with a "visited-realm" SDP attribute or a "secondary-realm" SDP attribute.

The session level checksum shall be calculated by summing all the hex values of the individual ASCII characters (excluding all white space) of the "b" and "a" session level lines. The media level checksum shall be calculated by summing all the hex values of the individual ASCII characters (excluding all white space) of the "m", "b", and "a" media level lines including attributes specific to OMR but excluding the session and media level checksum attribute lines themselves.

When there are no "b" or "a" session level lines to calculate the session level checksum, the session level checksum is set to "0".

6 IMS-ALG procedures

6.1 IMS-ALG handling of initial SDP offer

6.1.1 General

Upon receiving an initial SDP offer, the IMS-ALG supporting OMR shall apply the procedures in the following clauses for each media line with non-zero port value.

Upon receiving a subsequent SDP offer that includes OMR attributes for some media lines, the IMS-ALG supporting OMR shall apply the procedures in the following clauses for each media line with non-zero port value and OMR attributes.

NOTE: An example of a second SDP offer/answer transaction is when any of the IMS-ALGs performs proactive transcoding without resource reservation or removes media resources when transcoding is no longer required. See clauses 6.2.2 and 6.2.3.

After the completion of an initial SDP offer/answer transaction and when receiving an SDP offer without OMR attributes for a media line, the IMS-ALG supporting OMR shall apply the procedures for subsequent SDP offer/answer transaction in clause 8 for that media line.

6.1.2 Validating the received SDP offer

If any of the following conditions are true:

- 1) the received SDP offer includes any OMR attributes for the media line, but no visited-realm instance;
- 2) the connection-address and port information in the visited-realm instance with the highest value of instance-number for the media line does not match the connection address and port information for the media line; or
- 3) one of the following conditions are true:
 - the "omr-m-cksum" attribute does not match the checksum value computed for the media line as described in clause 5.6.3; or

- based on local policy, if the "omr-m-cksum" attribute matches the computed media line checksum, but the "omr-s-cksum" attribute does not match the checksum value computed for the session level lines as described in clause 5.6.3,

then the IMS-ALG shall remove all OMR attributes associated with the media line from the received SDP offer and use the modified SDP offer as the received SDP offer in the procedures in the following subclauses.

6.1.3 Deciding whether to allocate a primary local MR and if any previous MR can be bypassed

The IMS-ALG considers information in the received SDP offer and applies local policy to decide whether to allocate a primary local MR and if it is to bypass any previous MRs.

NOTE: An IMS-ALG can revise these decisions when receiving the SDP answer, applying procedures in clause 6.2.

The IMS ALG shall perform the following steps:

- 0) If the connection address for the media line in the received SDP offer is the unspecified address, then the IMS-ALG should:
 - a) select to not allocate a primary local MR (regardless of local policy), and to not bypass any previous MRs;
 - b) convert the unspecified address in the connection address for the media line in the received SDP offer to the addrtype of the outgoing IP realm, if necessary;
 - c) if subsequently choosing to perform proactive transcoding in clause 6.1.7, then select to perform proactive transcoding without resource reservation (regardless of local policy);
 - d) select to not add secondary-realm instances to the modified SDP offer when performing the procedure in clause 6.1.8 (regardless of local policy); and
 - e) skip to step 6),
- 1) If all of the following conditions apply:
 - a) local policy does not require the allocation of an MR for any non-OMR related reason (e.g. for hosted NAPT traversal on the incoming signalling path, or for legal interception; and
 - b) the IP realm, nettype and addrtype for the outgoing signalling path is the same as the IP realm, nettype and addrtype associated with a visited-realm or secondary-realm instance for the media line
 - such that the instance has an instance-number value i that is less than the highest instance-number value n associated with the media line in the received SDP offer; and
 - such that the instance i is associated with a codec list, determined using the procedures in clause 5.3, which includes all codecs required by local policy, unless the IMS-ALG has a policy to offer the missing codecs proactively without reserving an MR,

then the IMS-ALG shall store an indication that the allocation of a primary local MR is not required and shall store the realm instances with instance-number greater than i , which are associated with MRs that can be bypassed without allocating a primary local MR.

- 2) If the following condition applies:
 - a) the IMS-ALG controls an MR with access to an IP realm or connected IP realm, nettype and addrtype associated with a visited-realm or secondary-realm instance for the media line
 - such that the instance has an instance-number value j that is less than the highest instance-number value n associated with the media line in the received SDP offer; and
 - such that the instance j is associated with a codec list, determined using the procedures in clause 5.3, which includes all codecs required by local policy, unless such codecs are provided at a local MR via transcoding,

then the IMS-ALG shall store the realm instances with instance-number greater than j , which are associated with MRs that can be bypassed when allocating a primary local MR.

3) If all of the following conditions apply:

- a) the condition in step 1) does not apply;
- b) the IP realm, nettype and addrtype for the outgoing signalling path is the same as the IP realm, nettype and addrtype for the incoming signalling path;
- c) the codec list in the received SDP offer, determined from the SDP m-line and associated non-OMR attribute lines, includes all codecs required by local policy, unless the IMS-ALG has a policy to offer the missing codecs proactively without reserving an MR; and
- d) local policy does not require the allocation of an MR for any non-OMR related reason (e.g. for hosted NAPTraversal on the incoming signalling path, or for legal interception),

then the IMS-ALG shall store an indication that the allocation of a primary local MR is not required and that no MRs can be bypassed when no primary local MR is allocated.

4) If an indication that the allocation of a primary local MR is not required has been stored in steps 1) or 3),

- then the IMS-ALG shall compare the realm instances (and MRs) that can be bypassed with or without allocation of a primary local MR, as determined in steps 1), 2) and 3), and shall use local policy to select whether to allocate a primary local MR,
- else the IMS-ALG shall select to allocate a primary local MR,

NOTE: Usually the decision is made based on which choice retains the smallest total number of MRs in the media path, but local policy may apply other criteria.

5) If the IMS-ALG selected in step 4) to allocate a primary local MR, then the IMS-ALG shall:

- if one or more realm instances can be bypassed when allocating a primary local MR, then store instance-number value $k=j$ and apply the procedures in clause 6.1.4 to bypass previous MRs, else apply the procedures in clause 6.1.5 to not bypass previous MRs; and
- apply the procedures in clause 6.1.6 to allocate a primary local MR.

6) If the IMS-ALG selected in step 4) to not allocate a primary local MR, then the IMS-ALG shall:

- if one or more realm instances can be bypassed when not allocating a primary local MR, then store instance-number value $k=i$ and apply the procedures in clause 6.1.4 to bypass previous MRs, else apply the procedures in clause 6.1.5 to not bypass previous MRs; and
- apply the procedures in clause 6.1.7 to not allocate a primary local MR.

6.1.4 Bypassing previous MRs

If the IMS-ALG decides (applying the criteria in clauses 6.1.3, 6.2.2, 6.2.3 or 6.2.8) to bypass a previous MR, the IMS-ALG shall:

- 1) use the connection address and port information from the selected instance k for the media line in the received SDP offer as incoming connection address and incoming port information for the media line in the subsequent steps;
- 2) reconstruct the associated codec information for the media line in the received SDP offer from the selected instance k as described in clause 5.3, and use that codec information as incoming codec information in the subsequent steps; and
- 3) delete every OMR attribute for the media line with instance-number value higher than k .

6.1.5 Bypassing no previous MRs

If the IMS-ALG decides (applying the criteria in clauses 6.1.3, 6.2.2 or 6.2.3) not to bypass any previous MR, the IMS-ALG shall:

- 1) use the connection-address from the SDP c-line in the received SDP offer as incoming connection-address in subsequent steps;
- 2) use the port information from the SDP m-line in the received SDP offer as incoming port information in subsequent steps; and
- 3) use the codec information from the SDP m-line and associated non-OMR attribute lines in the received SDP offer as incoming codec information in the subsequent steps.

6.1.6 Allocating a primary local MR

If the IMS-ALG decides (applying the criteria in clauses 6.1.3 or 6.2.3) to allocate a local MR, the IMS-ALG shall:

- 1) if no MR context has been allocated due to a previous SDP offer-answer exchange, allocate an MR context with access to the IP realms, nettypes and addrtypes associated with the incoming connection address and port information determined in clause 6.1.4 or 6.1.5, and the outgoing signalling path, respectively applying procedures as described in clause 6.3;
- 2) if the IMS-ALG is not performing hosted NAPTR traversal on the incoming side, then insert the incoming connection address and incoming port information for the media line, as determined in clause 6.1.4 or 6.1.5, into the remote connection address and port information for the incoming termination on the MR;
- 3) if the IMS-ALG is performing hosted NAPTR traversal on the incoming side, then discover the remote connection address and port information for the incoming termination on the MR using latching or other unspecified technique;
- 4) if codec information is to be provided to the allocated MR on the incoming termination, provide to the MR the incoming codec information as determined in clause 6.1.4 or 6.1.5;

NOTE: The IMS-ALG can defer the allocation of an MR termination at the incoming side and the related procedures in steps 1) to 4) until it processes the SDP answer.

- 5) if the IMS-ALG requires according to local policy that its MR remain in the media path for reasons unrelated to OMR, remove all OMR specific attributes from the modified SDP offer;
- 6) if there is no visited-realm instance associated with the connection address and port information for the media line in the received (and possibly modified) SDP offer, and there is no local policy prohibiting removal of the allocated MR, then construct and add this visited-realm instance to the modified SDP offer;
- 7) replace the connection address and port information for the media line in the modified SDP offer with the connection address and port information from the MR termination on the outgoing side;
- 8) make any codec changes to incoming codec information, as determined in clause 6.1.4 or 6.1.5, according to local policy, taking into account the procedures in clause 5.4, and insert the changed codec information into the SDP m-line and associated attribute lines of the modified SDP offer;
- 9) if codec information is to be provided to the allocated MR for the outgoing termination, provide to the MR the modified codec information derived in step 8); and
- 10) add to the modified SDP offer a visited-realm instance for the IP realm associated with the connection address and port information for the media line in the modified SDP offer, including the incoming codec information encoded according to clause 5.2 if any codec changes were inserted in step 8).

6.1.7 Allocating no primary local MR

If the IMS-ALG decides (applying the criteria in clauses 6.1.3 or 6.2.2) not to allocate a primary local MR, the IMS-ALG shall:

- 1) decide according to local policy if the IMS-ALG performs any codec changes to the incoming codec information, as determined in clause 6.1.4 or 6.1.5, without allocating an MR (i.e., for proactive transcoding without resource reservation);

NOTE: The IMS-ALG can only make codec changes if the available SIP signalling allows the IMS-ALG to initiate a 2nd SDP offer/answer transaction if necessary to allocate a transcoding MR after receipt of the SDP answer, as described in clause 6.2.3.

- 2) if the IMS-ALG decided in step 1) to perform any codec changes, then
 - a) if there is no visited-realm instance associated with the connection address and port information for the media line in the received SDP offer, then construct and add this visited-realm instance;
 - b) make the codec changes to incoming codec information according to local policy, taking into account the procedures in clause 5.4, and insert the changed codec information into the SDP m-line and associated attribute lines of the modified SDP offer; and
 - c) add to the modified SDP offer a visited-realm instance with the same IP realm, connection address and port information as the previous visited-realm instance (after a possible execution of step 3 in clause 6.1.4 for the media line, including the incoming codec information encoded according to clause 5.2),
- 3) if the IMS-ALG decided in step 1) not to perform any codec changes, then
 - a) insert the incoming codec information, determined in clause 6.1.4 or 6.1.5 into the SDP m-line and associated attribute lines of the modified SDP offer.
- 4) use the incoming connection address, determined in clause 6.1.4 or 6.1.5, as the connection address in the SDP c-line of the modified SDP offer; and
- 5) use the incoming port information as determined in previous steps as port information in the SDP m-line of the modified SDP offer.

6.1.8 Allocating secondary local MRs

According to local policy, the IMS-ALG may allocate a secondary MR for each combination of IP realm, nettype and addrtype on the outgoing side for which the IMS-ALG can allocate an MR context. However, if the IMS-ALG does not require a local MR for non-OMR reasons, the IMS ALG should only allocate a secondary MR for a combination of IP realm, nettype and addrtype if the IP realm, nettype and addrtype are not represented by a visited-realm or secondary-realm instance for the media line in the SDP offer. To allocate a secondary MR, the IMS-ALG shall:

- 1) if no MR context has been allocated due to a previous SDP offer-answer exchange, allocate an MR context for the IP realm, nettype and addrtype on the outgoing side, using the incoming connection address and incoming port information for the media line, determined in clause 6.1.4 or 6.1.5, as the remote connection address and port information for the incoming termination;
- 2) if codec information is to be provided to the allocated MR for the incoming termination, provide to the MR the incoming codec information, as determined in clause 6.1.4 or 6.1.5;

NOTE: The IMS-ALG can defer the allocation of an MR termination at the incoming side and the related procedures in steps 1) and 2) until it processes the SDP answer.

- 3) if any codec information is to be provided to the allocated MR for the outgoing termination, provide to the MR the codec information from the SDP m-line and associated attribute lines of the modified SDP offer;
- 4) if the IMS-ALG did not yet add a visited-realm instance for the outgoing side (the IMS-ALG did not allocate a primary MR and did not perform any codec changes, see clause 6.1.7); then
 - a) if there is no visited-realm instance associated with the connection address and port information for the media line in the received SDP offer, then construct and add this visited-realm instance; and
 - b) add to the SDP offer a visited-realm instance with the same IP realm, connection address and port information as the previous visited-realm instance (after a possible execution of step 3 in clause 6.1.4 for the media line),
- 5) add to the modified SDP offer a secondary-realm instance for the context allocated in step 1).

6.1.9 Forwarding SDP offer

The IMS-ALG shall:

- 1) if local policy forbids sending of OMR related attributes to the outgoing IP realm, the IMS-ALG shall delete all OMR related attributes from the modified SDP offer; and
- 2) if the IMS-ALG has made any modifications to the received SDP offer before forwarding and the modified SDP offer includes OMR related attributes, the IMS-ALG shall compute checksum values as described in clause 5.6.3 and replace or add the "omr-s-cksum" and "omr-m-cksum" attributes for the media line.

The IMS-ALG forwards the SDP offer according to TS 24.229 [4].

6.2 IMS-ALG handling of initial SDP answer

6.2.1 General

Upon receiving the SDP answer corresponding to the initial or second SDP offer sent in clause 6.1, the IMS-ALG supporting OMR shall perform the procedures in the following clauses for each media line in the SDP answer.

6.2.2 IMS-ALG bypasses an allocated transcoding MR

The IMS-ALG uses the following conditions to determine that a previously allocated primary local MR or upstream MR is to be bypassed and that a second SDP offer/answer transaction is needed to update the connection information on the outgoing side. Two examples of this procedure are given in Annex Q of TS 23.228 [3]: steps 5) and 6) of Figure Q.5, and steps 7) and 8) of Figure Q.7.

If the following conditions are true:

- 1) the received initial SDP answer includes connection address information for the media line that is a valid IP address other than the unspecified address (i.e., IPv4: "0.0.0.0", IPv6: "invalid.invalid"); and
- 2) it is possible to immediately initiate a second SDP offer/answer transaction towards the initial SDP answerer with the available SIP signalling,

then the IMS-ALG should re-evaluate the conditions in clause 6.1.3, steps 1) to 4), taking into account the information from the originally received initial SDP offer, as well as the codecs received in the initial SDP answer as additional information (using the procedure in clause 5.5 if the initial SDP answer includes an actual configuration), to select again whether to allocate a primary local MR and to recompute how many realm instances can be bypassed. The IMS-ALG should select to modify the previous decision if a higher number of realm instances can be bypassed.

If the IMS-ALG selected in the previous step to modify the previous decision and

- to not allocate a primary local MR that has previously been allocated; or
- to not allocate a primary local MR and to bypass other previous realm instances than decided when previously evaluating clause 6.1.3,

then the IMS-ALG shall:

- 1) apply the procedures in clause 6.1.4 to bypass previous MRs or the procedures in clause 6.1.5 to not bypass previous MRs (using information from the originally received initial SDP offer), depending on its corresponding decision;
- 2) apply the procedures in clause 6.1.7 to not allocate a primary local MR without making any codec changes;
- 3) after clauses 6.2.2 and 6.2.3 are completed as applicable for all media lines, apply the procedures in clause 6.1.9 for each media line to send a second SDP offer within available SIP signalling, initiating a new second SDP offer/answer transaction towards the SDP answerer; and
- 4) upon receipt of the second SDP answer, continue handling of the second SDP answer as if it were the initial SDP answer, and reference the most recent data associated with the forwarding of the (modified) second SDP offer (i.e., incoming SDP information, allocated MRs and modified second SDP offer) as if it occurred the first time.

6.2.3 IMS-ALG allocates a local transcoding MR when performing proactive transcoding without resource reservation

The IMS-ALG uses the procedures in this clause if it receives an initial SDP answer without a realm instance, performed proactive transcoding without resource reservation when forwarding the initial SDP offer, as in step 2) of clause 6.1.7, and then determines that it needs to allocate an MR for proactive transcoding.

If all the following conditions are true:

- 1) the received initial SDP answer includes connection address information for the media line that is a valid IP address other than the unspecified address (i.e., IPv4: "0.0.0.0", IPv6: "invalid.invalid");
- 2) the IMS-ALG performed proactive transcoding without resource reservation when previously forwarding the initial SDP offer, as in step 2) of clause 6.1.7;
- 3) the selected codec in the received initial SDP answer is not supported by the incoming media path and incoming codec information, as previously determined in clause 6.1.4 or 6.1.5 (using information from the originally received initial SDP offer), indicating that an MR must be allocated to provide transcoding; and
- 4) it is possible to immediately initiate another second SDP offer/answer transaction towards the SDP answerer with the available SIP signalling,

NOTE: If a second SDP offer/answer transaction cannot be initiated with available SIP signalling, the OMR algorithm will fail to allocate a functioning end-to-end media path.

then the IMS-ALG shall:

- 1) if when previously handling the initial SDP offer it was determined in step 2) of clause 6.1.3 that one or more realm instances can be bypassed when allocating a primary local MR (using information from the originally received initial SDP offer), then store instance-number value $k=j$ and apply the procedures in clause 6.1.4 to bypass previous MRs, else apply the procedures in clause 6.1.5 to not bypass previous MRs (using information from the originally received initial SDP offer);
- 2) apply the procedures in clause 6.1.6 to allocate a primary local MR;
- 3) apply the procedures in clause 6.1.8 to update allocation of any secondary MRs, if necessary;
- 4) after clauses 6.2.2 and 6.2.3 are completed as applicable for all media lines, apply the procedures in clause 6.1.9 for each media line, to send a second SDP offer within available SIP signalling, and to initiate a new SDP offer/answer transaction towards the initial SDP answerer; and
- 5) upon receipt of the second SDP answer, continue handling of the second SDP answer as if it were the initial SDP answer, and reference the most recent data associated with the forwarding of the (modified) second SDP offer (i.e., incoming information, allocated MRs and modified second SDP offer) as if it occurred the first time.

6.2.4 IMS-ALG determines steps required to complete the handling of the SDP answer

The IMS-ALG performs the following steps to determine the disposition of any allocated MRs and to complete the handling of the SDP answer:

- 1) if the received SDP answer for the media line includes a connection address with unspecified address and a visited-realm instance, then the IMS-ALG shall apply the procedures in clause 6.2.5;
- 2) if the received SDP answer for the media line includes a connection address with unspecified address and a secondary-realm instance, then the IMS-ALG shall apply the procedures in clause 6.2.6;
- 2a) If the received SDP answer for the media line includes a connection address with unspecified address and no visited-realm or secondary-realm instance, then the IMS-ALG shall:
 - a) if necessary, update the unspecified connection address information in the SDP answer with the unspecified address of the appropriate type for the network into which the SDP answer will be sent (i.e., IPv4: "0.0.0.0", IPv6: "invalid.invalid");

- 3) if all the following conditions are true:
 - a) the connection address for the media line in the received SDP answer is a valid (not unspecified) address; and
 - b) the IMS-ALG did not allocate a primary local MR (i.e., executed clause 6.1.7) when forwarding the SDP offer,
then the IMS-ALG shall apply the procedures in clause 6.2.7, and
- 4) if all the following conditions are true:
 - a) the connection address for the media line in the received SDP answer is a valid (not unspecified) address; and
 - b) the IMS-ALG allocated a primary local MR (i.e., executed clause 6.1.6) when forwarding the SDP offer,
then the IMS-ALG shall apply the procedures in clause 6.2.8 to retain a primary local MR.

6.2.5 Receiving an unspecified connection address and a visited-realm instance

If the IMS-ALG receives a connection address with unspecified address and a visited-realm instance, then the IMS-ALG shall:

- 1) If the visited-realm instance for the media line in the SDP answer has an instance-number that matches the visited-realm instance associated with the incoming SDP offer information,

NOTE 1: The visited-realm instance associated with the incoming SDP offer information is either the one in the received SDP offer with highest instance-number (before any bypass decision is made), if one is present, or the one added in clause 6.1.6 step 6) or in clause 6.1.7 step 2a).

NOTE 2: The IP realms in the two visited-realm instances either have the same name or are connected.

then the IMS-ALG shall:

- replace the connection address and port information for the media line in the SDP answer with the connection address and port information from the visited-realm instance in the received SDP answer, and
- retain the visited-realm instance in the SDP answer,

- 2) else the IMS-ALG shall:

- if necessary, update the unspecified connection address information in the SDP answer with the unspecified address of the appropriate type for the network into which the SDP answer will be sent (i.e., IPv4: "0.0.0.0", IPv6: "invalid.invalid").

6.2.6 Receiving an unspecified connection address and a secondary-realm instance

If the IMS-ALG receives a connection address with unspecified address and a secondary-realm instance, then the IMS-ALG shall:

- 1) if the secondary-realm instance for the media line in the SDP answer has an instance-number that matches a secondary-realm instance added by the IMS-ALG when applying procedures in clause 6.1.8 then the IMS-ALG shall apply the procedures in clause 6.2.8 to retain a secondary local MR,

NOTE: The IP realms in the two secondary-realm instances either have the same name or are connected.

- 2) else the IMS-ALG shall:

- if necessary, update the unspecified connection address information in the SDP answer with the unspecified address of the appropriate type for the network into which the SDP answer will be sent (i.e., IPv4: "0.0.0.0", IPv6: "invalid.invalid").

6.2.7 Other handling when no primary local MR allocated

If the IMS-ALG receives (as determined in clause 6.2.4) an SDP answer with a valid connection address after forwarding an SDP offer without allocating a primary local MR, then the IMS-ALG shall:

- 1) If the IMS-ALG applied clause 6.1.4 to bypass previous MRs when handling the forwarding of the SDP offer, then the IMS-ALG shall:
 - a) copy into the media line of the SDP answer the visited-realm or secondary-realm instance from the media line of the received SDP offer that was used to populate the connection address and port information in the forwarded SDP offer, replacing the connection-address and port information in the instance with the connection address and port information from the received SDP answer, and if the IP realm in the instance is a connected IP realm, replacing the IP realm name with the corresponding local IP realm name; and
 - b) replace the connection address information in the SDP answer with the unspecified address of the appropriate type for the network into which the SDP answer will be sent (i.e., IPv4: "0.0.0.0", IPv6: "invalid.invalid"),
- 2) else the IMS-ALG did not bypass previous MRs when forwarding the SDP offer and the IMS-ALG shall not modify the SDP answer.

NOTE: In step 1) the received SDP answer never includes a realm instance. In step 2) the SDP answer can but does not necessarily include a realm instance.

6.2.8 Retaining a primary or secondary local MR

If the IMS-ALG decides (applying the criteria in clause 6.2.4 and clause 6.2.6) to retain a primary or secondary local MR, the IMS-ALG shall:

- 1) if the IMS-ALG received an SDP answer with no secondary-realm instance for the media line, then the IMS-ALG shall:

NOTE: The IMS-ALG retains a primary local MR in this case. The IMS-ALG can but does not necessarily receive a visited-realm instance in an SDP answer when retaining a primary local MR. If present, the visited-realm instance can be used to identify the connected IP realm for the outgoing termination, if different from the IP realm of the outgoing termination.

- a) update the remote connection address and port information for the outgoing termination on the selected primary local MR context with the connection address and port information for the media line in the received SDP answer,
 - b) delete the visited-realm instance from the SDP answer, if present,
- 2) if the IMS-ALG received an SDP answer with a secondary-realm instance for the media line, then the IMS-ALG shall:
 - a) update the remote connection address and port information for the outgoing termination on the selected secondary local MR context with the connection-address and port information from the secondary-realm instance in the received SDP answer; and
 - b) delete the secondary-realm instance from the SDP answer,
 - 3) if the selected codecs in the SDP answer are not in the set of codecs associated with the incoming SDP offer information, as determined in clause 6.1.4 or 6.1.5 when handling the SDP offer, then modify the SDP answer to include the codecs selected for the incoming termination of the selected local MR;
 - 4) if the selected MR has access to an IP realm or connected IP realm, nettype and addrtype associated with a visited-realm or secondary-realm instance for the media line
 - such that the instance has an instance-number value k that is less than the highest instance-number value n associated with the media line in the incoming SDP offer information, previously determined in clause 6.1.4 or 6.1.5; and

- such that the instance k is associated with a codec list, determined using the procedures in clause 5.3, which includes the codecs selected for the incoming termination of the selected local MR in step 3) (using the procedure in clause 5.5 if the SDP answer includes an actual configuration),

then the IMS-ALG shall:

- a) store the realm instances with instance-number greater than k , which are associated with additional MRs that can be bypassed after selecting a codec for the incoming media path when allocating a primary local MR;
 - b) apply the procedures in clause 6.1.4 to bypass additional previous MRs (using information from the originally received SDP offer);
 - c) insert the incoming connection address and incoming port information for the media line, as determined in step b), as the remote connection address and port information for the selected IP realm on the incoming termination of the selected MR;
 - d) if necessary, modify the selected codec information in the SDP answer to be a valid response to the incoming SDP offer codec information determined in step b);
 - e) if codec information is to be provided to the allocated MR on the incoming termination, provide to the MR the incoming codec information as determined in step d),
- 5) If the IMS-ALG applied clause 6.1.4 to bypass previous MRs when forwarding the SDP offer or in step 4b), then the IMS-ALG shall:
- a) copy into the media line of the SDP answer the visited-realm or secondary-realm instance from the media line of the received SDP offer that was used for the remote connection address and port information for the incoming termination on the MR, replacing the connection-address and port information in the instance with the local connection address and port information for the incoming termination on the selected MR, and if the IP realm in the instance is a connected IP realm, replacing the IP realm name with the corresponding local IP realm name; and
 - b) replace the connection address information in the SDP answer with the unspecified address of the appropriate type for the network into which the SDP answer will be sent (i.e., IPv4: "0.0.0.0", IPv6: "invalid.invalid"),
- 6) If the IMS-ALG applied clause 6.1.5 to not bypass previous MRs when forwarding the SDP offer, and did not bypass previous MRs in step 4b), then the IMS-ALG shall:
- a) replace the connection address and port information for the media line in the SDP answer with the local connection address and port information for the incoming termination on the selected MR.

6.2.9 Forwarding the SDP answer

The IMS-ALG forwards the SDP answer according to TS 24.229 [4].

The IMS-ALG shall release each MR for the media line, when it is no longer potentially needed for this and any other forked dialog.

6.3 IMS-ALG OMR media resource operations

6.3.1 General

The IMS-ALG OMR procedures as specified by clauses 6.1 and 6.2 refer to generic MR allocation operation. When no MR was previously allocated, e.g. during the initial SDP offer/answer exchange, this allocation will result in the allocation of one or more local media termination point pairs (ingress and egress) – one for the primary IP realm and possible additional terminations points for secondary IP realms.

Subsequent SDP offer/answer exchanges may result in the decision that a local MR is needed. If a local MR was not previously allocated, then one will now be allocated. If a local MR was previously allocated that matches the resource information needed, then the previously allocated resource will be used. If the previously allocated local MR does not match the resource information needed, then the local MR will be modified to meet the current need.

If it is determined that local MR may be by-passed or no longer needed, then any previously allocated local MRs will be deallocated.

6.3.2 IMS-ALG operations

The OMR MR procedures in this document are applicable to the following IMS entities that perform as IMS-ALG using the media resource interface operations as indicated.

- An IBCF acting as an IMS-ALG controlling a TrGW using the Ix interface as defined by TS 29.162 [16] and TS 29.238 [9]:
 - Reserve TrGW Connection Point;
 - Configure TrGW Connection Point,
 - Reserve and Configure TrGW Connection Point; and
 - Release TrGW Connection Point.
- A P-CSCF acting as IMS-ALG controlling an IMS-AGW using the Iq interface as defined by TS 23.334 [15] and TS 29.334 [10]:
 - Reserve AGW Connection Point;
 - Configure AGW Connection Point;
 - Reserve and Configure AGW Connection Point; and
 - Release AGW Connection Point.
- An AS acting as B2BUA and adapting IMS-ALG procedures to control an MRF shall use one or more of the following:
 - IETF RFC 4240 [11] conference service;
 - IETF RFC 4117 [19]; and
 - IETF RFC 3260 [12] and IETF RFC 6505 [13].

6.4 Handling of connected IP realms

For each IP realm to which a controlled MR has direct access, the IMS-ALG supporting OMR may be provisioned with a list of the names of connected IP realms, if any. The IMS-ALG shall determine if an IP realm is connected to a local IP realm based only on provisioning.

NOTE 1: The OMR algorithm assumes that a first IMS-ALG or UA sending an SDP offer that offers connectivity via a local IP realm will accept from a second IMS-ALG or UA an SDP answer with an address in a connected IP realm, even if the first IMS-ALG or UA does not have provisioned information about the connected IP realm.

NOTE 2: Connected IP realm lists only need to be provisioned at certain OMR-capable nodes. For example, it is preferred that an IBCF whose TrGW has connectivity to multiple peer networks via bilateral interconnect be provisioned with connected IP realm information.

7 UA Procedures

7.1 UA sending an initial SDP offer

Upon preparing an initial SDP offer for sending to begin an SDP offer/answer transaction, a UA supporting OMR shall additionally:

- 1) add to the SDP offer a visited-realm instance for the IP realm associated with the connection address and port information for the media line in the SDP offer;
- 2) for each combination of IP realm, nettype and addrtype on the outgoing side for which the UA can allocate an MR termination according to local policy, if the IP realm, nettype and addrtype are not associated with the media line in the SDP offer, allocate an MR termination for the IP realm, nettype and addrtype on the outgoing side, using the same codecs associated with the media line;
- 3) add to the SDP offer a secondary-realm instance for each termination allocated in step 2); and
- 4) compute a checksum values as described in clause 5.6.3 and add the "omr-s-cksum" and "omr-m-cksum" attributes for the media line.

The UA then sends the SDP offer according to TS 24.229 [4].

NOTE: A subsequent SDP offer is sent according to procedures in clause 8.

7.2 UA receiving an initial SDP offer

7.2.1 General

Upon receiving an SDP offer that includes OMR attributes and selecting a codec for the media line, a UA supporting OMR shall perform the procedures specified in clauses 7.2.2 and 7.2.3, and then send the SDP answer according to TS 24.229 [4].

7.2.2 Validating the incoming SDP offer

If any of the following conditions are true:

- 1) the SDP offer includes any OMR attributes for the media line, but no visited-realm instance;
- 2) the connection-address and port information in the visited-realm instance with the highest value of instance-number for the media line does not match the connection address and port information for the media line; or
- 3) one of the following checksum comparison failures are true:
 - the "omr-m-cksum" attribute does not match the checksum value computed for the media line as described in clause 5.6.3; or
 - based on local policy, if the "omr-m-cksum" attribute matches the computed media line checksum, but the "omr-s-cksum" attribute does not match the checksum value computed for the session level lines as described in clause 5.6.3,

then the UA shall remove all OMR related attributes associated with the media line.

7.2.3 UA may choose an alternate realm instance to bypass an upstream MR

If all the following conditions are true:

- 1) the UA can make available a media termination in an IP realm, nettype and addrtype such that this IP realm or a connected IP realm, nettype and addrtype match the IP realm, nettype and addrtype of a visited-realm or secondary-realm instance for the media line in the SDP offer;
- 2) the instance does not match the connection address and port information in the SDP offer; and
- 3) the instance supports the codec selected by the UA,

then the UA shall:

- 1) select the visited-realm or secondary-realm instance with the lowest value of instance-number such that the UA can make available a media termination in the IP realm or connected IP realm, nettype and addrtype that matches the IP realm, nettype and addrtype of the instance and the instance supports the codec selected by the UA;
- 2) allocate a media termination in the selected IP realm, nettype and addrtype;
- 3) copy into the media line of the SDP answer the selected visited-realm or secondary-realm instance from the media line of the received SDP offer, replacing the connection-address and port information in the instance with the local connection address and port information for the allocated termination, and if the IP realm in the instance is a connected IP realm, replacing the IP realm name with the corresponding local IP realm name; and
- 4) replace the connection address information in the SDP answer with the unspecified address of the appropriate type for the network into which the SDP answer will be sent (i.e., IPv4: "0.0.0.0", IPv6: "invalid.invalid").

7.3 UA receiving an initial SDP answer

7.3.1 General

Upon receiving the initial SDP answer corresponding to the initial SDP offer sent in clause 7.1, the UA supporting OMR shall perform the procedures specified in either clause 7.3.2 if the SDP answer included a realm instance or clause 7.3.3 if the SDP answer did not include a realm instance.

7.3.2 Receiving SDP answer with an unspecified connection address

If the received SDP answer for the media line includes an unspecified connection address (i.e., IPv4: "0.0.0.0", IPv6: "invalid.invalid") and a visited-realm or a secondary-realm instance with an instance-number that matches a visited-realm or secondary-realm instance for the media line from the SDP offer, then the UA shall:

NOTE: The IP realms in the two realm instances either have the same name or are connected.

- 1) update the remote connection address and port information for the selected outgoing termination with the connection-address and port information from the visited-realm or secondary-realm instance in the received SDP answer; and
- 2) release any other MR apart from the selected MR allocated for the media line, when it is no longer potentially needed for any other forked dialog.

7.3.3 Receiving SDP answer with a valid connection address

If the received SDP answer includes a valid (not unspecified) connection address for the media line, then the UA shall:

- 1) update the remote connection address and port information for the primary outgoing termination with the connection address and port information from the received SDP answer; and
- 2) release any secondary MR allocated for the media line, when it is no longer potentially needed for any other forked dialog.

7.4 UA OMR media resource operations

7.4.1 General

The UA OMR procedures as specified by clauses 7.1, 7.2, and 7.3 refer to generic MR allocation operation. This allocation will result in the allocation of a local media termination associated with the selected IP realm.

Subsequent SDP offer/answer exchanges may result in either the exact same local MR being allocated or possibly a different local MR. If the UA is able to determine that the same resource information is being requested, the existing allocated local MR will be used. If the previously allocated local MR does not match the resource information needed, then the local MR will be modified to meet the current need.

7.4.2 UA operations

The OMR MR procedures in this document are applicable to the following IMS entities that perform as UA using the media resource interface operations as indicated.

- An AS acting as B2BUA and adapting UA procedures to control an MRF shall use one or more of the following:
 - IETF RFC 4240 [11] conference service and tone/announcement service;
 - IETF RFC 5552 [18]; and
 - IETF RFC 3260 [12] and IETF RFC 6505 [13].
- An MGCF acting as an UA controlling an IM-MGW using the Mn interface as defined by TS 29.163 [17] and TS 29.332 [14]:
 - Reserve IMS Connection Point;
 - Configure IMS Connection Point;
 - Reserve and Configure IMS Connection Point; and
 - Release IMS Connection Point.

7.5 Handling of connected IP realms

For each IP realm to which a controlled MR has direct access, the UA supporting OMR may be provisioned with a list of the names of connected IP realms, if any. The UA shall determine if an IP realm is connected to a local IP realm based only on provisioning.

NOTE 1: The OMR algorithm assumes that a first IMS-ALG or UA sending an SDP offer that offers connectivity via a local IP realm will accept from a second IMS-ALG or UA an SDP answer with an address in a connected IP realm, even if the first IMS-ALG or UA does not have provisioned information about the connected IP realm.

NOTE 2: Connected IP realm lists only need to be provisioned at certain OMR-capable nodes. For example, it is preferred that an IBCF whose TrGW has connectivity to multiple peer networks via bilateral interconnect be provisioned with connected IP realm information.

8 Subsequent SDP offer/answer transactions

8.1 General

Any UA or IMS-ALG controlling a media stream may initiate a subsequent SDP offer/answer transaction at any time after first establishing the media flow, in order to modify characteristics of the media flow.

NOTE: For example, a media endpoint (IP address) can change, the preferred codec can change, or a server can select to insert a media function such as a tone generator or conference focus.

An IMS-ALG or UA shall handle a received SDP offer as a subsequent SDP offer as specified in clause 8.2 if an initial or second SDP offer/answer transaction has been completed and a received SDP offer contains no OMR specific SDP attributes.

8.2 IMS-ALG and UA subsequent SDP offer procedures

8.2 Procedures to minimize changes in OMR outcome

When a IMS-ALG determines according to clause 8.1 that a received SDP offer shall be handled as a subsequent SDP offer, the IMS-ALG with or without a local primary or secondary MR allocated shall perform the following steps:

- 1) determine if the local primary or secondary MR can be inserted or removed from the media path as specified in clause 8.4;
- 2) if the IMS-ALG keeps an allocated MR or allocates a new MR and continues with an MR inserted in the media path, the IMS-ALG shall:
 - if necessary (e.g. due to a codec change or allocation of a new MR) interact with the MR;
 - update the connection address for the media line in the outgoing subsequent SDP offer; and
 - forward the modified SDP offer as specified in TS 24.229 [4].
- 3) if the IMS-ALG does not allocate a new MR or deallocated an MR allocated in the initial or second SDP offer / answer transaction in clause 6 and continues without a MR inserted in the media path, forward the incoming subsequent SDP offer as received.

When a UA (e.g. a conference application treating the media resource as an endpoint or an MGCF) determines according to clause 8.1 that a SDP offer shall be sent as a subsequent SDP offer, the UA shall not apply OMR procedures in clause 7 when sending the subsequent SDP offer. If the conditions in clause 8.4 for reallocating a MR are fulfilled, the UA may reallocate a MR.

8.3 IMS-ALG and UA subsequent SDP answer procedures

When an IMS-ALG receives a subsequent SDP answer as the result of a subsequent SDP offer generated according to clauses 8.2, the IMS-ALG with or without a local primary or secondary MR allocated shall perform the following steps:

- 1) if the IMS-ALG has a local MR allocated:

NOTE: The local MR can have been allocated during the initial or second SDP offer / answer transaction as described in clause 6 or as the result of the subsequent SDP offer generated in clause 8.2.

- a) if necessary interact with the MR as described in clause 6.3; and
 - b) update connection address in the outgoing subsequent SDP answer for the media line with the MR connection information;
 - c) forward the modified SDP answer as specified in TS 24.229 [4]; and
- 2) if the IMS-ALG has no local MR allocated:
 - a) if the local MR was allocated when the subsequent SDP offer was received, release MR resources; and
 - b) forward the subsequent SDP answer as received.

When a UA not acting as a B2BUA (e.g. a conference application treating the media resource as an endpoint or the MGCF) receives a subsequent SDP answer, the UA shall not apply OMR procedures specified in clause 7.

8.4 Handling media resources during a subsequent SDP offer/answer transaction

An IMS-ALG, an AS acting as B2BUA and adapting IMS-ALG procedures to control an MRF or a UA not acting as a B2BUA (e.g. a conference application treating the media resource as an endpoint or the MGCF) shall not allocate, deallocate or reallocate a MR during the subsequent SDP offer/answer transaction unless any of the following exceptions apply:

- an IMS-ALG may allocate an MR resource if the downstream and upstream media anchoring points are within the same realm and in the same operator network as the IMS-ALG;
- an IMS-ALG may deallocate an MR resource if the downstream and upstream media anchoring points are within the same realm and in the same operator network as the IMS-ALG; or
- an UA may reallocate an MR resource if the downstream and upstream media anchoring point is within the same realm and in the same operator network as the UA.

If an IMS-ALG or UA decides to allocate or reallocate a MR, the IMS-ALG or UA shall interact with the MR as described in clause 6.3 or 7.4.

If a IMS-ALG decides to deallocate a MR, the IMS-ALG shall release the MR resource when receiving the subsequent SDP answer.

Annex A (informative): Signalling flows

A.1 Scope of signalling flows

This annex gives examples of signalling flows for Optimized Media Routing (OMR) based on the Session Initiation Protocol (SIP) and the Session Description Protocol (SDP). The OMR specific SDP syntax is described in TS 24.229 [4].

A.2 Introduction

The signalling flows in this annex are based on IP realm and IP structure in Figure A.2-1.

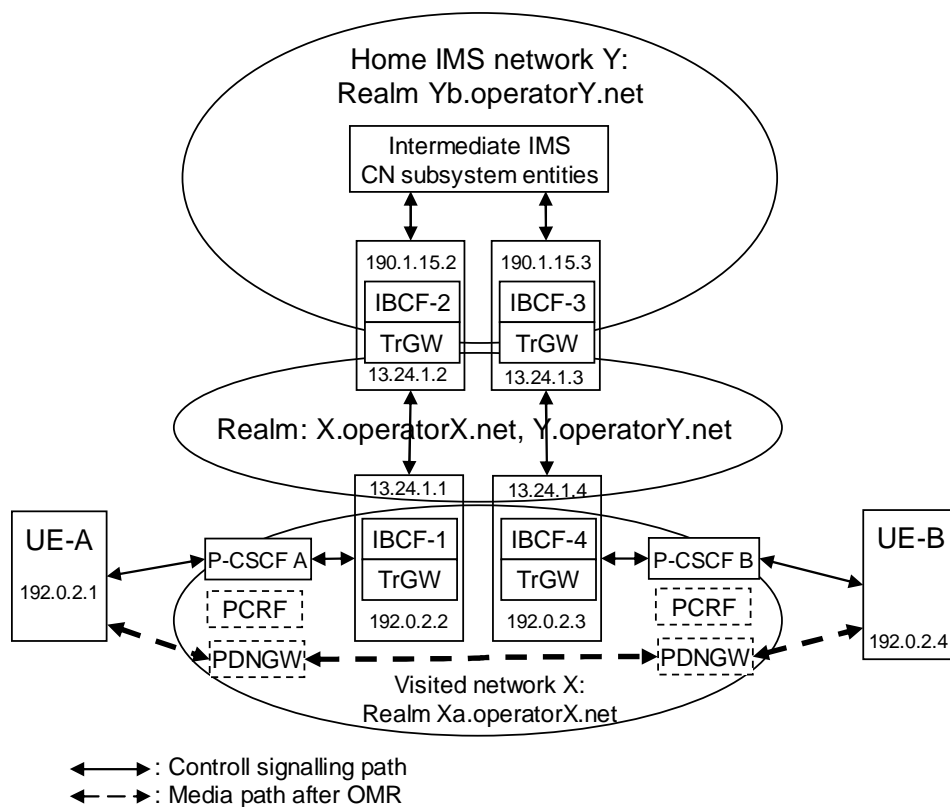


Figure A.2-1: IP realm and IP structure

Operator X and operator Y have an agreement to allow roaming users and to use OMR as much as possible.

UE-A and UE-B are mobile users roaming into the visited network X. IP addresses etc. are obtained as described in TS 24.229 [4].

The operator X implements the IBCF policy to allow OMR optimization of anchoring if originating UE is a visiting/roaming user respectively if terminating UE is a visiting/roaming user.

The operator Y implements the IBCF policy to allow OMR optimization of anchoring if home UE is visiting/roaming in another network.

A.3 Media bypassing all IMS-ALGs

A.3.1 General

This clause provides an example of a call where the media is bypassing all IMS-ALG and sent directly between the UEs.

A.3.2 Message flow

This clause describes the scenario when two mobile user A and B roams into a visited network X and both users belongs to the same operator Y.

Preconditions:

- Both user A and B are registered to the Home IMS network Y via the visited operator X network;
- the visited operator X and the operator of user A and B IMS home network Y have an agreement to allow media to be bypassed using OMR;
- both user A and B are connected to IP realm Xa of the visited operator network X;
- the AMR codec is allowed and accepted by all involved entities; and
- no B2BUA manipulating SDP is connected in the intermediate IM CN subsystem.

Figure A.3.2-1 shows the message flow for the scenario.

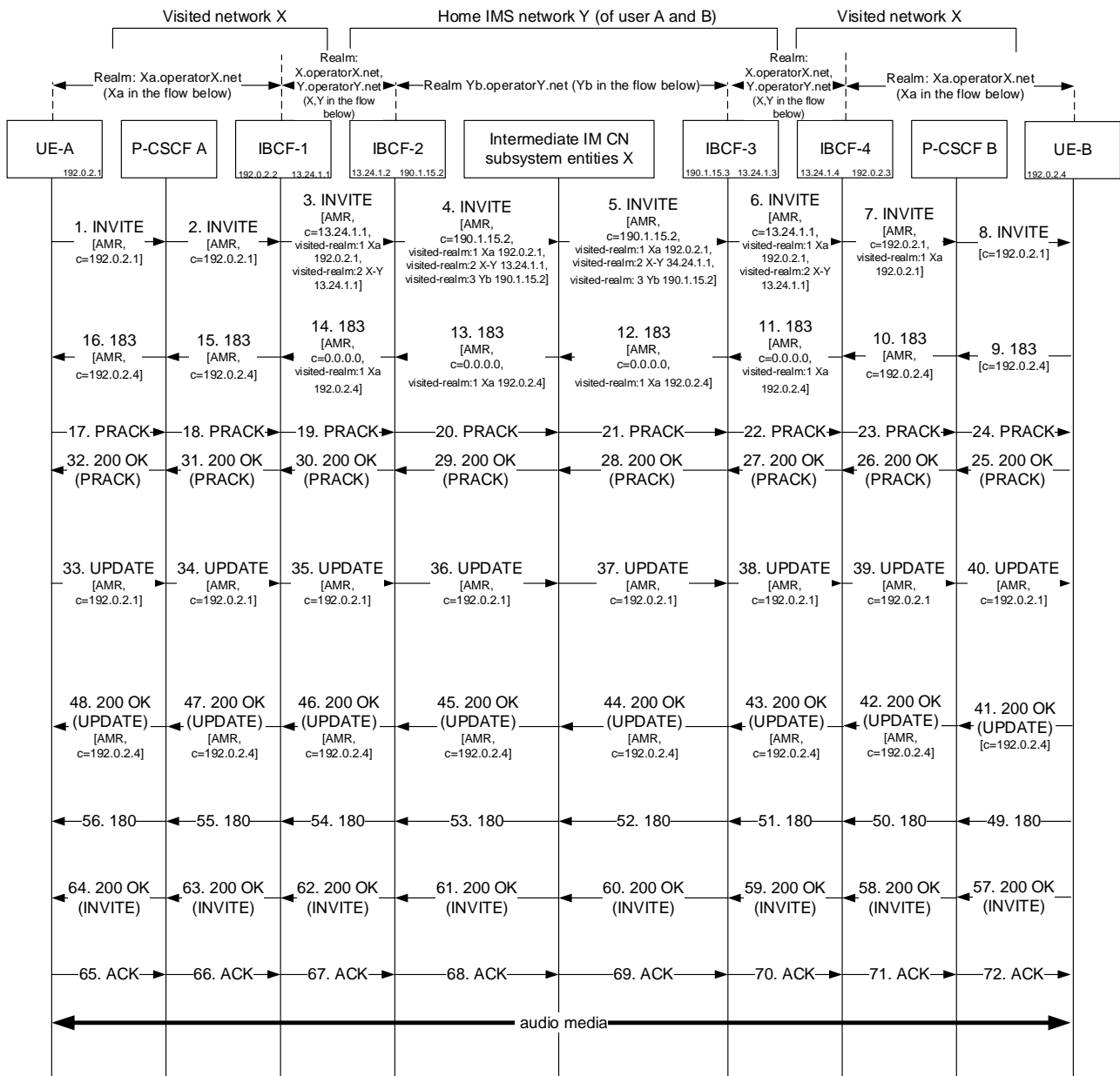


Figure A.3.2-1: Signalling flow for media bypassing all IMS ALGs

NOTE: For clarity, the SIP 100 (Trying) messages are not shown in the signalling flow.

The steps of the flow are as follows:

1. INVITE request (UE-A to P-CSCF-A) - see example in table A.3.2-1.

The UE-A sends a SIP INVITE request including an initial SDP offer according to TS 24.229 [4].

Table A.3.2-1: SIP INVITE request (UE-A to P-CSCF-A)

```

INVITE SIP: user_B@operator_Y.net; SIP/2.0

SIP headers according to 3GPP TS 24.229 [4]

Content-Type: application/sdp
Content-Length: (...)

v=0
o=- 2987933615 2987933615 IN IP4 192.0.2.1
s=
t=0 0
c=IN IP4 192.0.2.1
m=audio 49170 RTP/AVP 96 97
a=curr:gosp local none
a=curr:gosp remote none
a=des:gosp mandatory local sendrecv
a=des:gosp none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; mode-change-period=2
a=rtpmap:96 telephone-event
a=maxptime:20

```

2. INVITE request (P-CSCF-A to IBCF-1) - see example in table A.3.2-1.

The P-CSCF-A uses the procedures in clauses 6.1.5, 6.1.7 and 6.1.9 since no MR could be bypassed and no MR is allocated.

The P-CSCF-A:

- uses the connection-address from the SDP c-line as incoming connection-address in subsequent steps;
- uses the port information from the SDP m-line as incoming port information in subsequent steps;
- uses the codec information from the SDP m-line in subsequent steps;
- inserts the incoming codec information into the SDP m-line and associated attribute lines of the modified initial SDP offer;
- uses the incoming connection address as the connection address in the SDP c-line of the forwarded initial SDP offer, and
- use the incoming port information as port information in the SDP m-line of the modified initial SDP offer.

The P-CSCF-A then selects an IBCF, IBCF-1, in the IP realm "Xa.operatorX.net" and forwards the INVITE request with the initial SDP offer to the IBCF-1 according to TS 24.229 [4].

3. INVITE request (IBCF-1 to IBCF-2) - see example in table A.3.2-3

The IBCF-1 uses the procedures in clauses 6.1.5, 6.1.6 and 6.1.9 since no previous realm instance offers an opportunity to bypass a previous MR and a local MR is required for IP realm matching.

The IBCF-1:

- uses the connection-address from the SDP c-line as incoming connection-address in subsequent steps;
- uses the port information from the SDP m-line as incoming port information in subsequent steps;
- uses the codec information from the SDP m-line in subsequent steps;
- allocates an MR context with access to the IP realms and addrtypes associated with the incoming and outgoing signalling paths;
- inserts the incoming connection address and incoming port information for the media line into the remote connection address and port information for the incoming termination on the MR;
- provides to the MR the incoming codec information;

- replaces the connection address and port information for the media line in the initial SDP offer with the connection address and port information from the MR termination on the outgoing side;
- constructs and adds a visited-realm instance for the media line in the received initial SDP offer to the modified initial SDP offer;
- adds to the modified initial SDP offer a visited-realm instance for the IP realm associated with the connection address and port information for the media line in the modified initial SDP offer, including the incoming codec; and
- computes a checksum value for the media line as described in clause 5.6.3 and adds the "omr-m-cksum" and "omr-s-cksum" attributes for the media line. The "omr-s-cksum" is set to "0" since there are no session attributes to compute the checksum on.

The IBCF-1 then selects an IBCF, IBCF-2, in the IP realm "X-Y.operatorX.net" and forwards the INVITE request with the initial SDP offer to the IBCF-2 according to TS 24.229 [4].

Table A.3.2-3: SIP INVITE request (IBCF-1 to IBCF-2)

```
INVITE SIP: user_B@operator_Y.net; SIP/2.0

SIP headers according to 3GPP TS 24.229 [4]

Content-Type: application/sdp
Content-Length: (...)

v=0
o=- 2987933615 2987933615 IN IP4 192.0.2.1
s=
t=0 0
c=IN IP4 13.24.1.1
m=audio 62111 RTP/AVP 96 97
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; mode-change-period=2
a=rtpmap:96 telephone-event
a=maxptime:20
a=visited-realm:1 Xa.operatorX.net IN IP4 192.0.2.1 49170
a=visited-realm:2 X-Y.operator.netX IN IP4 13.24.1.1 62111
a=omr-m-cksum:(..)
a=omr-s-cksum:0
```

4-5. INVITE request (IBCF-2 to IBCF-3 via intermediate IMS CN subsystem entities) - see example in table A.3.2-4.

The IBCF-2 uses the procedure in clauses 6.1.5, 6.1.6 and 6.1.9 since no realm instance offers an opportunity to bypass a previous MR and a local MR is required for IP realm matching.

The IBCF-2:

- uses the connection-address from the SDP c-line as incoming connection-address in subsequent steps;
- uses the port information from the SDP m-line as incoming port information in subsequent steps;
- uses the codec information from the SDP m-line and associated non-OMR attribute lines as incoming codec information in subsequent steps;
- allocates an MR context with access to the IP realms, nettypes and addrtypes associated with the incoming and outgoing signalling paths, respectively, applying procedures as described in clause 6.3,
- insert the incoming connection address and incoming port information for the media line into the remote connection address and port information for the incoming termination on the MR;
- provides to the MR the incoming codec information;
- replaces the connection address and port information for the media line in the initial SDP offer with the connection address and port information from the MR termination on the outgoing side;

- adds to the modified SDP offer a visited-realm instance for the IP realm associated with the connection address and port information for the media line in the modified initial SDP offer, including the incoming codec; and
- computes a checksum value for the media line as described in clause 5.3.4 and adds the "omr-m-cksum" and "omr-s-cksum" attributes for the media line. The "omr-s-cksum" attribute is set to "0" since there are no session attributes to compute the checksum on..

The IBCF-2 forwards the INVITE request to the intermediate IMS CN subsystem entities in IP realm "Yb.operatorY.net" according to TS 24.229 [4].

None of the intermediate IMS CN subsystem entities manipulated with the initial SDP offer but the identity of [user_B@operator_Y.net](#) in the Request-URI is change to the contact address, i.e. UE-B@operatorX.net.

The intermediate IMS CN subsystem entities select an IBCF, IBCF-3, and forward the INVITE request with the initial SDP offer to the IBCF-3 according to TS 24.229 [4].

Table A.3.2-4: SIP INVITE request (IBCF-2 to IBCF-3 via intermediate IMS CN subsystem entities)

<pre> INVITE SIP: sip:UE-B@operatorX.net; SIP/2.0 SIP headers according to 3GPP TS 24.229 [4] Content-Type: application/sdp Content-Length: (...) v=0 o=- 2987933615 2987933615 IN IP4 192.0.2.1 s= t=0 0 c=IN IP4 190.1.15.2 m=audio 11324 RTP/AVP 96 07 a=curr:qos local none a=curr:qos remote none a=des:qos mandatory local sendrecv a=des:qos none remote sendrecv a=rtpmap:97 AMR a=fmtp:97 mode-set=0,2,5,7; mode-change-period=2 a=rtpmap:96 telephone-event a=maxptime:20 a=visited-realm:1 Xa.operatorX.net IN IP4 192.0.2.1 49170 a=visited-realm:2 X-Y.operator.netX IN IP4 13.24.1.1 62111 a=visited-realm:3 Yb.operatorY.net IN IP4 190.1.15.2 11324 a=omr-m-cksum:(..) a=omr-s-cksum:0 </pre>
--

6. INVITE request (IBCF-3 to IBCF-4) - see example in table A.3.2-6.

The IBCF-3 uses the procedures in clauses 6.1.4, 6.1.7 and 6.1.9 since a previous realm instance exists that can be used to bypass a previous MR, IBCF-2, and bypass is allowed according to operator X and operator Y agreements, and the previous realm instance match the outgoing IP realm so that no local MR is required.

The IBCF-3:

- uses the connection address and port information for the media line in the initial SDP offer with the connection-address and port information from the selected instance 2 as incoming connection address and incoming port information for the media line;
- deletes the visited-realm instance 3;
- inserts the incoming codec information into the SDP m-line and associated attribute lines of the modified initial SDP offer;
- uses the incoming connection address as the connection address in the SDP c-line of the forwarded initial SDP offer;
- uses the incoming port information as port information in the SDP m-line of the modified initial SDP offer; and

- computes a checksum value for the media line as described in clause 5.3.4 and adds the "omr-m-cksum" and "omr-s-cksum" attributes for the media line. The "omr-s-cksum" attribute is set to "0" since there are no session attributes to compute the checksum on.

The IBCF-3 then selects an IBCF, IBCF-4, in the IP realm "X.operatorX.net, Y.operatorY.net" and forwards the initial SDP offer according to TS 24.229 [4] to IBCF-4.

Table A.3.2-6: SIP INVITE request (IBCF-3 to IBCF-4)

<pre> INVITE SIP: sip:UE-B@operatorX.net; SIP/2.0 SIP headers according to 3GPP TS 24.229 [4] Content-Type: application/sdp Content-Length: (...) v=0 o=- 2987933615 2987933615 IN IP4 192.0.2.1 s= t=0 0 c=IN IP4 13.24.1.1 m=audio 62111 RTP/AVP 96 07 a=curr:qos local none a=curr:qos remote none a=des:qos mandatory local sendrecv a=des:qos none remote sendrecv a=rtpmap:97 AMR a=fmtp:97 mode-set=0,2,5,7; mode-change-period=2 a=rtpmap:96 telephone-event a=maxptime:20 a=visited-realm:1 Xa.operatorX.net IN IP4 192.0.2.1 49170 a=visited-realm:2 X-Y.operator.netIN IP4 13.24.1.1 62111 a=omr-m-cksum:(..) a=omr-s-cksum:0 </pre>
--

7. INVITE request (IBCF-4 to P-CSCF B) - see example in table A.3.2-7.

The IBCF-4 uses the procedures in clauses 6.1.4, 6.1.7 and 6.1.9 since a previous realm instance exists that can be used to bypass a previous MR, IBCF-1, and the previous realm instance match the outgoing IP realm so that no local MR is required.

The IBCF-4:

- uses the connection address and port information for the media line in the initial SDP offer with the connection-address and port information from the selected instance 1 as incoming connection address and incoming port information for the media line;
- deletes the visited-realm instance 2;
- inserts the incoming codec information into the SDP m-line and associated attribute lines of the modified initial SDP offer;
- uses the incoming connection address as the connection address in the SDP c-line of the forwarded initial SDP offer;
- uses the incoming port information as port information in the SDP m-line of the modified initial SDP offer; and
- computes a checksum value for the media line as described in clause 5.3.4 and adds the "omr-m-cksum" and "omr-s-cksum" attributes for the media line. The "omr-s-cksum" attribute is set to "0" since there are no session attributes to compute the checksum on.

The IBCF-4 forwards the INVITE request with the initial SDP offer to the P-CSCF-B, in the IP realm "X.operatorX.net" according to TS 24.229 [4].

Table A.3.2-7: SIP INVITE request (IBCF-4 to P-CSCF B)

```

INVITE SIP: sip:UE-B@operatorX.net; SIP/2.0

SIP headers according to 3GPP TS 24.229 [4]

Content-Type: application/sdp
Content-Length: (...)

v=0
o=- 2987933615 2987933615 IN IP4 192.0.2.1
s=
t=0 0
c=IN IP4 192.0.2.1
m=audio 49170 RTP/AVP 96 97
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; mode-change-period=2
a=rtpmap:96 telephone-event
a=maxptime:20
a=visited-realm:1 Xa.operatorX.net IN IP4 192.0.2.1 49170
a=omr-m-cksum:(..)
a=omr-s-cksum:0

```

8. INVITE request (P-CSCF to UE- B) - see example in table A.3.2-8.

The P-CSCF-B uses the procedures in clauses 6.1.5, 6.1.7 and 6.1.9 since no previous realm instance offers an opportunity to bypass an MR and no local MR is required to match the incoming realm to the outgoing realm.

- uses the connection-address from the SDP c-line as incoming connection-address;
- uses the port information from the SDP m-line as incoming port information;
- uses the codec information from the SDP m-line and associated non-OMR attribute lines as incoming codec information; and
- according to the local policy, deletes the visited-realm "visited-realm:1 Xa.operatorX.net IN IP4 192.0.2.1 49170", the "omr-m-cksum:(...)" and the "omr-s-cksum=:0" attributes from the SDP offer.

The P-CSCF-B forwards the INVITE request with the initial SDP offer to the UE-B according to TS 24.229 [4].

Table A.3.2-8: SIP INVITE request (P-CSCF to UE-B)

```

INVITE SIP: sip:UE-B@operatorX.net; SIP/2.0

SIP headers according to 3GPP TS 24.229 [4]

Content-Type: application/sdp
Content-Length: (...)

v=0
o=- 2987933615 2987933615 IN IP4 192.0.2.1
s=
t=0 0
c=IN IP4 192.0.2.1
m=audio 49170 RTP/AVP 96 97
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; mode-change-period=2
a=rtpmap:96 telephone-event
a=maxptime:20

```

9. 183 (Session Progress) response (UE-B to P-CSCF-B) - see example in table A.3.2-9.

The UE accepts the codec and sends a 183 (Session Progress) response with an initial SDP answer indicating that resources are not yet available to P-CSCF-B according to TS 24.229 [4].

Table A.3.2-9: 183 (Session Progress) response (UE-B to P-CSCF-B)

<pre> SIP/2.0 183 Session Progress SIP headers according to 3GPP TS 24.229 [4] Content-Type: application/sdp Content-Length: (...) v=0 o=- 2987933615 2987933615 IN IP4 192.0.2.1 s=- c=IN IP4 192.0.2.4 t=0 0 m=audio 16511 RTP/AVP 97 98 a=curr:qos local none a=curr:qos remote none a=des:qos mandatory local sendrecv a=des:qos none remote sendrecv a=rtptime:98 AMR a=fmtp:98 mode-set=0,2,5,7; mode-change-period=2 a=rtptime:97 telephone-event a=maxptime:20 </pre>
--

10. 183 (Session Progress) response (P-CSCF-B to IBCF-4) - see example in table A.3.2-9

The P-CSCF-B uses the procedures in clauses 6.2.7 and 6.2.9 since the connection address is valid and no primary local MR was allocated.

The P-CSCF-B:- does not modify the initial SDP answer and forwards the 183 (Session Progress) response with the initial SDP answer to IBCF-4 according to TS 24.229 [4].

11. 183 (Session Progress) response (IBCF-4 to IBCF-3) - see example in table A.3.2-11

The IBCF-4 uses the procedures in clause 6.2.7 and 6.2.9 since the connection address is valid and no primary local MR was allocated.

The IBCF-4:

- copies into the media line of the initial SDP answer the visited-realm instance 1 from the media line of the received initial SDP offer that was used to populate the connection address and port information in the forwarded initial SDP offer, replacing the connection-address and port information in the instance with the connection address and port information from the received initial SDP answer; and
- replaces the connection address information in the initial SDP answer with the unspecified IPv4 address.

The IBCF-4 forwards the 183 (Session Progress) response with the initial SDP answer to IBCF-3 according to TS 24.229 [4].

Table A.3.2-11 183 (Session Progress) response (IBCF-4 to IBCF-3)

<pre> SIP/2.0 183 Session Progress SIP headers according to 3GPP TS 24.229 [4] Content-Type: application/sdp Content-Length: (...) v=0 o=- 2987933615 2987933615 IN IP4 192.0.2.1 s=- c=IN IP4 0.0.0.0 t=0 0 m=audio 16511 RTP/AVP 97 98 a=curr:qos local none a=curr:qos remote sendrecv a=des:qos mandatory local sendrecv a=des:qos none remote sendrecv a=rtpmap:98 AMR a=fmtp:98 mode-set=0,2,5,7; mode-change-period=2 a=rtpmap:97 telephone-event a=maxptime:20 a=visited-realm:1 Xa.operatorX.net IN IP4 192.0.2.4 16511 </pre>

12-13. 183 (Session Progress) response (IBCF-3 to IBCF-2 via intermediate IMS CN subsystem entities) - see example in table A.3.2-11

The IBCF-3 uses the procedures in clauses 6.2.5 and 6.2.9 since the initial SDP answer contained an unspecified connection address and a realm instance matching one in the received initial SDP offer and since no primary local MR was allocated.

The IBCF-3 does not modify the initial SDP answer since the visited-realm instance does not match the information in the initial SDP offer.

The IBCF-3 then forwards the 183 (Session Progress) response with the initial SDP answer to intermediate IMS CN subsystem entities according to TS 24.229 [4].

The intermediate IMS CN subsystem entities do not modify the initial SDP answer and forwards the 183 (Session Progress) response with the initial SDP answer to IBCF-2 according to TS 24.229 [4].

14. 183 (Session Progress) response (IBCF-2 to IBCF-1) - see example in table A.3.2-11

The IBCF-2 uses the procedures in clauses 6.2.5 and 6.2.9 since the initial SDP answer contained an unspecified connection address and a realm instance matching one in the received initial SDP offer and the local MR allocated in step 4 can be bypassed.

The IBCF does not modify the initial SDP answer since the visited-realm instance does not match the information in the initial SDP offer.

The IBCF-2 forwards the 183 (Session Progress) response with the initial SDP answer to IBCF-1 according to TS 24.229 [4].

The IBCF-2 retains the primary local MR allocated in step 4, until it is no longer potentially needed for this and any other forked dialog.

15. 183 (Session Progress) response (IBCF-1 to P-CSCF-A) - see example in table A.3.2-15

The IBCF-1 uses the procedures in clauses 6.2.5 and 6.2.8 since the initial SDP answer contained an unspecified connection address and a realm instance matching one in the received initial SDP offer and the local MR allocated in step 3 can be bypassed.

The IMS-ALG:

- replaces the connection address and port information for the media line in the initial SDP answer with the connection address and port information from the visited-realm instance in the received initial SDP answer.

The IBCF-1 forwards the 183 (Session Progress) response with the initial SDP answer to P-CSCF-A according to TS 24.229 [4].

The IBCF-1 retains the primary local MR allocated in step 3, until it is no longer potentially needed for this and any other forked dialog.

Table A.3.2-15: 183 (Session Progress) response (IBCF-1 - P-CSCF-A)

<pre> SIP/2.0 183 Session Progress SIP headers according to 3GPP TS 24.229 [4] Content-Type: application/sdp Content-Length: (...) v=0 o=- 2987933615 2987933615 IN IP4 192.0.2.1 s=- c=IN IP4 192.0.2.4 t=0 0 m=audio 16511 RTP/AVP 97 98 a=curr:qos local none a=curr:qos remote sendrecv a=des:qos mandatory local sendrecv a=des:qos none remote sendrecv a=rtpmap:98 AMR a=fmtp:98 mode-set=0,2,5,7; mode-change-period=2 a=rtpmap:97 telephone-event a=maxptime:20 </pre>
--

16. 183 (Session Progress) response (P-CSCF-A to UE-A) - see example in table A.3.2-15

The P-CSCF-A:

- forwards the 183 (Session Progress) with the initial SDP answer to the UE-A according to TS 24.229 [4]; and
- deletes the visited-realm instance according to local policy.

17-24. PRACK request (UE-A to UE-B via P-CSCF-A, IBCF-1, IBCF-2, intermediate IMS CN subsystem entities, IBCF-3, IBCF-4 and P-CSCF-B).

The UE-A acknowledges the reception of the initial SDP answer and the 183 (Session Progress) response by means of a PRACK request.

25-32. 200 (OK) response to the PRACK request (UE-B to UE-A via P-CSCF-B, IBCF-4, IBCF-3, intermediate IMS CN subsystem entities, IBCF-2, IBCF-1 and P-CSCF-A).

The UE-B acknowledges the reception of the PRACK request by means of a 200 (OK) response.

33. UPDATE request (UE-A to P-CSCF-A) - see example in table A.3.2-33.

When the UE-B has got resources reserved the UE-B sends an UPDATE request.

The subsequent SDP offer in the UPDATE the request is the same as the initial SDP offer in the INVITE request in the step 1 with the only exception that "a=curr:qos local none" is now changed to "a=curr:qos local sendrecv".

Table A.3.2-33: UPDATE request (UE-A to P-CSCF-A)

<pre> UPDATE SIP: sip:UE-A@operatorX.net; SIP/2.0 SIP headers according to 3GPP TS 24.229 [4] Content-Type: application/sdp Content-Length: (...) v=0 o=- 2987933615 2987933616 IN IP4 192.0.2.4 s=- c=IN IP4 192.0.2.4 t=0 0 m=audio 16511 RTP/AVP 97 98 a=curr:gqos local sendrecv a=curr:gqos remote none a=des:gqos mandatory local sendrecv a=des:gqos none remote sendrecv a=rtpmap:98 AMR a=fmtp:98 mode-set=0,2,5,7; mode-change-period=2 a=rtpmap:97 telephone-event a=maxptime:20 </pre>
--

34-40. UPDATE request (P-CSCF-A to UE-B via IBCF-1, IBCF-2, intermediate IMS CN subsystem entities, IBCF-3, IBCF-4 and P-CSCF-B).

34) When the P-CSCF-A receives the UPDATE request, the P-CSCF-A forwards the UPDATE request without modifying the subsequent SDP offer.

35) When the IBCF-1 receives the UPDATE request, the IBCF-1 forwards the UPDATE request without modifying the subsequent SDP offer.

36) When the IBCF-2 receives the UPDATE request, the IBCF-2 forwards the UPDATE request without modifying the subsequent SDP offer.

37) Intermediate IMS CN subsystem entities do not manipulate the SDP offer.

38) When the IBCF-3 receives the UPDATE request, the IBCF-3 forwards the UPDATE request without modifying the subsequent SDP offer.

39) When the IBCF-4 receives the UPDATE request, the IBCF-4 forwards the UPDATE request without modifying the subsequent SDP offer.

40) When the P-CSCF-B receives the UPDATE request, the P-CSCF-B forwards the UPDATE request without modifying the subsequent SDP offer.

41. 200 (OK) response to the UPDATE request (UE-B to P-CSCF-B) - see example in table A.3.2-41.

The UE-B acknowledges the reception of the UPDATE request by means of a 200 (OK) response containing a subsequent SDP answer.

Table A.3.2-41: 200 (OK) response to the UPDATE request (UE-B to P-CSCF-B).

```

SIP/2.0 200 OK
Via:
To: <sip:user_A@operator_Y.net>; tag=171828
From: <sip:user_B@operator_Y.net>; tag=543210
Call-ID: cb03a0s09a2sdfglkj490237
CSeq:
P-Preferred-Identity:
Contact: sip:UE-B@operatorX.net;gr=urn:uuid:354faf-7dad-22a1-b123-8a0d21f676f
Allow:
Content-Type: application/sdp
Content-Length: (...)

v=0
o=- 2987933615 2987933615 IN IP4 192.0.2.4
s=
t=0 0
c=IN IP4 192.0.2.1
m=audio 49170 RTP/AVP 97 98
a=curr:gqos local sendrecv
a=curr:gqos remote sendrecv
a=des:gqos mandatory local sendrecv
a=des:gqos none remote sendrecv
a=rtpmap:97 AMR
a=fmtp:97 mode-set=0,2,5,7; mode-change-period=2
a=rtpmap:96 telephone-event
a=maxptime:20

```

42-48. 200 (OK) response to the UPDATE request (P-CSCF-B to UE-A via IBCF-4, IBCF-3, intermediate IMS CN subsystem entities, IBCF-2 and IBCF-1).

- 42) When P-CSCF-B receives the 200 (OK) response to the UPDATE request, the P-CSCF-B forwards the response without modifying the subsequent SDP answer.
- 43) When IBCF-4 receives the 200 (OK) response to the UPDATE request, the IBCF-4 forwards the response without modifying the subsequent SDP answer.
- 44) When IBCF-3 receives the 200 (OK) response to the UPDATE request, the IBCF-3 forwards the response without modifying the subsequent SDP answer.
- 45) The intermediate IMS CN subsystem entities do not manipulate the SDP answer.
- 46) When IBCF-2 receives the 200 (OK) response to the UPDATE request, the IBCF-2 forwards the response without modifying the subsequent SDP answer.
- 47) When IBCF-1 receives the 200 (OK) response to the UPDATE request, the IBCF-1 forwards the response without modifying the subsequent SDP answer.
- 48) When P-CSCF-A receives the 200 (OK) response to the UPDATE request, the P-CSCF-A forwards the response without modifying the subsequent SDP answer.

49-56. 180 (Ringing) response (UE-B to UE-A via P-CSCF-B, IBCF-4, IBCF-3, intermediate IMS CN subsystem entities, IBCF-2, IBCF-1 and P-CSCF-A).

No OMR specific action is required.

57-64. 200 (OK) response to the INVITE request (UE-B to UE-A via P-CSCF-B, IBCF-4, IBCF-3, intermediated IMS CN subsystem, IBCF-2, IBCF-1 and P-CSCF-A).

The User B accepts the call and the UE-B sends a 200 (OK) response to the INVITE request. No OMR specific action is required.

65-72. ACK request (UE-A to UE-B via P-CSCF-A, IBCF-1, IBCF-2, intermediated IMS CN subsystem, IBCF-3, IBCF-4 and P-CSCF-B).

The UE-B acknowledges the reception of the 200 (OK) response by means of a 200 (OK) response.

A.4 IMS-ALG allocates a local transcoding MR when performing proactive transcoding without resource reservation

A.4.1 General

This clause provides an example of a call where a transcoding MR adds the AMR codec to the initial SDP offer without MR allocation.

The UE selects the added codec and the IMS-ALG needs to reserve MR and send an UPDATE request with the IP address and port number of the allocated MR.

The IMS-ALG is transcoding between the AMR-WB codec and the AMR codec when the call is established.

Figure A.4.1-1 shows the realm and IP structure used in this example.

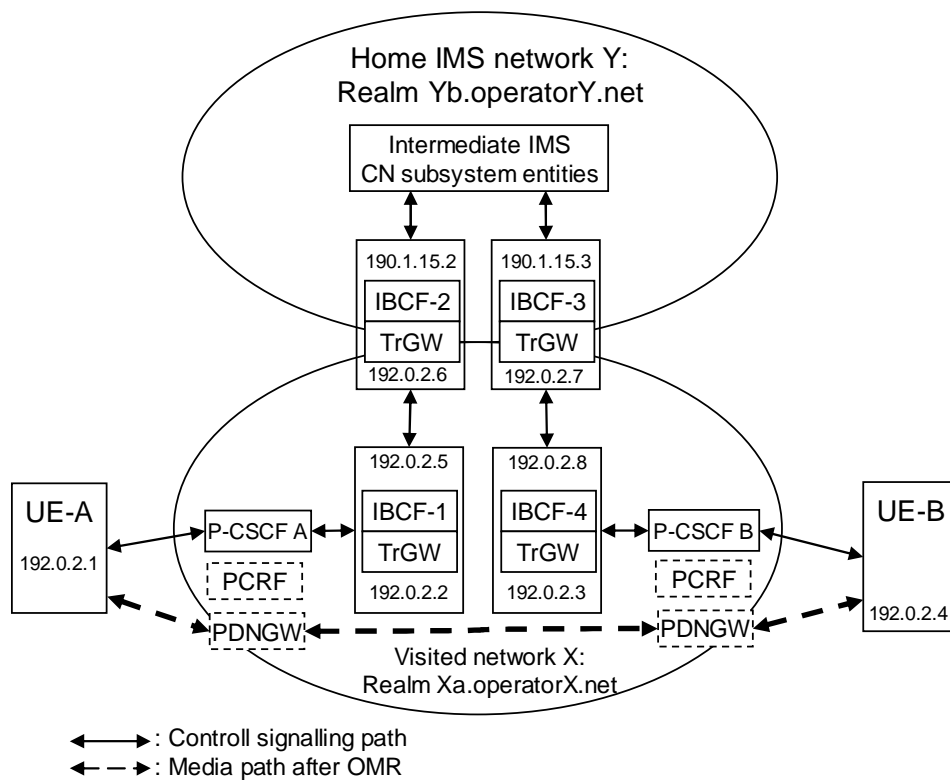


Figure A.4.1-1: IP realm and IP structure

A.4.2 Message flow

The user A at UE-A and the user B at UE-B are roaming into a visited network X and both users belong to the same operator Y.

Preconditions:

- Both user A and B are registered to the Home IMS network Y via the visited operator X network;
- the visited operator X and the operator Y have an agreement to allow media to be bypassed using OMR;

- both user A and B are connected to the realm "Xa.operatorX.net" of the visited operator network X;
- the AMR-WB codec is allowed and accepted by all involved entities. However, the local policy of operator X is that the AMR codec shall always be included in the initial SDP offer from a UE in the operator X network; and
- no B2BUA manipulating SDP is connected in the intermediate IM CN subsystem.

Figure A.4.2-1 shows the message flow for the scenario.

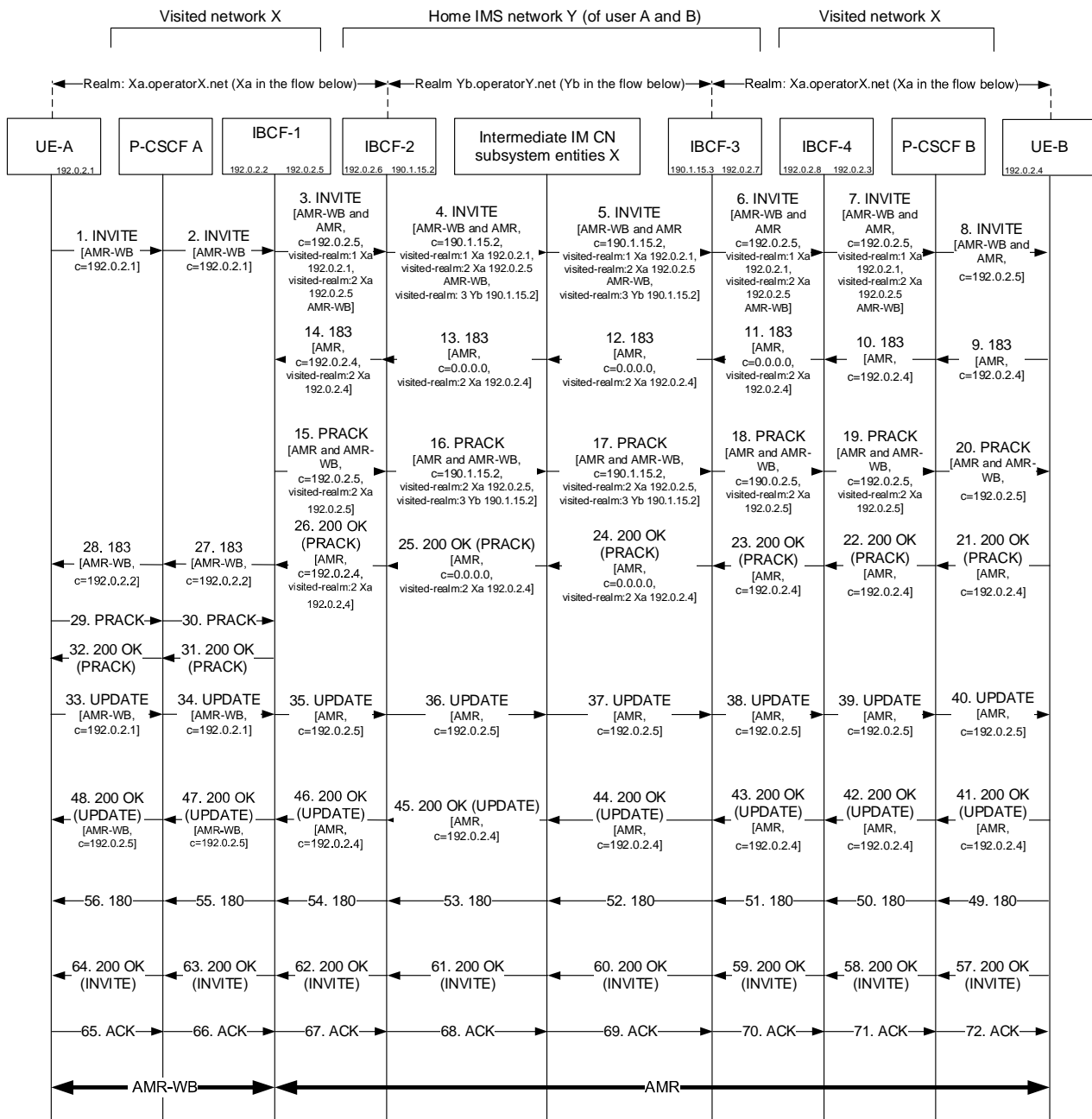


Figure A.4.2-1: Message flow for proactive transcoder without resource reservation

NOTE: For clarity, the SIP 100 (Trying) messages are not shown in the signalling flow.

The steps of the flow are as follows:

1. INVITE request (UE-A to P-CSCF-A) - see example in table A.4.2-1.

The UE-A sends a SIP INVITE request according to TS 24.229 [4]. The INVITE request includes an initial SDP offer proposing the use of the AMR-WB codec and inband DTMF.

Table A.4.2-1: SIP INVITE request (UE-A to P-CSCF-A)

```

INVITE SIP: user_B@operator_Y.net; SIP/2.0

SIP headers according to 3GPP TS 24.229 [4]

Content-Type: application/sdp
Content-Length: (...)

v=0
o=- 2987933615 2987933615 IN IP4 192.0.2.1
s=
b=AS:30
b=RS:0
b=RR:2000
c=IN IP4 192.0.2.1
m=audio 49170 RTP/AVP 96 97
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:96 telephone-event
a=rtpmap:97 AMR-WB/16000/1
a=fmtp:97 mode-change-capability=2; max-red=220
a=ptime:20
a=maxptime:240

```

2. INVITE request (P-CSCF-A to IBCF-1) - see example in table A.4.2-1.

The P-CSCF-A uses the procedures in clauses 6.1.5, 6.1.7 and 6.1.9 since no MR could be bypassed and no MR is allocated.

The P-CSCF-A:

- uses the connection-address from the SDP c-line as incoming connection-address;
- uses the port information from the SDP m-line as incoming port information;
- uses the codec information from the SDP m-line;
- inserts the incoming codec information into the SDP m-line and associated attribute lines of the modified initial SDP offer;
- uses the incoming connection address as the connection address in the SDP c-line of the forwarded initial SDP offer, and
- uses the incoming port information as port information in the SDP m-line of the modified initial SDP offer.

The P-CSCF-A then selects an IBCF, IBCF-1, in the realm "Xa.operatorX.net" and forwards the INVITE request with the initial SDP offer to the IBCF-1 according to TS 24.229 [4].

3. INVITE request (IBCF-1 to IBCF-2) - see example in table A.4.2-3

The IBCF-1 uses the procedures in clauses 6.1.5, 6.1.7 and 6.1.9 since no previous realm instance offers an opportunity to bypass a previous MR and a local MR is not required for realm matching. The IBCF-1 has access to a transcoding MR.

The IBCF-1:

- uses the connection-address from the SDP c-line as incoming connection-address;
- uses the port information from the SDP m-line as incoming port information;
- uses the codec information from the SDP m-line;
- constructs and adds to the modified initial SDP offer a visited-realm instance 1 for the media line associated with the connection address and port information for the media line in the received initial SDP offer;

- makes the codec changes to incoming codec information according to local policy, taking into account the procedures in clause 5.4, and inserts the AMR codec information into the SDP m-line and associated attribute lines of the modified initial SDP offer;
- adds to the modified initial SDP offer a visited-realm instance 2 with the same IP realm, connection address and port information as in the previous visited-realm instance 1 for the media line including the incoming codec information; and
- computes a checksum value for the media line as described in clause 5.6.3 and adds omr-m-cksum and omr-s-cksum attributes for the media line. The omr-s-cksum is set to "0" since there are no session line attributes left to calculate the checksum on.

The IBCF-1 then selects an IBCF, IBCF-2, in the realm "Xa.operatorX.net" and forwards the INVITE request with the initial SDP offer to the IBCF-2 according to TS 24.229 [4].

Table A.4.2.2-3: SIP INVITE request (IBCF-1 to IBCF-2)

```

INVITE SIP: user_B@operator_Y.net; SIP/2.0

SIP headers according to 3GPP TS 24.229 [4]

Content-Type: application/sdp
Content-Length: (...)

v=0
o=- 2987933615 2987933615 IN IP4 192.0.2.1
s=
c=IN IP4 192.0.2.5
m=audio 49170 RTP/AVP 96 97 98
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:96 telephone-event
a=rtpmap:97 AMR-WB/16000/1
a=fmtp:97 mode-change-capability=2; max-red=220
a=rtpmap:98 AMR/8000/1
a=fmtp:98 mode-change-capability=2; max-red=220; octet-align=1
a=ptime:20
a=maxptime:240
b=AS:30
b=RS:0
b=RR:2000
a=visited-realm:1 Xa.operatorX.net IN IP4 192.0.2.1 49170
a=visited-realm:2 Xa.operatorX.net IN IP4 192.0.2.5 49170
a=omr-codecs:2 audio RTP/AVP 96 97
a=omr-m-att:2 rtpmap:96 telephone-event
a=omr-m-att:2 rtpmap:97 AMR-WB/16000/1
a=omr-m-att:2 fmtp:97 mode-change-capability=2; max-red=220
a=omr-m-att:2 curr:qos local none
a=omr-m-att:2 curr:qos remote none
a=omr-m-att:2 des:qos mandatory local sendrecv
a=omr-m-att:2 des:qos none remote sendrecv
a=omr-m-att:2 ptime:20
a=omr-m-att:2 maxptime:240
a=omr-s-bw:2 AS:30
a=omr-s-bw:2 RS:0
a=omr-s-bw:2 RR:2000
a=omr-m-cksum:(..)
a=omr-s-cksum:0

```

4-5. INVITE request (IBCF-2 to IBCF-3 via intermediate IMS CN subsystem entities) - see example in table A.4.2-4.

The IBCF-2 uses the procedure in clauses 6.1.5, 6.1.6 and 6.1.9 since no realm instance offers an opportunity to bypass a previous MR and a local MR is required for realm matching.

The IBCF-2:

- uses the connection-address from the SDP c-line as incoming connection-address;
- uses the port information from the SDP m-line as incoming port information;

- uses the codec information from the SDP m-line and associated non-OMR attribute lines as incoming codec information;
- allocates an MR context with access to the IP realms, nettypes and addrtypes associated with the incoming connection address and port information and outgoing signalling paths, respectively, applying procedures as described in clause 6.3,
- insert the incoming connection address and incoming port information for the media line into the remote connection address and port information for the incoming termination on the MR;
- provides to the MR the incoming codec information;
- replaces the connection address and port information for the media line in the initial SDP offer with the connection address and port information from the MR termination on the outgoing side;
- adds to the modified initial SDP offer a visited-realm instance 3 for the IP realm associated with the connection address and port information for the media line in the modified initial SDP offer;
- computes a checksum value for the media line as described in clause 5.6.3 and adds the omr-m-cksum and omr-s-cksum attributes for the media line. The omr-s-cksum attribute is set to "0" since there are no session line attributes to compute the checksum on; and
- forwards the INVITE request to the intermediate IMS CN subsystem entities in realm "Yb.operatorY.net" according to TS 24.229 [4].

None of the intermediate IMS CN subsystem entities manipulated with the initial SDP offer but the identity of [user_B@operator_Y.net](#) in the Request-URI is change to the contact address, i.e. UE-B@operatorX.net.

The intermediate IMS CN subsystem entities select an IBCF, IBCF-3, and forward the INVITE request with the initial SDP offer to the IBCF-3 according to TS 24.229 [4].

Table A.4.2-4: SIP INVITE request (IBCF-2 to IBCF-3 via intermediate IMS CN subsystem entities)

```

INVITE SIP: sip:user_B@operatorX.net; SIP/2.0

SIP headers according to 3GPP TS 24.229 [4]

Content-Type: application/sdp
Content-Length: (...)

v=0
o=- 2987933615 2987933615 IN IP4 192.0.2.1
s=
c=IN IP4 190.1.15.2
m=audio 11324 RTP/AVP 96 97 98
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:96 telephone-event
a=rtpmap:97 AMR-WB/16000/1
a=fmtp:97 mode-change-capability=2; max-red=220
a=rtpmap:98 AMR/8000/1
a=fmtp:98 mode-change-capability=2; max-red=220; octet-align=1
a=ptime:20
a=maxptime:240
b=AS:30
b=RS:0
b=RR:2000
a=visited-realm:1 Xa.operatorX.net IN IP4 192.0.2.1 49170
a=visited-realm:2 Xa.operatorX.net IN IP4 192.0.2.5 49170
a=omr-codecs:2 audio RTP/AVP 96 97
a=omr-m-att:2 rtpmap:96 telephone-event
a=omr-m-att:2 rtpmap:97 AMR-WB/16000/1
a=omr-m-att:2 fmtp:97 mode-change-capability=2; max-red=220
a=omr-m-att:2 curr:qos local none
a=omr-m-att:2 curr:qos remote none
a=omr-m-att:2 des:qos mandatory local sendrecv
a=omr-m-att:2 des:qos none remote sendrecv
a=omr-m-att:2 ptime:20
a=omr-m-att:2 maxptime:240
a=omr-s-bw:2 AS:30
a=omr-s-bw:2 RS:0
a=omr-s-bw:2 RR:2000
a=visited-realm:3 Yb.operatorY.net IN IP4 190.1.15.2 11324
a=omr-m-cksum:(..)
a=omr-s-cksum:0

```

6. INVITE request (IBCF-3 to IBCF-4) - see example in table A.4.2-6.

The IBCF-3 uses the procedures in clauses 6.1.4, 6.1.7 and 6.1.9 since a previous realm instance exists that can be used to bypass a previous MR, IBCF-2, and bypass is allowed according to operator X and operator Y agreements, and the previous realm instance match the outgoing realm so that no local MR is required.

The IBCF-3:

- uses the connection address and port information for the media line in the initial SDP offer with the connection-address and port information from the selected instance 2 as incoming connection address and incoming port information for the media line;
- reconstruct the associated codec information for the media line in the received initial SDP offer from the selected instance 2 as described in clause 5.3, i.e. using the SDP a-lines, b-lines, transport format and list of media formats of the media line in the received initial SDP offer;
- deletes the visited-realm instance 3;
- inserts the incoming codec information into the SDP m-line and associated attribute lines of the modified initial SDP offer;
- uses the incoming connection address as the connection address in the SDP c-line of the forwarded initial SDP offer;
- uses the incoming port information as port information in the SDP m-line of the modified initial SDP offer;

- computes a checksum value for the media line as described in clause 5.6.3 and adds the omr-m-cksum and omr-s-cksum attributes for the media line. The omr-s-cksum attribute is set to "0" since there are no session line attributes to compute the checksum on; and
- selects an IBCF, IBCF-4, in the realm "Xa.operatorX.net" and forwards the initial SDP offer according to TS 24.229 [4] to IBCF-4.

Table A.4.2-6: SIP INVITE request (IBCF-3 to IBCF-4)

```

INVITE SIP: sip:UE-B@operatorX.net; SIP/2.0

SIP headers according to 3GPP TS 24.229 [4]

Content-Type: application/sdp
Content-Length: (...)

v=0
o=- 2987933615 2987933615 IN IP4 192.0.2.1
s=
c=IN IP4 192.0.2.5
m=audio 49170 RTP/AVP 96 97 98
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:96 telephone-event
a=rtpmap:97 AMR-WB/16000/1
a=fmtp:97 mode-change-capability=2; max-red=220
a=rtpmap:98 AMR/8000/1
a=fmtp:98 mode-change-capability=2; max-red=220; octet-align=1
a=ptime:20
a=maxptime:240
b=AS:30
b=RS:0
b=RR:2000
a=visited-realm:1 Xa.operatorX.net IN IP4 192.0.2.1 49170
a=visited-realm:2 Xa.operatorX.net IN IP4 192.0.2.5 49170
a=omr-codecs:2 audio RTP/AVP 96 97
a=omr-m-att:2 rtpmap:96 telephone-event
a=omr-m-att:2 rtpmap:97 AMR-WB/16000/1
a=omr-m-att:2 fmtp:97 mode-change-capability=2; max-red=220
a=omr-m-att:2 curr:qos local none
a=omr-m-att:2 curr:qos remote none
a=omr-m-att:2 des:qos mandatory local sendrecv
a=omr-m-att:2 des:qos none remote sendrecv
a=omr-m-att:2 ptime:20
a=omr-m-att:2 maxptime:240
a=omr-s-bw:2 AS:30
a=omr-s-bw:2 RS:0
a=omr-s-bw:2 RR:2000
a=omr-m-cksum:(..)
a=omr-m-cksum:0

```

7. INVITE request (IBCF-4 to P-CSCF B) - see example in table A.4.2-7.

The IBCF-4 uses the procedures in clauses 6.1.5, 6.1.7 and 6.1.9 since a previous realm instance exists that can be used to bypass a previous MR, IBCF-1, and the previous realm instance match the outgoing realm so that no local MR is required.

The IBCF-4:

- uses the connection address and port information from the SDP c-line in the received initial SDP offer in the initial SDP offer as incoming connection address and incoming port information in subsequent steps;
- use the port information from the SDP m-line in the received initial SDP offer as incoming port in subsequent steps;
- uses the codec information from the SDP m-line and associated non-OMR attribute lines in the received initial SDP offer as incoming codec information in the subsequent steps;
- inserts the incoming codec information into the SDP m-line and associated attribute lines of the modified initial SDP offer;

- uses the incoming connection address as the connection address in the SDP c-line of the forwarded initial SDP offer; and
- uses the incoming port information as port information in the SDP m-line of the modified initial SDP offer; and
- forwards the INVITE request with the unmodified initial SDP offer to the P-CSCF-B, in the realm "X.operatorX.net" according to TS 24.229 [4].

Table A.4.2-7: SIP INVITE request (IBCF-4 to P-CSCF B)

<pre> INVITE SIP: sip:UE-B@operatorX.net; SIP/2.0 SIP headers according to 3GPP TS 24.229 [4] Content-Type: application/sdp Content-Length: (...) v=0 o=- 2987933615 2987933615 IN IP4 192.0.2.1 s= c=IN IP4 192.0.2.5 m=audio 49170 RTP/AVP 96 97 98 a=curr:qos local none a=curr:qos remote none a=des:qos mandatory local sendrecv a=des:qos none remote sendrecv a=rtpmap:96 telephone-event a=rtpmap:97 AMR-WB/16000/1 a=fmtp:97 mode-change-capability=2; max-red=220 a=rtpmap:98 AMR/8000/1 a=fmtp:98 mode-change-capability=2; max-red=220; octet-align=1 a=ptime:20 a=maxptime:240 b=AS:30 b=RS:0 b=RR:2000 a=visited-realm:1 Xa.operatorX.net IN IP4 192.0.2.1 49170 a=visited-realm:2 Xa.operatorX.net IN IP4 192.0.2.5 49170 a=omr-codecs:2 audio RTP/AVP 96 97 a=omr-m-att:2 rtpmap:96 telephone-event a=omr-m-att:2 rtpmap:97 AMR-WB/16000/1 a=omr-m-att:2 fmtp:97 mode-change-capability=2; max-red=220 a=omr-m-att:2 curr:qos local none a=omr-m-att:2 curr:qos remote none a=omr-m-att:2 des:qos mandatory local sendrecv a=omr-m-att:2 des:qos none remote sendrecv a=omr-m-att:2 ptime:20 a=omr-m-att:2 maxptime:240 a=omr-s-bw:2 AS:30 a=omr-s-bw:2 RS:0 a=omr-s-bw:2 RR:2000 a=omr-m-cksum:(..) a=omr-m-cksum:0 </pre>
--

8. INVITE request (P-CSCF to UE- B) - see example in table A.4.2-8.

The P-CSCF-B uses the procedures in clauses 6.1.5, 6.1.7 and 6.1.9 since no previous realm instance offers an opportunity to bypass an MR and no local MR is required to match the incoming realm to the outgoing realm.

- uses the connection-address from the SDP c-line as incoming connection-address;
- uses the port information from the SDP m-line as incoming port information;
- uses the codec information from the SDP m-line and associated non-OMR attribute lines as incoming codec information;
- according to the local policy, deletes all OMR attributes from the initial SDP offer; and
- forwards the INVITE request with the unmodified initial SDP offer to the UE-B according to TS 24.229 [4].

Table A.4.2-8: SIP INVITE request (P-CSCF-B to UE-B)

```

INVITE SIP: sip:UE-B@operatorX.net; SIP/2.0

SIP headers according to 3GPP TS 24.229 [4]

Content-Type: application/sdp
Content-Length: (...)

v=0
o=- 2987933615 2987933615 IN IP4 192.0.2.1
s=
c=IN IP4 192.0.2.5
m=audio 49170 RTP/AVP 96 97 98
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:96 telephone-event
a=rtpmap:97 AMR-WB/16000/1
a=fmtp:97 mode-change-capability=2; max-red=220
a=rtpmap:98 AMR/8000/1
a=fmtp:98 mode-change-capability=2; max-red=220; octet-align=1
a=ptime:20
a=maxptime:240
b=AS:30
b=RS:0
b=RR:2000

```

9. 183 (Session Progress) response (UE-B to P-CSCF-B) - see example in table A.4.2-9.

The UE accepts the AMR codec and sends a 183 (Session Progress) response with an initial SDP answer indicating that resources are not yet available to P-CSCF-B according to TS 24.229 [4].

Table A.4.2-9: 183 (Session Progress) response (UE-B to P-CSCF-B)

```

SIP/2.0 183 Session Progress

SIP headers according to 3GPP TS 24.229 [4]

Content-Type: application/sdp
Content-Length: (...)

v=0
o=- 2987933615 2312345678 IN IP4 192.0.2.1
s=-
c=IN IP4 192.0.2.4
m=audio 16511 RTP/AVP 96 98
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:96 telephone-event
a=rtpmap:98 AMR/8000/1
a=fmtp:98 mode-change-capability=2; max-red=220; octet-align=1
a=ptime:20
a=maxptime:240
b=AS:30
b=RS:0
b=RR:2000

```

10. 183 (Session Progress) response (P-CSCF-B to IBCF-4) - see example in table A.4.2-9

The P-CSCF-B uses the procedures in clauses 6.2.7 and 6.2.9 since the connection address is valid and no primary local MR was allocated.

The P-CSCF-B:

- does not modify the initial SDP answer and forwards the 183 (Session Progress) response with the initial SDP answer to IBCF-4 according to TS 24.229 [4].

11. 183 (Session Progress) response (IBCF-4 to IBCF-3) - see example in table A.4.2-11

The IBCF-4 uses procedures in clauses 6.2.7 and 6.2.9 since a valid connection address was received in the initial SDP answer and no MR was allocated when sending the initial SDP answer.

The IBCF-4:

- copies into the media line of the SDP answer the visited-realm instance 2 from the media line of the received initial SDP offer that was used to populate the connection address and port information in the forwarded initial SDP offer, replacing the connection-address and port information in the instance with the connection address and port information from the received initial SDP answer;
- replaces the connection address information in the initial SDP answer with the unspecified address of IPv4, i.e. "0.0.0.0"; and
- forwards the 183 (Session Progress) response with the modified initial SDP answer according to TS 24.229 [4].

Table A.4.2-11: 183 (Session Progress) response (IBCF-4 to IBCF-3)

<pre> SIP/2.0 183 Session Progress SIP headers according to 3GPP TS 24.229 [4] Content-Type: application/sdp Content-Length: (...) v=0 o=- 2987933615 2312345678 IN IP4 192.0.2.1 s=- c=IN IP4 0.0.0.0 m=audio 16511 RTP/AVP 96 98 a=curr:qos local none a=curr:qos remote none a=des:qos mandatory local sendrecv a=des:qos none remote sendrecv a=rtpmap:96 telephone-event a=rtpmap:98 AMR/8000/1 a=fmtp:98 mode-change-capability=2; max-red=220; octet-align=1 a=ptime:20 a=maxptime:240 b=AS:30 b=RS:0 b=RR:2000 a=visited-realm:1 Xa.operatorX.net IN IP4 192.0.2.4 16511 </pre>

12-13. 183 (Session Progress) response (IBCF-3 to IBCF-2 via intermediate IMS CN subsystem entities) - see example in table A.4.2-11

The IBCF-3 uses procedures in clauses 6.2.5 and 6.2.9 since an unspecified connection address and a visited-realm was received.

The IBCF-3 forwards the 183 (Session Progress) response with the unmodified initial SDP answer to the intermediate IM CN subsystem entities according to TS 24.229 [4].

The intermediate IM CN subsystem entities forward without modification the 183 (Session Progress) response to the IBCF-2 according to TS 24.229 [4].

14. 183 (Session Progress) response (IBCF-2 to IBCF-1) - see example in table A.4.2-14

The IBCF-2 uses the procedures in clauses 6.2.5 and 6.2.9 since the initial SDP answer contained an unspecified connection address and a realm instance matching one in the received initial SDP offer and the local MR allocated in step 4 can be bypassed.

The IBCF-2:

- replaces the connection address and port information for the media line in the initial SDP answer with the connection address and port information from the visited-realm instance 2 in the received initial SDP answer.

The IBCF-2 retains the primary local MR allocated for realm matching in step 4, until it is no longer potentially needed for this and any other forked dialog.

The IBCF-2 forwards the 183 (Session Progress) response with initial SDP answer to IBCF-1 according to TS 24.229 [4].

Table A.4.2-14: 183 (Session Progress) response (IBCF-2 to IBCF-1)

<pre> SIP/2.0 183 Session Progress SIP headers according to 3GPP TS 24.229 [4] Content-Type: application/sdp Content-Length: (...) v=0 o=- 2987933615 2312345678 IN IP4 192.0.2.1 s=- c=IN IP4 192.0.2.4 m=audio 16511 RTP/AVP 96 98 a=curr:qos local none a=curr:qos remote none a=des:qos mandatory local sendrecv a=des:qos none remote sendrecv a=rtpmap:96 telephone-event a=rtpmap:98 AMR/8000/1 a=fmtp:98 mode-change-capability=2; max-red=220; octet-align=1 aptime:20 a=maxptime:240 b=AS:30 b=RS:0 b=RR:2000 </pre>

15. PRACK request (IBCF-1 to IBCF-2) - see example in table A.4.2-15

The IBCF-1 determines by clause 6.2.3 that a transcoder MR is needed since the UE-B selected the codec added by IBCF-1 in step 7. The IBCF-4 uses clause 6.1.5, 6.1.6 and 6.1.9 since no IMS-ALG can be bypassed and a primary MR is allocated.

The IBCF-1:

- uses the connection-address from the SDP c-line in the initial SDP offer as incoming connection-address in subsequent steps;
- uses the port information from the SDP m-line in the initial SDP offer as incoming port information in subsequent steps;
- use the codec information from the SDP m-line and associated non-OMR attribute lines in the initial SDP offer as incoming codec information in the subsequent steps;
- allocates an MR context with access to the IP realms, nettypes and addrtypes associated with the incoming connection address and port information and the outgoing signalling path;
- inserts the incoming connection address and incoming port information for the media line into the remote connection address and port information for the incoming termination on the MR;
- provides to the MR the incoming codec information;
- remove all OMR specific attributes from the modified second SDP offer;
- replaces the connection address and port information for the media line in the second SDP offer with the connection address and port information from the MR termination on the outgoing side;
- inserts the modified codec information (keeps the telephone-event codec, removes the AMR-WB codec and adds the AMR codec) into the SDP m-line and associated attribute lines of the modified second SDP offer;
- adds to the modified second SDP offer a visited-realm instance 2 for the IP realm associated with the connection address and port information for the media line in the modified second SDP offer;
- provides to the MR the modified codec information;
- computes checksum values as described in clause 5.6.3 adds the "omr-s-cksum" and "omr-m-cksum" attributes for the media line; and

- forwards the PRACK request with the second SDP offer to IBCF-2 according to TS 24.229 [4].

Table A.4.2-15: PRACK request (IBCF-1 to IBCF-2)

<pre> PRACK SIP: sip:UE-B@operatorX.net; SIP/2.0 SIP headers according to 3GPP TS 24.229 [4] Content-Type: application/sdp Content-Length: (...) v=0 o=- 2987933615 2087654321 IN IP4 192.0.2.1 s= b=AS:30 b=RS:0 b=RR:2000 c=IN IP4 192.0.2.5 m=audio 18435 RTP/AVP 96 97 98 a=curr:qos local none a=curr:qos remote none a=des:qos mandatory local sendrecv a=des:qos none remote sendrecv a=rtpmap:96 telephone-event a=rtpmap:97 AMR-WB/16000/1 a=fmtp:97 mode-change-capability=2; max-red=220 a=rtpmap:98 AMR/8000/1 a=fmtp:98 mode-change-capability=2; max-red=220; octet-align=1 a=ptime:20 a=maxptime:240 a=visited-realm:2 Xa.operatorX.net IN IP4 192.0.2.5 18435 a=omr-m-cksum:(..) a=omr-s-cksum:(..) </pre>

16-17. PRACK request (IBCF-2 to IBCF-3 via intermediate IMS CN subsystem entities) - see example in table A.4.2-16

The IBCF-2 uses the procedures in clauses 6.1.5, 6.1.6 and 6.1.9 since no previous MRs can be bypassed and a local MR is needed for realm matching.

The IBCF-2:

- uses the connection-address from the SDP c-line in the received second SDP offer as incoming connection-address in subsequent steps;
- uses the port information from the SDP m-line in the received second SDP offer as incoming port information in subsequent steps; and
- uses the codec information from the SDP m-line and associated non-OMR attribute lines in the received second SDP offer as incoming codec information in the subsequent steps.
- inserts the incoming connection address and incoming port information for the media line into the remote connection address and port information for the incoming termination on the MR;
- provides to the MR the incoming codec information;
- replaces the connection address and port information for the media line in the second SDP offer with the connection address and port information from the MR termination on the outgoing side;
- add to the modified second SDP offer a visited-realm instance 3 for the IP realm associated with the connection address and port information for the media line in the modified second SDP offer;
- computes checksum values as described in clause 5.6.3 and replace or add the "omr-s-cksum" and "omr-m-cksum" attributes for the media line; and
- forwards the PRACK request with the modified second SDP offer to the intermediate IM CN subsystem entities according to TS 24.229 [4].

The intermediate IM CN subsystem entities forward the PRACK request without modifying the SDP offer to the IBCF-3 according to TS 24.229 [4].

Table A.4.2-16: PRACK request (IBCF-2 to IBCF-3 via intermediate IMS CN subsystem entities)

<pre> PRACK SIP: sip:UE-B@operatorX.net; SIP/2.0 SIP headers according to 3GPP TS 24.229 [4] Content-Type: application/sdp Content-Length: (...) v=0 o=- 2987933615 2087654321 IN IP4 192.0.2.1 s= b=AS:30 b=RS:0 b=RR:2000 c=IN IP4 190.1.15.2 m=audio 11324 RTP/AVP 96 97 98 a=curr:gqos local none a=curr:gqos remote none a=des:gqos mandatory local sendrecv a=des:gqos none remote sendrecv a=rtpmap:96 telephone-event a=rtpmap:97 AMR-WB/16000/1 a=fmtp:97 mode-change-capability=2; max-red=220 a=rtpmap:98 AMR/8000/1 a=fmtp:98 mode-change-capability=2; max-red=220; octet-align=1 a=ptime:20 a=maxptime:240 a=visited-realm:2 Xa.operatorX.net IN IP4 192.0.2.5 18435 a=visited-realm:3 Yb.operatorY.net IN IP4 190.1.15.2 11324 a=omr-m-cksum:(..) a=omr-s-cksum:(..) </pre>

18. PRACK request (IBCF-3 to IBCF-4) - see example in table A.4.2-18

The IBCF-3 uses procedures in clauses 6.1.4, 6.1.7 and 6.1.9 since previous MR can be bypassed and no local MR is needed.

The IBCF:

- uses the connection address and port information from the selected instance 2 for the media line in the received second SDP offer as incoming connection address and incoming port information for the media line in the subsequent steps;
- reconstructs the associated codec information for the media line in the received second SDP offer from the selected instance 2 as described in clause 5.3, and use that codec information as incoming codec information in the subsequent steps;
- inserts the incoming codec information into the SDP m-line and associated attribute lines of the modified second SDP offer,
- uses the incoming connection address as the connection address in the SDP c-line of the forwarded second SDP offer; and
- uses the incoming port information as determined in previous steps as port information in the SDP m-line of the modified second SDP offer;
- computes checksum values as described in clause 5.6.3 and replaces the "omr-s-cksum" and "omr-m-cksum" attributes for the media line; and
- forwards the PRACK request with the modified second SDP offer to IBCF-2 according to TS 24.229 [4].

Table A.4.2-18: PRACK request (IBCF-3 to IBCF-4)

<pre> PRACK SIP: sip:UE-B@operatorX.net; SIP/2.0 SIP headers according to 3GPP TS 24.229 [4] Content-Type: application/sdp Content-Length: (...) v=0 o=- 2987933615 2087654321 IN IP4 192.0.2.1 s= b=AS:30 b=RS:0 b=RR:2000 c=IN IP4 192.0.2.5 m=audio 18435 RTP/AVP 96 97 98 a=curr:gosp local none a=curr:gosp remote none a=des:gosp mandatory local sendrecv a=des:gosp none remote sendrecv a=rtpmap:96 telephone-event a=rtpmap:97 AMR-WB/16000/1 a=fmtp:97 mode-change-capability=2; max-red=220 a=rtpmap:98 AMR/8000/1 a=fmtp:98 mode-change-capability=2; max-red=220; octet-align=1 a=ptime:20 a=maxptime:240 a=visited-realm:2 Xa.operatorX.net IN IP4 192.0.2.5 18435 a=omr-m-cksum:(..) a=omr-s-cksum:(..) </pre>

19. PRACK request (IBCF-4 to P-CSCF-B) - see example in table A.4.2-18

The IBCF-4 uses the procedures in clauses 6.1.5, 6.1.7 and 6.1.9 since allocation of a local MR is not needed and no previous MR can be passed.

The IBCF-4:

- uses the connection-address from the SDP c-line in the received second SDP offer as incoming connection-address in subsequent steps;
- uses the port information from the SDP m-line in the received second SDP offer as incoming port information in subsequent steps;
- uses the codec information from the SDP m-line and associated non-OMR attribute lines in the received second SDP offer as incoming codec information in the subsequent steps;
- inserts the incoming codec information into the SDP m-line and associated attribute lines of the modified second SDP offer;
- uses the incoming connection address as the connection address in the SDP c-line of the forwarded second SDP offer;
- uses the incoming port information as determined in previous steps as port information in the SDP m-line of the modified second SDP offer; and
- forwards the PRACK request with the unmodified second SDP offer to P-CSCF-B according to TS 24.229 [4].

20. PRACK request (P-CSCF-B to UE- B) - see example in table A.4.2-20.

The P-CSCF-B uses the procedures in clauses 6.1.5, 6.1.7 and 6.1.9 since no previous realm instance offers an opportunity to bypass an MR and no local MR is required to match the incoming realm to the outgoing realm.

- uses the connection-address from the SDP c-line as incoming connection-address;
- uses the port information from the SDP m-line as incoming port information;

- uses the codec information from the SDP m-line and associated non-OMR attribute lines as incoming codec information;
- inserts the incoming codec information into the SDP m-line and associated attribute lines of the modified second SDP offer;
- uses the incoming connection address as the connection address in the SDP c-line of the forwarded second SDP offer;
- uses the incoming port information as port information in the SDP m-line of the modified second SDP offer;
- according to the local policy, deletes the visited-realm "visited-realm:1 Xa.operatorX.net IN IP4 192.0.2.5 18435", the omr-s-cksum:(..) and the "omr-m-cksum=(..)" from the second SDP offer ; and
- forwards the PRACK request with the modified second SDP offer to the UE-B according to TS 24.229 [4].

Table A.4.2-20: SIP PRACK request (P-CSCF-B to UE-B)

```

UPDATE SIP: sip:UE-B@operatorX.net; SIP/2.0

SIP headers according to 3GPP TS 24.229 [4]

Content-Type: application/sdp
Content-Length: (...)

v=0
o=- 2987933615 2087654321 IN IP4 192.0.2.1
s=
c=IN IP4 192.0.2.5
m=audio 18435 RTP/AVP 96 98
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:96 telephone-event
a=rtpmap:98 AMR/8000/1
a=fmtp:98 mode-change-capability=2; max-red=220; octet-align=1
a=ptime:20
a=maxptime:240

```

21. 200 (OK) response (UE-B to P-CSCF-B) - see example in table A.4.2-21.

The UE accepts the AMR codec (again) and sends a 200 (OK) response to the PRACK request with a second SDP answer still indicating that resources are not yet available to P-CSCF-B according to TS 24.229 [4].

Table A.4.2-21: 200 (OK) response to PRACK request (UE-B to P-CSCF-B)

```

SIP/2.0 200 OK

SIP headers according to 3GPP TS 24.229 [4]

Content-Type: application/sdp
Content-Length: (...)

v=0
o=- 2987933615 2312345678 IN IP4 192.0.2.1
s=-
b=AS:30
b=RS:0
b=RR:2000
c=IN IP4 192.0.2.4
m=audio 16511 RTP/AVP 96 98
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:96 telephone-event
a=rtpmap:98 AMR/8000/1
a=fmtp:98 mode-change-capability=2; max-red=220; octet-align=1
a=ptime:20
a=maxptime:240

```

22. 200 (OK) response (P-CSCF-B to IBCF-4) - see example in table A.4.2-21.

The P-CSCF-B uses the procedures in clauses 6.2.7 and 6.2.9 since no local MR was allocated the connection address is valid and no visited-realm instance was received in the second SDP answer.

The P-CSCF-B:

- does not modify the second SDP answer and forwards the 200 (OK) response with the second SDP answer to IBCF-4 according to TS 24.229 [4].

23. 200 (OK) response (IBCF-4 to IBCF-3) - see example in table A.4.2-21.

The IBCF-4 uses the procedures in clauses 6.2.7 and 6.2.9 since no local MR was allocated and a valid connection address was received in the second SDP answer.

The IBCF-4 forwards the 200 (OK) response to the PRACK request with the unmodified second SDP answer according to TS 24.229 [4].

24-25. 200 (OK) response (IBCF-3 to IBCF-2 via intermediate IM CN subsystem entities) - see example in table A.4.2-24.

The IBCF-3 uses procedures in clauses 6.2.7 and 6.2.9 since no local MR was allocated and an unspecified connection address and no visited-realm instance was received in the second SDP answer.

The IBCF-3:

- copies into the media line of the second SDP answer the visited-realm instance 2 from the media line of the received second SDP offer that was used to populate the connection address and port information in the forwarded second SDP offer, replacing the connection-address and port information in the instance with the connection address and port information from the received second SDP answer;
- replaces the connection address information in the second SDP answer with the unspecified address of the IPv4, i.e. "0.0.0.0"; and
- forwards the 200 (OK) response to the PRACK request with the modified second SDP answer to the intermediate IM CN subsystem entities according to TS 24.229 [4].

The intermediate IM CN subsystem entities forward the 200 (OK) response to the PRACK request to the IBCF-2 according to TS 24.229 [4] without modifying the second SDP answer.

Table A.4.2-24: 200 (OK) response to PRACK request (IBCF-3 to IBCF-2 via intermediate IM CN subsystem entities)

<pre> SIP/2.0 200 OK SIP headers according to 3GPP TS 24.229 [4] Content-Type: application/sdp Content-Length: (...) v=0 o=- 2987933615 2312345678 IN IP4 192.0.2.1 s=- b=AS:30 b=RS:0 b=RR:2000 c=IN IP4 0.0.0.0 m=audio 16511 RTP/AVP 96 98 a=curr:qos local none a=curr:qos remote none a=des:qos mandatory local sendrecv a=des:qos none remote sendrecv a=rtpmap:96 telephone-event a=rtpmap:98 AMR/8000/1 a=fmtp:98 mode-change-capability=2; max-red=220; octet-align=1 a=ptime:20 a=maxptime:240 a=visited-realm:2 Xa.operatorX.net 192.0.2.4 16511 </pre>

26. 200 (OK) response (IBCF-2 to IBCF-1) - see example in table A.4.2-26.

The IBCF-2 uses the procedures in clauses 6.2.5 and 6.2.9 since an unspecified connection address and a visited-realm instance was received.

The IBCF-2:

- replaces the connection address and port information for the media line in the second SDP answer with the connection address and port information from the visited-realm instance 2 in the received second SDP answer;
- forwards the 200 (OK) response to the PRACK request with the modified second SDP answer to IBCF-1 according to TS 24.229 [4]; and
- keeps the allocated MR until it is no longer potentially needed for this and any other forked dialog.

Table A.4.2-26: 200 (OK) response to PRACK request (IBCF-2 to IBCF-1)

<pre> SIP/2.0 200 OK SIP headers according to 3GPP TS 24.229 [4] Content-Type: application/sdp Content-Length: (...) v=0 o=- 2987933615 2312345678 IN IP4 192.0.2.1 s=- b=AS:30 b=RS:0 b=RR:2000 c=IN IP4 192.0.2.4 m=audio 16511 RTP/AVP 96 98 a=curr:gqos local none a=curr:gqos remote none a=des:gqos mandatory local sendrecv a=des:gqos none remote sendrecv a=rtpmap:96 telephone-event a=rtpmap:98 AMR/8000/1 a=fmtp:98 mode-change-capability=2; max-red=220; octet-align=1 a=ptime:20 a=maxptime:240 </pre>
--

27.183 (Session Progress) response (IBCF-1 to P-CSCF-A) - see example in table A.4.2-27.

The IBCF-1 continues from the point when the 183 (Session Progress) response to the INVITE request was received in step 14 and uses the procedures in clauses 6.2.8 and 6.2.9 since the IBCF-4 retains the MR allocated in step 14.

The IBCF-1:

- updates the remote connection address and port information for the outgoing termination on the selected MR context with the connection address and port information for the media line in the received second SDP answer;
- modifies the second SDP answer to include the codecs selected for the incoming termination of the selected local MR;
- replaces the connection address and port information for the media line in the initial SDP answer with the local connection address and port information for the incoming termination on the selected MR;
- removes the visited-realm instance; and
- forwards 183 (Session Progress) response with the modified initial SDP answer to P-CSCF-A according to TS 24.229 [4].

Table A.4.2-27 183 (Session Progress) response (IBCF-1 to P-CSCF-A)

<pre> SIP/2.0 183 Session Progress SIP headers according to 3GPP TS 24.229 [4] Content-Type: application/sdp Content-Length: (...) v=0 o=- 2987933615 2087654321 IN IP4 192.0.2.3 s=- b=AS:30 b=RS:0 b=RR:2000 c=IN IP4 192.0.2.2 m=audio 23563 RTP/AVP 96 97 a=curr:qos local none a=curr:qos remote sendrecv a=des:qos mandatory local sendrecv a=des:qos none remote sendrecv a=rtpmap:97 AMR-WB/16000/1 a=fmtp:97 mode-change-capability=2; max-red=220 a=rtpmap:96 telephone-event a=maxptime:20 a=maxptime:240 </pre>
--

28. 183 (Session Progress) response (P-CSCF-A to UE-A) - see example in table A.4.2-27

The P-CSCF-A forwards the 183 (Session Progress) with the initial SDP answer to the UE-A according to TS 24.229 [4].

29-30. PRACK request (UE-A to IBCF-1 via P-CSCF-A).

The UE-A acknowledge the reception of the initial SDP answer and the 183 (Session Progress) response by means of a PRACK request.

31-32. 200 (OK) response to the PRACK request (IBCF-1 to UE-A via P-CSCF-A).

The IBCF-1 acknowledges the reception of the PRACK request by means of a 200 (OK) response.

33. UPDATE request (UE-A to P-CSCF-A) - see example in table A.4.2-33.

When the UE-A has got resources reserved the UE-A sends an UPDATE request.

The subsequent SDP offer in the UPDATE the request is the same as the initial SDP offer in the INVITE request in the step 1 with the only exception that "a=curr:qos local none" is now changed to "a=curr:qos local sendrecv".

Table A.4.2.-33: UPDATE request (UE-A to P-CSCF-A)

```

UPDATE SIP: sip:UE-A@operatorX.net; SIP/2.0

SIP headers according to 3GPP TS 24.229 [4]

Content-Type: application/sdp
Content-Length: (...)

v=0
o=- 2987933615 2987933616 IN IP4 192.0.2.1
s=
b=AS:30
b=RS:0
b=RR:2000
c=IN IP4 192.0.2.1
m=audio 49170 RTP/AVP 96 97
a=curr:qos local sendrecv
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtptime:96 telephone-event
a=rtptime:97 AMR-WB/16000/1
a=fmtp:97 mode-change-capability=2; max-red=220
a=ptime:20
a=maxptime:240

```

34-40. UPDATE request (P-CSCF-A to UE-B via IBCF-1, IBCF-2, intermediate IMS CN subsystem entities IBCF-3, IBCF-4 and P-CSCF-B).

- 34) The P-CSCF-A forwards the subsequent SDP offer as received.
- 35) The IBCF-1 replaces the connection information received in the subsequent SDP offer with the IBCF-1 own MR connection information.
- 36) The IBCF-2 forwards the subsequent SDP offer as received.
- 37) Intermediate IMS CN subsystem entities do not manipulate the SDP offer.
- 38) The IBCF-3 forwards the subsequent SDP offer as received.
- 39) The IBCF-4 forwards the subsequent SDP offer as received.
- 40) The P-CSCF-B forwards the subsequent SDP offer as received.

41. 200 (OK) response to the UPDATE request (UE-B to P-CSCF-B) - see example in table A.4.2-41.

The UE-B acknowledges the reception of the UPDATE request by means of a 200 (OK) response containing a subsequent SDP answer.

Table A.4.2-41: 200 (OK) response to the UPDATE request (UE-B to P-CSCF-B).

```

SIP/2.0 200 OK

SIP headers according to 3GPP TS 24.229 [4]

Content-Type: application/sdp
Content-Length: (...)

v=0
o=- 2987933615 2987933615 IN IP4 192.0.2.4
s=
t=0 0
c=IN IP4 192.0.2.4
m=audio 16511 RTP/AVP 96 98
a=curr:gqos local sendrecv
a=curr:gqos remote sendrecv
a=des:gqos mandatory local sendrecv
a=des:gqos none remote sendrecv
a=rtpmap:98 AMR/8000/1
a=fmtp:98 mode-change-capability=2; max-red=220; octet-align=1
a=rtpmap:96 telephone-event
a=maxptime:20

```

42-48. 200 (OK) response to the UPDATE request (P-CSCF-B to UE-A via IBCF-4, IBCF-3, intermediate IMS CN subsystem entities, IBCF-2 and IBCF-1).

- 42) The P-CSCF-B forwards the subsequent SDP answer as received.
- 43) The IBCF-4 forwards the subsequent SDP answer as received.
- 44) The IBCF-3 forwards the subsequent SDP answer as received.
- 45) Intermediate IMS CN subsystem entities do not manipulate the SDP answer.
- 46) The IBCF-2 forwards the subsequent SDP answer as received.
- 47) The IBCF-1 replaces the connection information received in the subsequent SDP answer with the IBCF-1 own MR connection information.
- 48) The P-CSCF-A forwards the subsequent SDP answer as received.

49-56. 180 (Ringing) response (UE-B to UE-A via P-CSCF-B, IBCF-4, IBCF-3, intermediate IMS CN subsystem entities, IBCF-2, IBCF-1 and P-CSCF-A).

No OMR specific action is required.

57-64. 200 (OK) response to the INVITE request (UE-B to UE-A via P-CSCF-B, IBCF-4, IBCF-3, intermediated IMS CN subsystem, IBCF-2, IBCF-1 and P-CSCF-A).

The User B accepts the call and the UE-B sends a 200 (OK) response to the INVITE request. The response contains no SDP.

The IBCF-2 releases the MR not used in the call.

65-72. ACK request (UE-A to UE-B via P-CSCF-A, IBCF-1, IBCF-2, intermediated IMS CN subsystem, IBCF-3, IBCF-4 and P-CSCF-B).

The UE-B acknowledges the reception of the 200 (OK) response by means of a 200 (OK) response.

A.5 IMS-ALG bypasses an allocated transcoding MR

A.5.1 General

This clause provides an example of a call where the UE initiating a call offers the AMR codec. An IMS-ALG, IBCF-1 in figure A.2.1, adds the AMR-WB codec to the initial SDP offer and reserves an MR resource.

The terminating UE selects the AMR codec and the IMS-ALG needs to deallocate the MR and update the terminating UE with the IP addresses of the UE-A in a realm instance to allow bypassing of the IMS-ALG itself.

Figure A.5.1-1 shows the realm and IP structure used in this example.

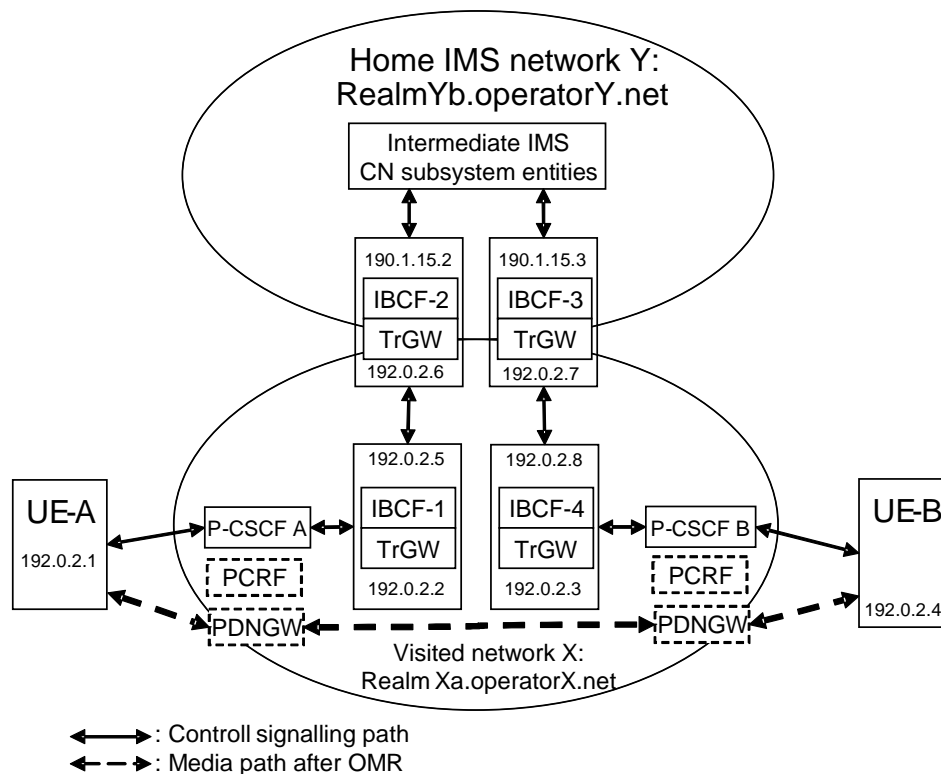


Figure A.5.1-1: IP realm and IP structure

A.5.2 Message flow

The user A at UE-A and the user B at UE-B roams into a visited network X and both users belongs to the same operator Y.

Preconditions:

- Both users A and B are registered to the Home IMS network Y via the visited operator X network;
- the visited operator X and the operator of user A and B IMS home network Y have an agreement to allow media to be bypassed using OMR;
- both users A and B are connected to realm Xa of the visited operator network X;
- the AMR codec is allowed and accepted by all involved entities. However, the local policy of operator X is that the AMR-WB codec shall always be included in the initial SDP offers from the operator X network; and
- no B2BUA manipulating SDP is connected in the intermediate IM CN subsystem.

Figure A.5.2-1 shows the message flow for the scenario.

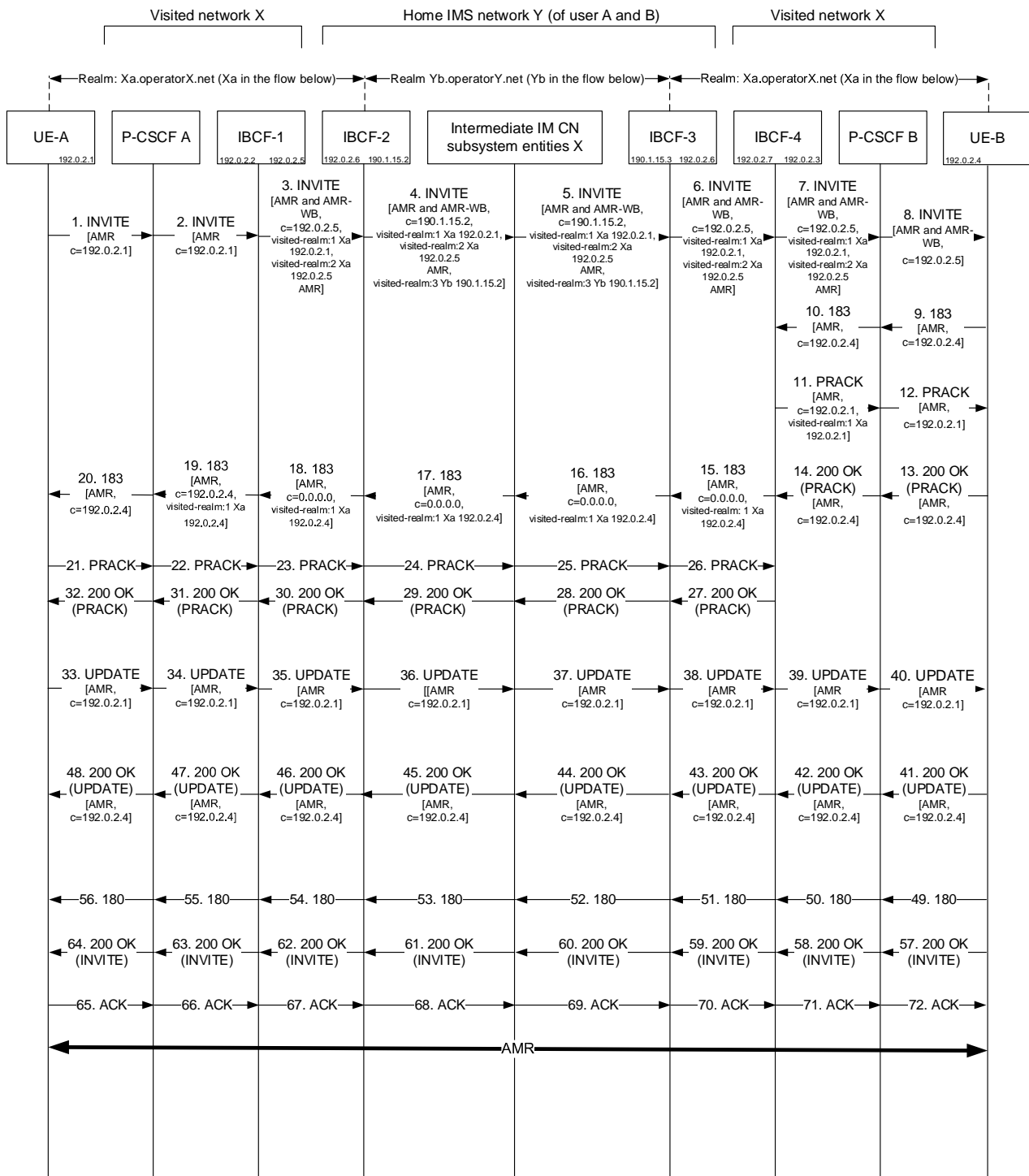


Figure A.5.2-1: Message flow for transcoder with resource reservation, codec not selected

NOTE: For clarity, the SIP 100 (Trying) messages are not shown in the signalling flow.

The steps of the flow are as follows:

1. INVITE request (UE-A to P-CSCF-A) - see example in table A.5.2-1.

The UE-A sends a SIP INVITE request according to TS 24.229 [4]. The INVITE request includes an initial SDP offer proposing the use of the AMR codec and inband DTMF.

Table A.5.2-1: SIP INVITE request (UE-A to P-CSCF-A)

```

INVITE SIP: user_B@operator_Y.net; SIP/2.0

SIP headers according to 3GPP TS 24.229 [4]

Content-Type: application/sdp
Content-Length: (...)

v=0
o=- 2987933615 2987933615 IN IP4 192.0.2.1
s=
b=AS:30
b=RS:0
b=RR:2000
c=IN IP4 192.0.2.1
m=audio 49170 RTP/AVP 96 97
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:96 telephone-event
a=rtpmap:97 AMR/8000/1
a=fmtp:97 mode-change-capability=2; max-red=220; octet-align=1
aptime:20
a=maxptime:240

```

2. INVITE request (P-CSCF-A to IBCF-1) - see example in table A.5.2-1.

The P-CSCF-A uses the procedures in clauses 6.1.5, 6.1.7 and 6.1.9 since no MR could be bypassed and no MR is allocated.

The P-CSCF-A:

- uses the connection-address from the SDP c-line as incoming connection-address;
- uses the port information from the SDP m-line as incoming port information;
- uses the codec information from the SDP m-line;
- inserts the incoming codec information into the SDP m-line and associated attribute lines of the modified initial SDP offer;
- uses the incoming connection address as the connection address in the SDP c-line of the forwarded initial SDP offer, and
- use the incoming port information as port information in the SDP m-line of the modified initial SDP offer.

The P-CSCF-A then selects an IBCF, IBCF-1, in the realm "Xa.operatorX.net" and forwards the INVITE request with the initial SDP offer to the IBCF-1 according to TS 24.229 [4].

3. INVITE request (IBCF-1 to IBCF-2) - see example in table A.5.2-3

The IBCF-1 uses the procedures in 6.1.5, 6.1.6 and 6.1.9 since IBCF-1 determines according to local policy that a transcoding MR is needed and that there is no previous MR to bypass.

The IBCF-1:

- uses the connection-address from the SDP c-line in the received SDP offer as incoming connection-address in subsequent steps;
- uses the port information from the SDP m-line in the received SDP offer as incoming port information in subsequent steps;
- uses the codec information from the SDP m-line and associated non-OMR attribute lines in the received SDP offer as incoming codec information in the subsequent steps;
- allocates an MR context with access to the IP realms, nettypes and addrtypes associated with the incoming connection address and port information and the outgoing signalling path;

- inserts the incoming connection address and incoming port information for the media line into the remote connection address and port information for the incoming termination on the MR;
- provides to the MR the incoming codec information;
- constructs a visited-realm instance 1;
- replaces the connection address and port information for the media line in the initial SDP offer with the connection address and port information from the MR termination on the outgoing side;
- adds a AMR-WB codec changes to incoming codec information, according to local policy, taking into account the procedures in clause 5.4, and insert the changed codec information into the SDP m-line and associated attribute lines of the modified initial SDP offer;
- provides to the MR the modified codec information;
- adds to the modified initial SDP offer a visited-realm instance 2 for the IP realm associated with the connection address and port information for the media line in the modified initial SDP offer, including the incoming codec information encoded according to clause 5.2;
- computes checksum values as described in clause 5.6.3 and adds the "omr-s-cksum" and "omr-m-cksum" attributes for the media line. The "omr-s-cksum" is set to "0" since there is no session line attributes to compute the checksum on; and
- selects an IBCF, IBCF-2, in the realm "Xa.operatorX.net" and forwards the INVITE request with the modified initial SDP offer to the IBCF-2 according to TS 24.229 [4].

Table A.5.2-3: SIP INVITE request (IBCF-1 to IBCF-2)

```

INVITE SIP: user_B@operator_Y.net; SIP/2.0

SIP headers according to 3GPP TS 24.229 [4]

Content-Type: application/sdp
Content-Length: (...)

v=0
o=- 2987933615 2987933615 IN IP4 192.0.2.1
s=
c=IN IP4 192.0.2.5
m=audio 62111 RTP/AVP 96 97 98
a=crr:qos local none
a=crr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:96 telephone-event
a=rtpmap:97 AMR/8000/1
a=fmtp:97 mode-change-capability=2; max-red=220; octet-align=1
a=rtpmap:98 AMR-WB/16000/1
a=fmtp:98 mode-change-capability=2; max-red=220
a=ptime:20
a=maxptime:240
b=AS:30
b=RS:0
b=RR:2000
a=visited-realm:1 Xa.operatorX.net IN IP4 192.0.2.1 49170
a=visited-realm:2 Xa.operatorX.net IN IP4 192.0.2.5 62111
a=omr-codecs:2 audio RTP/AVP 96 97
a=omr-m-att:2 rtpmap:96
a=omr-m-att:2 telephone-event
a=omr-m-att:2 rtpmap:97 AMR/8000/1
a=omr-m-att:2 fmtp:97
a=omr-m-att:2 mode-change-capability=2; max-red=220; octet-align=1
a=omr-m-att:2 curr:qos local none
a=omr-m-att:2 curr:qos remote none
a=omr-m-att:2 des:qos mandatory local sendrecv
a=omr-m-att:2 des:qos none remote sendrecv
a=omr-m-att:2 ptime:20
a=omr-m-att:2 maxptime:240
a=omr-s-bw:2 AS:30
a=omr-s-bw:2 RS:0
a=omr-s-bw:2 RR:2000
a=omr-m-cksum:(..)
a=omr-s-cksum:0

```

4-5. INVITE request (IBCF-2 to IBCF-3 via intermediate IMS CN subsystem entities) - see example in table A.5.2-4

The IMS-ALG uses the procedures in clauses 6.1.5, 6.1.6 and 6.1.9 since no MR can be bypassed and a local MR is needed for realm matching.

The IBCF-2:

- uses the connection-address from the SDP c-line as incoming connection-address in subsequent steps;
- uses the port information from the SDP m-line as incoming port information in subsequent steps;
- uses the codec information from the SDP m-line and associated non-OMR attribute lines as incoming codec information in the subsequent steps.
- allocates an MR context with access to the IP realms, nettypes and addrtypes associated with the incoming connection address and port information and the outgoing signalling path;
- inserts the incoming connection address and incoming port information for the media line into the remote connection address and port information for the incoming termination on the MR;
- provides to the MR the incoming codec information;
- replaces the connection address and port information for the media line in the initial SDP offer with the connection address and port information from the MR termination on the outgoing side;

- adds to the modified initial SDP offer a visited-realm instance 3 for the IP realm associated with the connection address and port information for the media line in the modified initial SDP offer; and
- computes checksum values as described in clause 5.6.3 and adds the "omr-s-cksum" and "omr-m-cksum" attributes for the media line. The "omr-s-cksum" is set to "0" since there is no session line attributes to compute the checksum on.

None of the intermediate IMS CN subsystem entities manipulated with the initial SDP offer but the identity of [user_B@operator_Y.net](#) in the Request-URI is change to the contact address, i.e. UE-B@operatorX.net.

The intermediate IMS CN subsystem entities select an IBCF, IBCF-3, in the realm "Ya.operatorY.net" and forward the INVITE request with the initial SDP offer to the IBCF-3 according to TS 24.229 [4].

Table A.5.2-4: SIP INVITE request (IBCF-2 to IBCF-3 via intermediate IMS CN subsystem entities)

<pre> INVITE SIP: user_B@operator_Y.net; SIP/2.0 SIP headers according to 3GPP TS 24.229 [4] Content-Type: application/sdp Content-Length: (...) v=0 o=- 2987933615 2987933615 IN IP4 192.0.2.1 s= c=IN IP4 190.1.15.2 m=audio 11324 RTP/AVP 96 97 98 a=curr:gosp local none a=curr:gosp remote none a=des:gosp mandatory local sendrecv a=des:gosp none remote sendrecv a=rtpmap:96 telephone-event a=rtpmap:97 AMR/8000/1 a=fmtp:97 mode-change-capability=2; max-red=220; octet-align=1 a=rtpmap:98 AMR-WB/16000/1 a=fmtp:98 mode-change-capability=2; max-red=220 a=ptime:20 a=maxptime:240 b=AS:30 b=RS:0 b=RR:2000 a=visited-realm:1 Xa.operatorX.net IN IP4 192.0.2.1 49170 a=visited-realm:2 Xa.operatorX.net IN IP4 192.0.2.5 62111 a=omr-codecs:2 audio RTP/AVP 96 97 a=omr-m-att:2 rtpmap:96 a=omr-m-att:2 telephone-event a=omr-m-att:2 rtpmap:97 AMR/8000/1 a=omr-m-att:2 fmtp:97 a=omr-m-att:2 mode-change-capability=2; max-red=220; octet-align=1 a=omr-m-att:2 curr:gosp local none a=omr-m-att:2 curr:gosp remote none a=omr-m-att:2 des:gosp mandatory local sendrecv a=omr-m-att:2 des:gosp none remote sendrecv a=omr-m-att:2 ptime:20 a=omr-m-att:2 maxptime:240 a=omr-s-bw:2 AS:30 a=omr-s-bw:2 RS:0 a=omr-s-bw:2 RR:2000 a=visited-realm:3 Ya.operatorY.net IN IP4 190.1.15.2 11324 a=omr-m-cksum:(..) a=omr-s-cksum:0 </pre>
--

6. INVITE request (IBCF-3 to IBCF-4) - see example in table A.5.2-6

The IBCF-3 uses procedures in clauses 6.1.4, 6.1.7 and 6.1.9 since previous MRs can be bypassed and no local MR is needed for realm matching.

The IBCF-3:

- uses the connection address and port information from the selected instance 2 for the media line in the initial SDP offer as incoming connection address and incoming port information for the media line in the subsequent steps. The instance 2 is selected since it contains more codecs than the visited-realm instance 1;

- reconstructs the associated codec information for the media line in the initial SDP offer from the selected instance 2 according to clause 5.3 and uses that codec information as incoming codec information in the subsequent steps;
- deletes visited-realm instance 3;
- insert the incoming codec information into the SDP m-line and associated attribute lines of the modified initial SDP offer;
- uses the incoming connection address as the connection address in the SDP c-line of the forwarded initial SDP offer;
- uses the incoming port information as determined in previous steps as port information in the SDP m-line of the modified initial SDP offer;
- computes checksum values as described in clause 5.6.3 and adds the "omr-s-cksum" and "omr-m-cksum" attributes for the media line. The "omr-s-cksum" is set to "0" since there is no session line attributes to compute the checksum on; and
- selects an IBCF, IBCF-4, in the realm "Xa.operatorX.net" and forwards the INVITE request with the initial SDP offer according to TS 24.229 [4] to IBCF-4.

Table A.5.2-6: SIP INVITE request (IBCF-3 to IBCF-4)

```

INVITE SIP: UE-B@operator_Y.net; SIP/2.0

SIP headers according to 3GPP TS 24.229 [4]

Content-Type: application/sdp
Content-Length: (...)

v=0
o=- 2987933615 2987933615 IN IP4 192.0.2.1
s=
c=IN IP4 192.0.2.5
m=audio 62111 RTP/AVP 96 97 98
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:96 telephone-event
a=rtpmap:97 AMR/8000/1
a=fmtp:97 mode-change-capability=2; max-red=220; octet-align=1
a=rtpmap:98 AMR-WB/16000/1
a=fmtp:98 mode-change-capability=2; max-red=220
aptime:20
a=maxptime:240
b=AS:30
b=RS:0
b=RR:2000
a=visited-realm:1 Xa.operatorX.net IN IP4 192.0.2.1 49170
a=visited-realm:2 Xa.operatorX.net IN IP4 192.0.2.5 62111
a=omr-codecs:audio RTP/AVP 96 97
a=omr-m-att:2 rtpmap:96
a=omr-m-att:2 telephone-event
a=omr-m-att:2 rtpmap:97 AMR/8000/1
a=omr-m-att:2 fmtp:97
a=omr-m-att:2 mode-change-capability=2; max-red=220; octet-align=1
a=omr-m-att:2 curr:qos local none
a=omr-m-att:2 curr:qos remote none
a=omr-m-att:2 des:qos mandatory local sendrecv
a=omr-m-att:2 des:qos none remote sendrecv
a=omr-m-att:2 ptime:20
a=omr-m-att:2 maxptime:240
a=omr-s-bw:2 AS:30
a=omr-s-bw:2 RS:0
a=omr-s-bw:2 RR:2000
a=omr-m-cksum:(...)
a=omr-s-cksum:0

```

7. INVITE request (IBCF-4 to P-CSCF B) - see example in table A.5.2-7.

The IBCF-4 uses procedures in clauses 6.1.5, 6.1.7 and 6.1.9 since the visited-realm with the highest instance number is connected to the same realm as the IBCF-4 and contains codecs according to the local policy. Using the visited-realm instance 1 would reduce the number of available codecs. No MR for realm matching is needed.

The IBCF-4:

- uses the connection-address from the SDP c-line in the received SDP offer as incoming connection-address in subsequent steps;
- uses the port information from the SDP m-line in the received SDP offer as incoming port information in subsequent steps;
- uses the codec information from the SDP m-line and associated non-OMR attribute lines in the received initial SDP offer as incoming codec information in the subsequent steps;
- inserts the incoming codec information into the SDP m-line and associated attribute lines of the modified initial SDP offer;
- uses the incoming connection address as the connection address in the SDP c-line of the forwarded initial SDP offer; and
- use the incoming port information as determined in previous steps as port information in the SDP m-line of the modified initial SDP offer; and
- forwards the INVITE request with the unmodified initial SDP offer to the P-CSCF-B according to TS 24.229 [4].

Table A.5.2-7: SIP INVITE request (IBCF-4 to P-CSCF B)

```

INVITE SIP: UE-B@operator_Y.net; SIP/2.0

SIP headers according to 3GPP TS 24.229 [4]

Content-Type: application/sdp
Content-Length: (...)

v=0
o=- 2987933615 2987933615 IN IP4 192.0.2.1
s=
c=IN IP4 192.0.2.5
m=audio 62111 RTP/AVP 96 97 98
a=crr:qos local none
a=crr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:96 telephone-event
a=rtpmap:97 AMR/8000/1
a=fmtp:97 mode-change-capability=2; max-red=220; octet-align=1
a=rtpmap:98 AMR-WB/16000/1
a=fmtp:98 mode-change-capability=2; max-red=220
a=ptime:20
a=maxptime:240
b=AS:30
b=RS:0
b=RR:2000
a=visited-realm:1 Xa.operatorX.net IN IP4 192.0.2.1 49170
a=visited-realm:2 Xa.operatorX.net IN IP4 192.0.2.5 62111
a=omr-codecs:2 audio RTP/AVP 96 97
a=omr-m-att:2 rtpmap:96
a=omr-m-att:2 telephone-event
a=omr-m-att:2 rtpmap:97 AMR/8000/1
a=omr-m-att:2 fmtp:97
a=omr-m-att:2 mode-change-capability=2; max-red=220; octet-align=1
a=omr-m-att:2 crr:qos local none
a=omr-m-att:2 crr:qos remote none
a=omr-m-att:2 des:qos mandatory local sendrecv
a=omr-m-att:2 des:qos none remote sendrecv
a=omr-m-att:2 ptime:20
a=omr-m-att:2 maxptime:240
a=omr-s-bw:2 AS:30
a=omr-s-bw:2 RS:0
a=omr-s-bw:2 RR:2000
a=omr-m-cksum:(..)
a=omr-s-cksum:0

```

8. INVITE request (P-CSCF to UE- B) - see example in table A.5.2-8.

The P-CSCF-B uses the procedures in clauses 6.1.5, 6.1.7 and 6.1.9 since no previous realm instance offers an opportunity to bypass an MR and no local MR for realm matching is needed.

The P-CSCF-B:

- uses the connection-address from the SDP c-line in the received initial SDP offer as incoming connection-address in subsequent steps;
- uses the port information from the SDP m-line in the received initial SDP offer as incoming port information in subsequent steps;
- uses the codec information from the SDP m-line and associated non-OMR attribute lines in the received initial SDP offer as incoming codec information in the subsequent steps;
- inserts the incoming codec information into the SDP m-line and associated attribute lines of the modified initial SDP offer;
- uses the incoming connection address as the connection address in the SDP c-line of the forwarded initial SDP offer;
- use the incoming port information as determined in previous steps as port information in the SDP m-line of the modified initial SDP offer;

- deletes all OMR attributes from the initial SDP offer according to the local policy; and
- forwards the INVITE request with the modified initial SDP offer to the UE-B according to TS 24.229 [4].

Table A.5.2-8: SIP INVITE request (P-CSCF to UE-B)

```

INVITE SIP: UE-B@operator_Y.net; SIP/2.0

SIP headers according to 3GPP TS 24.229 [4]

Content-Type: application/sdp
Content-Length: (...)

v=0
o=- 2987933615 2987933615 IN IP4 192.0.2.1
s=
c=IN IP4 192.0.2.5
m=audio 62111 RTP/AVP 96 97 98
b=AS:30
b=RS:0
b=RR:2000
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:96 telephone-event
a=rtpmap:97 AMR/8000/1
a=fmtp:97 mode-change-capability=2; max-red=220; octet-align=1
a=rtpmap:98 AMR-WB/16000/1
a=fmtp:98 mode-change-capability=2; max-red=220
aptime:20
a=maxptime:240

```

9. 183 (Session Progress) response (UE-B to P-CSCF-B) - see example in table A.5.2-9.

The UE accepts the AMR codec and sends a 183 (Session Progress) response to P-CSCF-B with an initial SDP answer selecting the AMR codec and indicating that resources are not yet available according to TS 24.229 [4].

Table A.5.2-9: 183 (Session Progress) response (UE-B to P-CSCF-B)

```

SIP/2.0 183 Session Progress

SIP headers according to 3GPP TS 24.229 [4]

Content-Type: application/sdp
Content-Length: (...)

v=0
o=- 2987933615 2312345678 IN IP4 192.0.2.1
s=-
c=IN IP4 192.0.2.4
m=audio 16511 RTP/AVP 96 97
b=AS:30
b=RS:0
b=RR:2000
a=curr:qos local none
a=curr:qos remote none
a=des:qos mandatory local sendrecv
a=des:qos none remote sendrecv
a=rtpmap:96 telephone-event
a=rtpmap: 97 AMR/8000/1
a=fmtp: 97 mode-change-capability=2; max-red=220; octet-align=1
aptime:20
a=maxptime:240

```

10. 183 (Session Progress) response (P-CSCF-B to IBCF-4) - see example in table A.5.2-9

The P-CSCF-B uses the procedures in clauses 6.2.7 and 6.2.9 since the connection address is valid and no primary local MR was allocated when the initial SDP offer was sent.

The P-CSCF-B forwards the 183 (Session Progress) response with the unmodified initial SDP answer to IBCF-4 according to TS 24.229 [4].

11. PRACK request (IBCF-4 to P-CSCF-B) - see example in table A.5.2-11.

The IBCF-4 uses the procedure in clause 6.2.2 to determine that the transcoder allocated by IBCF-1 is not needed any longer and that a PRACK request can be sent to update the IP address according to visited-realm instance 1.

The IBCF-4 uses the procedures in 6.1.4, 6.1.7 and 6.1.9 since the previous MR at IBCF-1 can be bypassed and no local MR is needed for realm matching.

The IBCF-4:

- uses the connection address and port information from the selected visited-realm instance 1 for the media line in the received initial SDP offer (received in the initial INVITE request in step 6) as incoming connection address and incoming port information for the media line in the subsequent steps;
- reconstructs the associated codec information for the media line in the received initial SDP offer from the selected instance 1 as described in clause 5.3, and use the AMR codec and associated attribute lines as incoming codec information in the subsequent steps;
- deletes every OMR attribute for the media line with instance-number value 2 and 3;
- inserts the incoming codec information into the SDP m-line and associated attribute lines of the modified second SDP offer;
- uses the incoming connection address as the connection address in the SDP c-line of the forwarded second SDP offer;
- uses the incoming port information as port information in the SDP m-line of the modified second SDP offer;
- computes checksum values as described in clause 5.6.3 and replaces or add the "omr-s-cksum" and "omr-m-cksum" attributes for the media line; and
- sends the PRACK request with the modified second SDP offer to P-CSCF-B according to TS 24.229 [4].

Table A.5.2-11: SIP PRACK request (IBCF-4 to P-CSCF-B)

<pre> UPDATE SIP: UE_B@operator_Y.net; SIP/2.0 SIP headers according to 3GPP TS 24.229 [4] Content-Type: application/sdp Content-Length: (...) v=0 o=- 2987933615 2987933615 IN IP4 192.0.2.1 s= b=AS:30 b=RS:0 b=RR:2000 c= IN IP4 192.0.2.1 m=audio 49170 RTP/AVP 96 97 a=rtpmap:96 telephone-event a=rtpmap:97 AMR/8000/1 a=fmtp:97 mode-change-capability=2; max-red=220; octet-align=1 a=qos local none a=curr: qos remote none a=des:qos mandatory local sendrecv a=des:qos none remote sendrecv a=ptime:20 a=maxptime:240 a=visited-realm:1 Xa.operatorX.net IN IP4 192.0.2.1 49170 a=omr-m-cksum:(..) a=omr-s-cksum:(..) </pre>
--

12. PRACK request (P-CSCF-B to UE-B) - see example in table A.5.2-12.

The P-CSCF-B uses the procedure in 6.1.5, 6.1.7 and 6.1.9 since there are no MR to bypass and since no local MR is allocated for realm matching.

The P-CSCF-B:

- uses the connection-address from the SDP c-line in the received second SDP offer as incoming connection-address in subsequent steps;
- uses the port information from the SDP m-line in the received second SDP offer as incoming port information in subsequent steps;
- uses the codec information from the SDP m-line and associated non-OMR attribute lines in the received second SDP offer as incoming codec information in the subsequent steps;
- inserts the incoming codec information into the SDP m-line and associated attribute lines of the modified second SDP offer;
- uses the incoming connection address as the connection address in the SDP c-line of the forwarded second SDP offer;
- uses the incoming port information as port information in the SDP m-line of the modified second SDP offer;
- deletes all OMR related attributes from the second SDP offer according to local policy; and
- forwards the PRACK request and the modified second SDP offer to the UE-B according to TS 24.229 [4].

Table A.5.2-12: SIP PRACK request (P-CSCF-B to UE-B)

<pre> PRACK SIP: UE_B@operator_Y.net; SIP/2.0 SIP headers according to 3GPP TS 24.229 [4] Content-Type: application/sdp Content-Length: (...) v=0 o=- 2987933615 2987933615 IN IP4 192.0.2.1 s= b=AS:30 b=RS:0 b=RR:2000 c= IN IP4 192.0.2.1 m=audio 49170 RTP/AVP 96 97 a=rtpmap:96 telephone-event a=rtpmap:97 AMR/8000/1 a=fmtp:97 mode-change-capability=2; max-red=220; octet-align=1 a=qos local none a=curr: qos remote none a=des:qos mandatory local sendrecv a=des:qos none remote sendrecv a=ptime:20 a=maxptime:240 </pre>

13. 200 (OK) response (UE-B to P-CSCF-B) - see the SDP example in table A.5.2-9.

The UE accepts the AMR codec and sends a 200 (OK) response to the PRACK request to P-CSCF-B with a second SDP answer indicating that resources are not yet available according to TS 24.229 [4].

14. 200 (OK) response (P-CSCF-B to IBCF-4) - see the SDP example in table A.5.2-9.

The P-CSCF-B uses the procedures in clauses 6.2.7 and 6.2.9 since the connection address is valid and no primary local MR was allocated when the second SDP offer was sent.

The P-CSCF-B forwards the 200 (OK) response to the PRACK request with the unmodified second SDP answer to IBCF-4 according to TS 24.229 [4].

15. 183 (Session Progress) response (IBCF-4 - to IBCF-3) - see example in table A.5.2-15.

The IBCF-4 continues from the point in step 10 where the 183 (Session Progress) response was received with an initial SDP answer corresponding to the visited-realm 1 and no transcoding by IBCF-1 was required.

The IBCF-4 uses the procedures in clause 6.2.7 and 6.2.9 since a valid connection address was received in the 200 (OK) response to the UPDATE request and no MR was allocated when the second SDP offer was sent.

The IBCF-4:

- copies into the media line of the initial SDP answer the visited-realm instance 1 from the media line of the received initial SDP offer that was used to populate the connection address and port information in the forwarded second SDP offer, replacing the connection-address and port information in the instance with the connection address and port information from the received second SDP answer;
- replaces the connection address information in the initial SDP answer with the unspecified address of IPv4, "0.0.0.0"; and
- sends the 183 (Session Progress) response with the modified second SDP answer as the initial SDP answer to the IBCF-3 according to TS 24.229 [4].

Table A.5.2-15: 183 (Session Progress) response (IBCF-4 - to IBCF-3)

<pre> SIP/2.0 183 Session Progress SIP headers according to 3GPP TS 24.229 [4] Content-Type: application/sdp Content-Length: (...) v=0 o=- 2987933615 2312345678 IN IP4 192.0.2.1 s=- b=AS:30 b=RS:0 b=RR:2000 c=IN IP4 0.0.0.0 m=audio 16511 RTP/AVP 96 97 a=curr:qos local none a=curr:qos remote none a=des:qos mandatory local sendrecv a=des:qos none remote sendrecv a=rtptime:96 telephone-event a=rtptime:97 AMR/8000/1 a=fmtp:97 mode-change-capability=2; max-red=220; octet-align=1 a=ptime:20 a=maxptime:240 a=visited-realm:1 Xa.operatorX.net IN IP4 192.0.2.4 16511 </pre>
--

16-17. 183 (Session Progress) response (IBCF-3 to IBCF-2 via intermediate IM CN subsystem entities) - see example in table A.5.2-16.

The IBCF-3 uses the procedures in clauses 6.2.5 and 6.2.9 since the initial SDP answer contains an unspecified connection address and a visited-realm instance and the allocated MR is not needed.

The IBCF-3 forwards the 183 (Session Progress) response with the unmodified initial SDP answer to the intermediate IM CN subsystem entities according to TS 24.229 [4].

The intermediate IM CN subsystem entities forwards the 183 (Session Progress) response with the unmodified initial SDP answer to the IBCF-2 according to TS 24.229 [4].

18. 183 (Session Progress) response (IBCF-2 to IBCF-1) - see example in table A.5.2-16.

The IBCF-2 uses procedures in clauses 6.2.5 and 6.2.9 since an unspecified connection address and a visited-realm instance was received and the allocated MR is not needed.

IBCF-2:

- forwards the 183 (Session Progress) response with the unmodified initial SDP answer to IBCF-1 according to TS 24.229 [4]; and
- keeps the allocated MR until it is no longer potentially needed for this and any other forked dialog.

19. 183 (Session Progress) response (IBCF-1 to P-CSCF-A) - see example in table A.5.2-19.

The IBCF-1 uses the procedures in clauses 6.2.5 and 6.2.9 since an unspecified connection address and a visited-realm instance was received and the MR allocated for transcoding is not needed.

- replaces the connection address and port information for the media line in the initial SDP answer with the connection address and port information from the visited-realm instance 1 in the received initial SDP answer;

- forwards the 183 (Session Progress) response with the modified initial SDP answer to P-CSCF-A according to TS 24.229 [4]; and
- keeps the MR allocated for transcoding until it is no longer potentially needed for this and any other forked dialog.

Table A.5.2-19: 183 (Session Progress) response (IBCF-1 to P-CSCF-A)

<pre> SIP/2.0 183 Session Progress SIP headers according to 3GPP TS 24.229 [4] Content-Type: application/sdp Content-Length: (...) v=0 o=- 2987933615 2312345678 IN IP4 192.0.2.1 s=- b=AS:30 b=RS:0 b=RR:2000 c=IN IP4 192.0.2.4 m=audio 16511 RTP/AVP 96 97 a=curr:qos local none a=curr:qos remote none a=des:qos mandatory local sendrecv a=des:qos none remote sendrecv a=rtpmap:96 telephone-event a=rtpmap:97 AMR/8000/1 a=fmtp:97 mode-change-capability=2; max-red=220; octet-align=1 a=ptime:20 a=maxptime:240 </pre>
--

20. 183 (Session Progress) response (P-CSCF-A to UE-A) - see example in table A.5.2-23.

The P-CSCF-A uses procedures in clause 6.2.7 and 6.2.9 since a valid connection address is received and no MR was allocated when the initial SDP offer was sent.

P-CSCF-A forwards the 183 (Session Progress) response with the unmodified initial SDP answer to the UE-B according to TS 24.229 [4].

21-74. Remaining SIP message for establishing the call

The rest of the steps follow the same principles as described in clause A.3.2 steps 17 – 65.

Annex B (informative): Change history

Change history							
Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment	Old	New
03/2011	TSG#51				3GPP TS 29.079 2.0.0 have been approved in TSG#51	2.0.0	10.0.0
06/2011	TSG#52	CP-110408	1	2	Adding session checksum in the simple example flow	10.0.0	10.1.0
06/2011	TSG#52	CP-110408	2	2	Update of proactive transcoder without resource reservation FLOW	10.0.0	10.1.0
06/2011	TSG#52	CP-110408	3	3	Clarifying checksum calculation	10.0.0	10.1.0
06/2011	TSG#52	CP-110408	4	3	Receiving and modified SDP offer clarification	10.0.0	10.1.0
06/2011	TSG#52	CP-110408	5	2	IMS-ALG bypasses an allocated transcoding MR - FLOW	10.0.0	10.1.0
06/2011	TSG#52	CP-110408	6	2	Enhanced IP realm definition	10.0.0	10.1.0
06/2011	TSG#52	CP-110408	7	2	Making connected IP realm information available	10.0.0	10.1.0
09/2011	TSG#53				Editorial Improvement by MCC	10.1.0	10.1.1
12/2011	TSG#54	CP-110834	8		Updated references - Media Control Channel Framework	10.1.1	10.2.0
06/2012	TSG#56	CP-120343	12		IETF reference update (mixer-control)	10.2.0	10.3.0
12/2012	TSG#58	CP-120827	17		Reference update of draft-ietf-mediactrl-mixer-control-package	10.3.0	10.4.0
12/2012	TSG#58	CP-120827	19	2	OMR Signalling Flows	10.3.0	10.4.0
06-2014	TSG#64	CP-140362	023	2	Correcting IP addresses on OMR call flow examples	10.4.0	10.5.0
09-2014	CT-65	CP-140528	0030	1	Message flow correction for media bypassing all IMS-ALGs	10.5.0	10.6.0
09-2014	CT-65	CP-140528	0033	1	Correcting references	10.5.0	10.6.0
03-2015	CT-67	CP-150100	0034		Instance-number value for secondary-realm	10.6.0	10.7.0
03-2015	CT-67	CP-150100	0037		Checksum calculation	10.6.0	10.7.0
03-2015	CT-67	CP-150100	0040		Correcting UA procedure	10.6.0	10.7.0
06-2015	CT-68	CP-150340	0047	2	Procedures for avoiding changes in the OMR algorithm outcome on subsequent SDP offer/answer transactions	10.7.0	10.8.0

History

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V10.6.0	October 2014	Publication
V10.7.0	April 2015	Publication
V10.8.0	July 2015	Publication