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Technical Specification

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Foreword

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Contents

Foreword

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

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

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1 Scope

The present document describes the I1 interface between IMS Centralized Services (ICS) UE and Service Centralization and Continuity (SCC) Application Server (AS).

This specification defines a new application layer protocol over I1 interface, specifies the interaction between the ICS UE and the SCC AS including session control procedures and supplementary services control procedures.

The protocol is intended to be independent of the transport protocol used so it can be applied to a number of technologies that need different transport protocols.

The overall ICS architecture is specified in 3GPP TS 23.292 [2].

The present document is applicable to User Equipment (UE) and Application Servers (AS) which are intended to support the IMS centralized services.

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 23.292: "IP Multimedia Subsystem (IMS) Centralized Services; Stage 2".

[3] 3GPP TS 24.008: "Mobile radio interface layer 3 specification; Core Network protocols; Stage 3".

[4] 3GPP TS 24.090: "Unstructured Supplementary Service Data; Stage 3".

[5] 3GPP TS 24.292: " IP Multimedia (IM) Core Network (CN) subsystem Centralized Services (ICS); Stage 3".

[6] RFC 3261 (June 2002): "SIP: Session Initiation Protocol".

[7] 3GPP TS 23.237: "IP Multimedia Subsystem (IMS) Service Continuity; Stage 2".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in 3GPP 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 3GPP TR 21.905 [1].

For the purposes of the present document, the following terms and definitions given in 3GPP TS 23.292 [2] apply:

ICS UE

SCC AS

For the purposes of the present document, the following terms and definitions given in 3GPP TS 23.237 [7] apply

Access Transfer

Remote Leg

Service Control Signalling Path

Session Transfer

Session Transfer Identifier (STI)

Source Access Leg

Target Access Leg

For the purposes of the present document, the following terms and definitions given in 3GPP TS 24.292 [5] apply:

PSI DN

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in 3GPP TR 21.905 [1].

ICS	IMS Centralized Services
SCC AS	Service Centralization and Continuity Application Server
STI	Session Transfer Identifier
USSD	Unstructured Supplementary Service Data

4 General description

4.1 General

For the current version of the specification the application layer protocol is run over Unstructured Supplementary Service Data (USSD) transport as defined in 3GPP TS 24.090 [4], however the application layer protocol is not restricted to USSD transport.

4.2 Structure of the protocol

4.2.1 Introduction

The I1 protocol is a message based point to point protocol. The I1 protocol messages are transported within a point-to-point transport layer connection protocol and are exchanged between the ICS UE and SCC AS.

The I1 protocol is a transport-independent protocol, i.e. the I1 protocol call control entities can exchange the I1 protocol messages over any transport-layer connection that connects the ICS UE and the SCC AS.

The I1protocol's notation maintains a format of two parts, i.e. I1 message common part and I1 information elements. The I1 message common part is included in every I1 message. The I1 information elements those are included in an I1 message depend on a type of I1 message being sent.

4.2.2 Application level protocol

Overall descriptions with application level protocol are specified as following:

1) it is used to access IMS services (e.g., IMS session origination);

2) it is a point to point protocol between the ICS UE and the SCC AS;

3) its protocol does not support authentication;

4) it does not support segmentation of messages;

5) its messages are self-identifying; and

6) it runs over any point-to-point transport-layer connection (e.g. USSD).

4.2.3 Transport level protocols

4.2.3.1 General

The transport-layer connection that is used to transfer the I1 protocol messages is a bi-directional point-to-point connection between the ICS UE and the SCC AS. This transport-layer connection is a symmetric connection, i.e. the source-point on the transport-layer connection that is used to send the I1 protocol messages is also a destination-point for the incoming I1 protocol messages.

4.2.3.2 USSD as transport level protocol

The USSD provides a two-way-alternative interactive service (i.e.semiduplex) to the user. Only the entity (ICS UE or SCC AS) with the turn may send and its counterpart is permitted only to receive. I1 protocol control function (in ICS UE or SCC AS) has to buffer the I1 protocol message until it has the turn.

Editor's Note: Exchanging a token if the I1 protocol is two sides interactive, in order to determine whether the UE or SCC AS can transmit one or more I1 messages may be a drain on the UE's battery.

When USSD used as transport level protocol, overall descriptions are specified as following:

1) the application level protocol messages shall be buffered until the USSD layer (in the ICS UE or CS network) gets the turn to send on the USSD connection;

2) if the USSD connection still in maintenance and the USSD layer (in the ICS UE or CS network) hasn"t sent an application level protocol message for a specific time, an I1-Dummy message shall be delivered to the counterpart to transfer the turn with the consideration of not delaying its transmission of I1 protocol message; and

Editor's Note: the need for a message transferring the turn (i.e. I1 Dummy message) is FFS.

3) if the I1 session is established, USSD connection will be released.

5 Functional entities

5.1 User Equipment (UE)

To be compliant with this specification, a UE shall implement the role of ICS UE capabilities defined in subclauses 6.1.1, 6.2.1.2, 6.2.2.2, 6.2.3.2, 6.2.4.2. 6.2.5.2, 6.2.6.2, 7.5.3.2.1.1, and 7.5.3.2.2.1

5.2 Application Server (AS)

To be compliant with this specification, a AS shall implement the role of SCC AS capabilities defined in subclauses 6.1.2, 6.2.1.3, 6.2.2.3, 6.2.3.3, 6.2.4.3. 6.2.5.3, 6.2.6.3, 7.5.3.2.1.2, and 7.5.3.2.2.2.

6 Communication between ICS UE and SCC AS via I1 interface

6.1 Introduction

The ICS UE and SCC AS use the I1 interface to setup, control, maintain and release an I1 session control channel and associated media over the CS bearer.

6.2 Session control procedures

6.2.1 Session setup

6.2.1.1 General

The ICS UE setups the session with CS media and the service control signalling via the I1 reference point. I1 is used to control services in the IM CN subsystem.

I1 sessions can only be created by I1 session setup messages. An I1 Invite message is an I1 session setup message. I1 sessions can be torn down by I1 session release messages. An I1 BYE message is an I1 session release message.

The following subclauses describe the procedures of the ICS UE and the SCC AS for session setup:

- subclause 6.2.1.2.1 describes the procedures of ICS UE session origination;
- subclause 6.2.1.2.2 describes the procedures of ICS UE session termination without UE assisted T-ADS function;
- subclause 6.2.1.2.3 describes the procedures of ICS UE session termination with UE assisted T-ADS function;
- subclause 6.2.1.3.1 describes the procedures of SCC AS session origination;
- subclause 6.2.1.3.2 describes the procedures of SCC AS session termination without UE assisted T-ADS function; and
- subclause 6.2.1.3.3 describes the procedures of SCC AS session termination with UE assisted T-ADS function.

6.2.1.2 Detailed behaviour of ICS UE

6.2.1.2.1 ICS UE CS Session Origination

When the ICS UE originates a session using an I1reference point, the UE shall:

1) generate an I1 Invite message that includes:
   a) a Message type subfield set to the value that includes that this is an I1 Invite message;
   b) a new value in the Call-Identifier (Part-1) subfield, as specified in subclause 7.2.2. The Call-Identifier will uniquely identify this I1 session between the ICS UE and the SCC AS;

Editor"s note: if forking is supported then such can have impact on the call-ID

   c) an allocated Message sequence number;
   d) a From-id information element that includes either a SIP URI or an E.164 number, and it will be used by the SCC AS to identify the ICS UE;

Editor"s note: How to include the SIP URI into the I1 messages is FFS.

e) a To-id information element that includes either a SIP URI or an E.164 number, and will be used by the SCC AS to determine the identity of the called user;

f) a Privacy information element that indicates the ICS UE's privacy preferences. The SCC AS will apply these preferences to the SIP session that the SCC AS will establish on behalf of the UE; and

g) a CS access network type indicator; and

Editor's Note: It is FFS whether more items are needed. The ordering of the parameters and how they are coded is FFS. The transaction style is FFS. PUD naming is FFS.

2) select the transport layer protocol depending on the access network type, and forward the I1 Invite message toward the SCC AS.

When the UE receives an I1 Progress message with Progress reason set to Call progressing, the UE shall:

1) save the received Call-Identifier value and use it for further reference to this session;

2) verify if the message is in sequence according to the Message sequence number value, and save the received Message sequence number;

3) store the SCC AS PSI DN value (i.e. the E.164 number) received in the SCC-AS-id information element; and

4) store the STI value (i.e. the E.164 number) if received in the Session-identifier information element;

NOTE 1: The STI value uniquely identifies the I1 session being established, and it may be subsequently used to refer to this I1 session, e.g. the SCC AS uses the STI to correlate the access transfer request received via the PS access with the active session established via the I1 interface.

NOTE 2: The UE may indicate the Progress reason value to the user.

Editor"s note: Responses indicating an error are FFS.

Upon receiving the SCC AS PSI DN (i.e. the E.164 number) conveyed in the I1 Progress message with Progress reason set to Call progressing from the SCC AS, the ICS UE shall initiates the call over the CS domain by sending a SETUP message to the MSC Server as specified in 3GPP TS 24.008 [3] as follows:

1) the Called Party BCD Number information element is set to the SCC AS PSI DN (i.e. the E.164 number) received in the I1 Progress message with Progress reason set to Call progressing.

When the ICS UE receives an I1 Success message, the UE shall:

1) verify if a I1 session exists for the received Call-Identifier value;

2) verify if a the message is in sequence according to the Message sequence number value; and

3) consider the call to be established, if verification was successful.

Editor"s note: Responses indicating an error are FFS.

6.2.1.2.2 ICS UE CS Session Termination without UE assisted T-ADS

If the ICS UE receives an I1 Invite message from the SCC AS, and the UE determines that no I1 session exists for the received Call-Identifier value, the ICS UE shall:

1) store the information contained in the I1 Invite message, including the called party identity included in the To-id information element, the calling user's public user identity included in the From-id information element, the IUA PSI DN (i.e., the E.164 number) included in the SCC-AS-id information element, the Message sequence number, the Call-Identifier (Part-2) subfield, the STI value (i.e. the E.164 number) if received in the Session-identifier information element, and transport layer information identifying the transport connection over which the I1 Invite message was received; and

2) initiate a call over CS bearer by sending a SETUP message to the MSC Server as specified in 3GPP TS 24.008 [3] with the Called Party BCD Number information element is set to the received SCC AS PSI DN (i.e., the E.164 number).

NOTE 1: The ICS UE may indicate the From-id information element value or an I1 session received indication to the user.

NOTE 2: When the ICS UE receives an I1 Invite message, the UE may send an I1 Progress message with Reason set to Call progressing. The I1 Progress message with Reason set to Call progressing is identical to the I1 Progress message with Reason set to Ringing described below, except the Reason subfield will be set to Call progressing.

Editor"s note: Responses indicating an error are FFS.

Editor's Note: It is FFS whether more items are needed. The ordering of the parameters and how they are coded is FFS.

When the ICS UE receives an indication from the CS domain that the media resources are available (i.e. the UE receives a CONNECT message) the UE shall:

1) generate an I1 Progress message with Progress reason set to Ringing containing the following information:

   a) a Message type subfield set to the value that indicates that is an I1 Progres message;

   b) a new value in the Call-Identifier (Part-1) subfield, as specified in subclause 7.2.2. The resulting Call-Identifier uniquely identifies this I1 session between the UE and SCC AS;

NOTE 3: A new value in the Call-Identifier (Part-1) subfield is inserted only if this is the first I1 message sent to the SCC AS. Otherwise the previously set Call-Identifier value is used.

   c) increment the stored Message sequence value, store it, and include it in the Message sequence subfield; and

   d) set the Reason subfield (per figure 7.3.1) to 183; and

2) send the I1 Progress message with Progress reason set to Ringing towards the SCC AS over the transport layer connection over which the I1 Invite message was received.

If the user accepts the request, the ICS UE shall:

1) generate an I1 Success message containing the following information:

   a) a Message type subfield set to the value that indicates that is an I1 Success message;

   b) the stored Call-Identifier value that uniquely identifies this I1 session between the UE and SCC AS; and

Editor"s note: if forking is supported then such can have impact on the call-ID.

   c) increment the stored Message sequence value, store it, and include it in the Message sequence subfield; and

Editor's Note: include a B-Party URI header value set to a SIP or tel URI is FFS.

Editor's Note: It is FFS whether more items are needed. The ordering of the parameters and how they are coded is FFS.

2) send the I1 Success message towards the SCC AS over the transport layer connection over which the I1 Invite message was received.

6.2.1.2.3 ICS UE CS Session Termination with UE assisted T-ADS

If the ICS UE receives an I1 Invite message with a Replaces header field and it is determined that there is a SIP session being established for the Replaces header value (e.g., the Replaces header is set to a value identical to (or deduced from) the SIP session identifier in a previously received SIP INVITE), the ICS UE:

1) shall interpret it as session control fallback from Gm to I1; and

2) shall use the Replaces header value to correlate the I1 Invite message with the SIP INVITE request prevously received, to get IUA PSI DN, the called party identity and the calling party identity.

NOTE: In this case, some headers (e.g. To, From, Privacy header) and IUA PSI DN can be omitted from the I1 Invite message, for the information can be get by the ICS UE from the correlated SIP INVITE request.

Editor's Note: It is FFS whether more items are needed. The ordering of the parameters and how they are coded is FFS.

Afterwards, the ICS UE shall behave as specified in subclause 6.2.1.2.2.

6.2.1.3 Detailed behaviour of SCC AS

6.2.1.3.1 SCC AS CS Session Origination

The following subclause describes the procedures at the SCC AS for session origination. In this scenario, the SCC AS serves the originating user.

Upon receiving an initial I1 Invite message from the ICS UE via the I1 reference point, the SCC AS shall:

1) store the information received in the I1 Invite message, including the called party identity included in the To-id information element, the calling user's public user identity included in the From-id information element, the requested privacy type included in the Privacy information element, the Sequence-ID header value, and transport layer information identifying the transport connection over which the I1 Invite message was received;

1A) dynamiclly allocate a STI and bind it to the information stored in step 1. The STI is specified as an E.164 number;

NOTE 1: The STI value uniquely identifies the I1 session being established, and it may be subsequently used to refer to this I1 session, e.g. the SCC AS uses the STI to correlate the access transfer request received via the PS access with the active session established via the I1 interface.

2) allocate the SCC AS PSI DN which is specified as an E.164 number and shall identify the stored information in step 1) and associated with the SCC AS;

3) generate an I1 Progress message containing the following information:

   a) a Message type field set to the value that indicates that is an I1 Progress message;

   b) include the stored Call-ID header value;

   c) add one to the stored Sequence-ID header value. Store and include the Sequence-ID header value;

   d) include the allocated SCC AS PSI DN (i.e., the E.164 number) in the SCC-AS-id information element; e) set the Reason field to 183 (per figure 7.3.1); and

   f) include the allocated STI (i.e., the E.164 number) in the Session-identifier information element;

Editor's Note: It is FFS whether more items are needed. The ordering of the parameters and how they are coded is FFS.

4) perform the procedures per 3GPP TS 24.292 subclause 7.4.2.1 item 3;

5) perform the procedures per 3GPP TS 24.292 subclause 7.4.2.1 item 4; and

6) send the I1 Progress message towards the originating UE over the transport layer connection over which the I1 Invite message was received.

Subsequently, the SCC AS will wait for an initial SIP INVITE request from the CS domain (via MGCF) with the Request-URI set to the allocated SCC AS PSI DN. The SCC AS shall use the received SCC AS PSI DN and correlate it with the information saved in step 1).

NOTE 2: The SCC AS will use the information received in the initial SIP INVITE request from the CS domain and the information saved in step 1 when sending a request toward the remote UE.

Subsequently the SCC AS may send towards the ICS UE either an I1 Progress message with Progress reason set (per figure 7.3.1) to 180 or an I1 Success message.

When sending an I1 Progress message with Progress reason set to 180 towards the originating UE, the SCC AS shall:

1) generate an I1 Progress message containing the following information:

a) a Message type field set to the value that indicates that is an I1 Progress message;

b) include the stored Call-ID header value; and

c) add one to the stored Sequence-ID header value. Store and include the Sequence-ID header value; and

2) send the I1 Progress message towards the originating UE over the transport layer connection over which the I1 Invite message was received.

Editor's Note: It is FFS whether more items are needed. The ordering of the parameters and how they are coded is FFS.

When sending an I1 Success message towards the orginating UE, the SCC AS shall:

1) generate an I1 Success message containing the following information:

a) a Message type field set to the value that indicates that is an I1 Success message; and

b) a Call-Identifier field containing the Call-Identifier value that uniquely identifies this I1 session between the UE and SCC AS;

2) add one to the stored Sequence-ID header value. Store and include the Sequence-ID header value; and

3) send the I1 Success message towards the originating UE over the transport layer connection over which the I1 Invite message was received.

Editor's Note: have the B-Party URI header value set to the value of the P-Asserted-Identity header field in the received SIP 200 (OK) response is FFS.

Editor's Note: It is FFS whether more items are needed. The ordering of the parameters and how they are coded is FFS.

6.2.1.3.2 SCC AS CS Session Termination without UE assisted T-ADS

Prior to sending an I1 Invite message towards the ICS UE, the SCC AS performs the Terminating Access Domain Selection and chooses the CS domain for the setup of the media.When sending an I1 Invite towards the ICS UE, the SCC AS shall:

1) perform the procedures per 3GPP TS 24.292 subclause 10.4.4 item 1;

1A)dynamiclly allocate a STI. The STI is specified as an E.164 number;

NOTE 1: The STI value uniquely identifies the I1 session being established, and it may be subsequently used to refer to this I1 session, e.g. the SCC AS uses the STI to correlate the access transfer request received via the PS access with the active session established via the I1 interface.

2) create an I1 Invite message that includes:

a) a Message type subfield set to the value that indicates that this is an I1 Invite message;

b) generate a Call-ID that identifies the transaction between the ICS UE and SCC AS. Include the Call-ID header value in the I1 INVITE;

Editor"s note: if forking is supported then such can have impact on the call-ID.

c) generate a Sequence-ID. Include the Sequence-ID header value in the I1 Invite Message;

d) a From-id information element that identifies the remote calling party, if available;

NOTE 2: The SCC AS will include in the From-id information element the remote calling party only if it is an E.164 number.

e) a To-id information element that includes the E.164 number of the UE;

Editor"s note: How to include the SIP URI into the I1 messages is FFS.

f) a Privacy information element set to the value requested by the remote calling party, if available;

g) a SCC-AS-id information element that contains an SCC AS DN set to the E.164 number allocated by the SCC AS itself; and

h) a Session-identifier information element that contains the allocated STI;

Editor's Note: It is FFS whether more items are needed. The ordering of the parameters and how they are coded is FFS.

3) store the information sent in the I1 Invite message against the allocated SCC AS PSI DN; and

4) select the transport layer protocol depending on the access network type, and forward the I1 Invite message toward the UE.

When the SCC AS receives a SIP INVITE request from the CS domain with the Request URI set to a SCC AS PSI DN, if the SCC AS PSI DN is valid the SCC AS shall:

- use the received SCC AS PSI DN and correlate it with the information saved in step 2 above;
- use the SCC AS PSI DN and correlate the SCC AS PSI DN against the incoming SIP INVITE request from the originating UE; and
- create a response in accordance with 3GPP TS 24.229 [11], indicating local preconditions met and route towards CS domain.

NOTE 3: The SCC AS will use the information received in the initial SIP INVITE request from the CS domain and the information saved in step 2 when handling a session with the remote party.

NOTE 4: The receipt of the SIP INVITE request from the CS domain indicates that the UE has received the I1 Invite message.

Subsequently the SCC AS may receive either an I1 Success message or an I1 Progress message (with Reason subfield set either to Ringing or Call progressing) from the ICS UE.

When the SCC AS receives either an I1 Success message or an I1 Progress message (with Reason subfield set either to Ringing or Call progressing), the SCC AS shall:

1) verify if a I1 session exists for the received Call-Identifier value; and

2) verify if the message is in sequence according to the Sequence-ID header value.

NOTE 5: The SCC AS will use the information received in the I1 Success message or an I1 Progress message (with Reason subfield set either to Ringing or Call progressing) and the information saved in step 2 when handling a session with the remote party.

When the SCC AS receives an I1 Progress message prior to the related SIP INVITE request from the CS domain, the SCC AS shall wait until the SIP INVITE request from the CS domain is received.

6.2.1.3.3 SCC AS CS Session Termination with UE assisted T-ADS

In the case of UE assisted T-ADS, the SCC AS performs initial T-ADS selecting Gm for the service control signalling and sends a SIP INVITE request to the ICS UE via the I/S-CSCF as specified in 3GPP TS 24.292 [5].Upon receiving a 183 Session Progress message from the UE which indicates that a CS bearer is required for the session and service control will be via I1, the SCC AS shall generate an I1 Invite message to the terminating ICS UE as specified in subclause 6.2.1.3.2 with the following addition:

1) Include a Replaces header in the I1 Invite message, which is set to a value identical to (or deduced from) the SIP session identifier in the previous SIP INVITE request, to indicate that it is session control fallback from Gm to I1.

NOTE: In this case, some headers (e.g., To, From, Privacy header) and IUA PSI DN can be omitted from the I1 Invite message, for the information can be get by the ICS UE from the correlated SIP INVITE request.

Afterwards, the SCC AS shall complete the IMS session setup as specified in subclause 6.2.1.3.2.

6.2.2 Session modification

6.2.3 Session release

6.2.3.1 General

I1 sessions can be torn down by the I1 session release requests and by receipt of a DISCONNECT message as specified in 3GPP TS 24.008 [3]. An I1 Bye message is an I1 session release request.

6.2.3.2 Detailed behaviour of ICS UE

When the ICS UE releases a session using using the I1 session control channel by sending an I1 Bye message, it shall:

1) set the Call-ID to a value that identifies the I1 session between the ICS UE and SCC AS. Include the Call-ID header value in the I1 Bye;

2) set the Sequence-ID. Include the Sequence-ID header value in the I1 Bye message;

3) a From-id information element that includes either a SIP URI or an E.164 number, and it will be used by the SCC AS to identify the ICS UE;

Editor"s note: How to include the SIP URI into the I1 messages is FFS.

4) a To-id information element that includes either a SIP URI or an E.164 number, and will be used by the SCC AS to determine the identity of the called user;

5) a Privacy information element that indicates the ICS UE's privacy preferences. The SCC AS will apply these preferences to the SIP session that the SCC AS will establish on behalf of the UE;

6) a CS access network type indicator; and

7) if there are no more I1 service control sessions using the CS bearer, set the the CS bearer release timer value.

Editor"s note: For voice calls is there a need to include any SDP type of information, by the virtue of using I1 in the context of this contribution it can be implied that CS voice is being used.

Editor's Note: It is FFS whether more items are needed. The ordering of the parameters and how they are coded is FFS. The transaction style is FFS. PUD naming is FFS.

If the CS bearer release timer expires, the ICS UE shall send a DISCONNECT message to the MSC Server as specified in 3GPP TS 24.008 [3], if needed.

Subsequently, if the ICS UE receives an I1 Success message from the SCC AS, it shall:

1) verify if a I1 session exists for the received Call-Identifier value;

2) verify if a the message is in sequence according to the Message sequence number value; and

3) consider the I1 session to be released, if verification was successful and clear the CS bearer release timer value.

Editor"s note: Responses indicating an error are FFS.

When the ICS UE releases a session using the I1 session control channel by receiving an I1 Bye message, it shall:

1) if there are no more I1 service control sessions using the CS bearer, the UE shall send a DISCONNECT message to the MSC Server as specified in 3GPP TS 24.008 [3], if there are no more I1 service control sessions using the CS bearer;

2) if there are more I1 service control sessions using the CS bearer, the UE shall transmit a I1 Success message, containing the following information:

   a) a Message type subfield set to the value that indicates that is an I1 Success message;

   b) the stored Call-Identifier value that uniquely identifies this I1 session between the ICS UE and SCC AS; and

Editor"s note: if forking is supported then such can have impact on the call-ID.

c) increment the stored Message sequence value, store it, and include it in the Message sequence subfield.

Editor's Note: the support for multiple I1 service control sessions is FFS.

When the UE receives a DISCONNECT message to release the CS bearer as specified in 3GPP TS 24.008 [3]:

- the CS bearer release timer expires shall be cleared, if needed;
- if the UE has a SIP REGISTER request associated with the ongoing CS call, the UE shall send a SIP reINVITE request requesting the media over the CS bearer to be deleted.

If the UE receives a SIP reINVITE request requesting the media over the CS bearer to be deleted and a DISCONNECT message for the CS bearer was already received, the UE shall accept the request to delete the media over the CS bearer.

6.2.3.3 Detailed behaviour of SCC AS

When the SCC AS enhanced for I1 releases a session by sending an I1 Bye message, it shall implement interworking of established call clearing between I1 signalling and SIP as specified in 3GPP TS 24.292 [5], with the following addition:

1) set the Call-ID to a value that identifies the I1 session between the ICS UE and SCC AS. Include the Call-ID header value in the I1 BYE;
2) set the Sequence-ID. Include the Sequence-ID header value in the I1 INVITE.
3) include a From-id information element that identifies the remote calling party, if available;
4) include a To-id information element that includes the E.164 number of the ICS UE;
5) include a Privacy information element set to the value requested by the remote calling party, if available; and
6) include a SCC-AS-id information element that contains an SCC AS DN set to the E.164 number allocated by the SCC AS itself;

Editor's Note: It is FFS whether more items are needed. The ordering of the parameters and how they are coded is FFS.

7) store the information sent in the I1 Bye message against the allocated SCC AS PSI DN.

Subsequently, if the SCC AS receives an I1 Success message from the ICS UE, it shall implement interworking of established call clearing between I1 signalling and SIP as specified in 3GPP TS 24.292 [5], with the following addition:

1) verify if a I1 session exists for the received Call-Identifier value;
2) verify if a the message is in sequence according to the Message sequence number value; and
3) consider the call to be released, if verification was successful.

Editor"s note: Responses indicating an error are FFS.

When the SCC AS receives an I1 Bye message from ICS UE via the I1 reference point, it shall implement interworking of established call clearing between I1 signalling and SIP as specified in 3GPP TS 24.292 [5], with the following addition:

1) if the SCC AS transmits an I1 SUCCESS message using the I1 session control channel, it shall containing the following information:

a) a Message type subfield set to the value that indicates that is an I1 Success message;

b) the stored Call-Identifier value that uniquely identifies this I1 session between the ICS UE and SCC AS; and

Editor"s note: if forking is supported then such can have impact on the call-ID.

c) increment the stored Message sequence value, store it, and include it in the Message sequence subfield.

6.2.4 Adding I1 control to existing CS session (I1 Augmentation)

6.2.4.1 General

Standard CS procedures can be used to deliver the incoming session to the ICS UE as specified in 3GPP TS 24.292 [5] subclause 10.4.7 (SCC AS for call termination over CS to non-ICS UE) or originate a session as specified in 3GPP TS 24.292 [5] subclause 7.4.3 (ICS UE using CS). Additional IMS parameters or service control can be optionally communicated to the ICS UE using I1 after the session has been setup. The UE or SCC AS shall add I1 control to an existing session only when there is a single session over CS.

6.2.4.2 Detailed behaviour of ICS UE

If the ICS UE wants to add I1 control to an existing session that was established without I1 and Gm, it shall send an I1 Invite message over I1. The ICS UE shall populate the I1 Invite message as specified in subclause 6.2.1.2.1 with the following additions:

1) set the To information element to the static STI;

NOTE: In this case, some information elements (e.g. From, Privacy) can be omitted from the I1 Invite message, for the information is already known for the ongoing session.

Upon receiving an I1 Success message, the ICS UE shall treat the ongoing session as established using I1.

If the ICS UE receives a new I1 Invite message containing a SCC AS PSI DN which matches the B-party number of the ongoing session that was established without I1 and Gm, the ICS UE shall:

1) respond to the I1 Invite message with an I1 Success message; and

2) treat the ongoing session as established using I1.

6.2.4.3 Detailed behaviour of SCC AS

If the SCC AS receives an I1 Invite message containing the static STI in the To information element, the SCC AS shall determine if this I1 Invite message is for an ongoing session using STI or CS domain number (e.g., MSISDN) from transport layer. If the ICS UE has an ongoing session, the SCC AS shall:

1) respond to the I1 Invite message with an I1 Success message; and

2) treat the ongoing session as established using I1.

If the SCC AS wants to add I1 control to an existing session that was established without Gm and I1, the SCC AS shall send a new I1 Invite message over I1 reference point. The SCC AS shall populate the I1 Invite message as specified in subclause 6.2.1.2.2 with the following addition:

1) include a SCC AS PSI DN which matches the B-party number of the ongoing session.

NOTE: In this case, some information elements (e.g. From, To, Privacy) can be omitted from the I1 Invite message, for the information is already known for the ongoing session.

Upon receiving an I1 Success message, the SCC AS shall treat the ongoing session as established using I1.

6.2.5 Service control transfer (Gm fallback to I1)

6.2.5.1 General

If the ICS UE discovers Gm is not available for an ongoing session using CS bearer which was established over Gm reference point, the ICS UE can transfer service control from Gm to I1 if I1 is available while maintain the CS bearer.

6.2.5.2 Detailed behaviour of ICS UE

When the ICS UE originates a service control transfer from Gm to I1 using an I1Invite message, the ICS UE shall generate the I1 Invite message to the SCC AS as specified in subclause 6.2.1.2.1 with the following additions:

1) Include a Replaces information element in the I1 Invite message to indicate that it is session control fallback from Gm to I1. The Replaces information element is set to a value identical to (or deduced from) the SIP session identifier of the existing IMS session using CS bearer for which the control will be transferred from Gm to I1.

NOTE: In this case, some information elements (e.g. Call-ID, To, From, Privacy) can be omitted from the I1 Invite message, for the information is already known for the ongoing session.

If the ICS UE receives an I1 Success message, the service control transfer completes.

6.2.5.3 Detailed behaviour of SCC AS

Upon receiving an initial I1 Invite message with a Replaces information element set to a value identical to (or deduced from) the SIP session identifier of an existing IMS session using CS bearer established over Gm reference point, and the SCC AS can correlate the SIP Call-ID to an existing IMS session with CS bearer, the SCC AS shall:

1) interpret it as service control transfer from Gm to I1;

2) correlate the I1 Invite message to the existing IMS session using CS bearer based on the Replaces information element, e.g. to get SCC AS PSI DN, the called party identity and the calling party identity; and

NOTE: In this case, some information elements (e.g. Call-ID, To, From, Privacy) can be omitted from the I1 Invite message, for the information is already known for the ongoing session.

3) generate an I1 Success message to the ICS UE.

6.3 Supplementary services control procedures

Editor's note: This subclause describes the procedures related to supplementary services control procedures supported by I1 interface.

7 Protocol specification and implementation

7.1 Overview of I1 protocol functionality

The I1 protocol includes the procedures for establishing, maintaining, and clearing call legs between the ICS UE and the SCC AS (see figure 7.1).

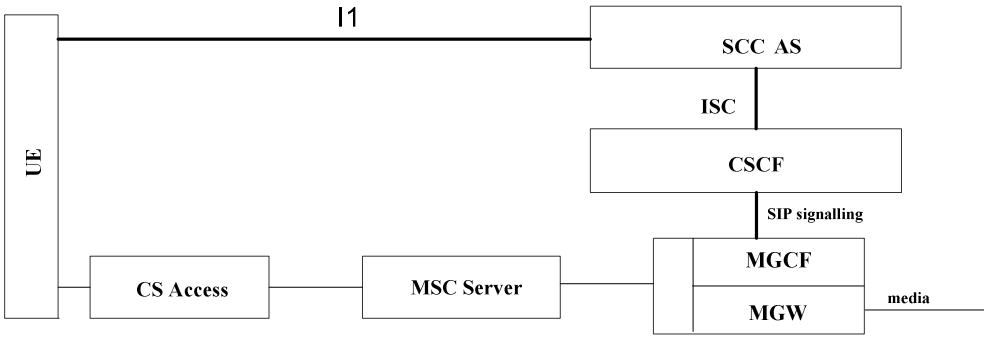

Figure 7.1 UE session signalling and bearer path using I1 interface for Service Control Signalling Path

NOTE 1: Figure 7.1 illustrates an MSC server that is not enhanced for ICS. I1 can also be used when deploying an MSC server enhanced for ICS as specified in 3GPP TS 23.292 [2].

The I1 protocol is a message based point-to-point protocol. The I1 protocol messages are wrapped in a point-to-point transport layer connection protocol (e.g.USSD) and are exchanged between the ICS UE and the SCC AS. Therefore, the I1 protocol does not include any routing capabilities. To address the ICS UE in CS network and establish a transport-

layer connection, (the IUA of) the SCC AS shall convert the called party identity (i.e., IMS public user identity) to the CS domain party identity that is required to route the transport layer protocol(i.e., MSISDN, MDN, etc.).

The I1 protocol assumes that there is an associated connection-control protocol that incorporates media negotiation capabilities and provides the setting up and clearing of the connection over which the media will be exchanged. Therefore, any signalling between the UE and the CS access domain (see figure 7.1), as well as the SIP signalling between the MGCF and the SCC AS should be viewed as a procedure to establish a media connection rather then a call control signalling. Obviously, the I1 endpoints will correlate and synchronize the progress of the call establishment and clearing of the call with the associated media-establishing procedures.

NOTE 2: The primitives that are used to communicate between the I1 protocol call-controlling entity and the associated connection-control protocol entity, internally in the UE and SCC AS, respectively, are not specified in this document.

The I1 protocol assumes that the application level segmentation of the I1 protocol messages is not supported. The size of the I1 protocol messages is constrained by the limits of the transport-layer message size. For example, USSD allows for a message size of 160 octets. This means that it is not possible to send an I1 protocol message greater than 160 octets, unless message segmentation is designed into the I1 protocol. A USSD dialogue is already segmented by the use of USSD sub-dialogues as a USSD conversation, and this usage of USSD is inappropriate for the I1 protocol.

Editor's note: It has to be specified whether the transport-layer connection provides a reliable transport (i.e. the messages will not be lost, delayed, duplicated, or delivered out of order). In case of an unreliable transport, the I1 protocol will incorporate timeouts, retransmissions, and sequencing mechanisms to account for the lost, duplicated, and out of order I1 protocol messages.

The I1 protocol is a transport-independent protocol, i.e. the I1 protocol call control entities can exchange the I1 protocol messages over any transport-layer connection that connects the ICS UE and the SCC AS. The ICS UE sends the I1 protocol messages to the SCC AS over a transport-layer connection (e.g. USSD) that the ICS UE knows it will reach the SCC AS. Likewise, The SCC AS sends the I1 protocol messages to the ICS UE over a transport-layer connection (e.g. USSD) that the SCC AS knows that it will reach the ICS UE. For example, the SCC AS forwards the I1 protocol message to the ICS UE over the same transport-layer connection (e.g. USSD) over which it received the previous I1 protocol message from the ICS UE.

The I1 protocol message are self-identifying, i.e. the information contained in the I1 protocol message uniquely identifies the call to which the I1 protocol message pertains to.

Editor's Note: It is FFS how a particular UE's public user identity bound to a given transport-level connection used for signaling, will be described. For example, the establishment of an USSD channel can implicitly bind the UE's E.164 number to this transport-layer connection.

The I1 protocol is a binary-oriented protocol (i.e. the I1 messages are binary encoded). The bit-map tables are used to describe the I1 messages and associated information elements.

In this release of this document, it is assumed that the ICS UE, when establishing a transport-layer connection (e.g. USSD channel) to the SCC AS, will have been authenticated by the CS domain. Due to a relationship between the SCC AS and the CS domain, the ICS UE is not authenticated (e.g. challenged) by the SCC AS when sending any I1 protocol message to the SCC AS. However, the SCC AS will check the UE identity for potential invalid IMS public user identity included by the ICS UE. The CS domain number received from the transport-layer is trustable and will be used by (the IUA of) the SCC AS to check the URI of the UE before the SCC AS provides SIP UA behaviour on behalf of the ICS UE.

7.2 I1-protocol messages and functional definition

7.2.1 I1-protocol messages

7.2.1.1 General

This subclause provides the list of I1-protocol messages (see table 7.2.1) and brief description of each I1-protocol message. Based on their function the I1-protocol messages can be grouped into five categories:

- I1-Session establishment messages;

- I1-Stable Session messages;
- I1-Session clearing messages;
- I1-Error messages;
- I1- Supplementary Service -Invocation messages;and
- I1-Other messages.

Editor's Note: the need for an I1-other messages such as I1 Dummy message is FFS.

Editor's note: a definition of the term stable call is FFS

Table 7.2.1.1: I1-protocol messages

Message type	Description and content (subclause)
Session establishment messages:	7.2.1.2
I1 Invite message I1 Progress message I1 Success message	
***Stable Session messages*:**	7.2.1.3
I1 Refer message	
***Session clearing messages*:**	7.2.1.4
I1 Bye message I1 Success message	
***Error messages*:**	7.2.1.5
I1 Failure message	
***Supplementary Service Invocation messages*:**	7.2.1.6
I1 Mid Call Request message I1 Redirection message I1 Notify message	
Other messages:	
I1 Dummy message	7.2.1.7

Editor's note: it is FFS if an I1 Cancel message would be needed in addition to the I1 Bye message.

Editor's Note: the need for a I1 Dummy message is FFS

7.2.1.2 Session establishment messages

The session establishment I1 messages can be sent either by the ICS UE to the SCC AS or by the SCC AS to the ICS UE.

I1 Invite message

The I1 Invite message is sent either by the calling UE to the SCC AS or by the SCC AS to the called UE to initiate session establishment.

I1 Progress message

The I1 Progress message is a general purpose provisional response, semantically similar to SIP 1xx class responses. The binary Reason field value (per figure 7.3.1) corresponds with the received SIP 1xx response's numeric status-code value.

Editor"s note: depending on whether the transport-layer connection provides a reliable transport, the I1 Progress message with Progress reason set to Call progressing can quench the retransmissions of the I1 Invite messages. In case of forking, it is FFS if the SCC AS, upon receiving an I1-Invite message from the UE, responds with multiple I1 Progress messages with Progress reason set to Call progressing due to a forking. Each I1 Progress message with Progress reason set to Call progressing may result in a distinct call leg between the UE and the SCC AS, with a distinct call identifier for each call leg.

I1 Success message

The I1 Success message indicates that the action requested in the respective I1 message has been accomplished successfully.

The I1 Success message:

- is transmitted by the SCC AS to the calling UE to indicate that the session has been accepted; or
- is transmitted by the called UE to the SCC AS to indicate that the called UE has accepted the session.

The Reason's corresponding to the I1 Success message are specified in table 7.3.1 and correspond with a SIP 2xx response's numeric status-code.

Editor"s note: In case of forking, it is FFS if the SCC AS, upon receiving an I1-Setup request message from the UE may respond back to the UE with multiple I1-Setup-Complete final-response messages due to a forking of the original I1-Setup request message. Each I1-Setup-Complete final-response message returned to the UE may result in a distinct call leg with a distinct call identifier for each call leg.

7.2.1.3 Stable session messages

I1 Refer message

The I1 Refer message is sent either by the ICS UE to the SCC AS or by the SCC AS to the ICS UE to indicate that the recipient of the I1 Refer message should contact the target identified in the I1 Refer message.

Editor"s Note: Whether the I1 Refer request sent outside an existing call creates a call, and how is the sender of the I1 Refer request notified about the outcome of the referenced request is FFS. In addition, it may be useful to have some flows in order to determine e.g. whether this message is a stable call as well as a non call category message

7.2.1.4 Session clearing messages

I1 Bye message

The I1 Bye message:

- is transmitted by the SCC AS to the ICS UE to clear the session; or
- is transmitted by the ICS UE to the SCC AS to clear the session.

Editor"s Note: Whether an indication needs to be transmitted that the call has disconnected in response to an I1 Bye message and that the media and associated resources (if any) have been released, is FFS.

7.2.1.5 Error messages

I1 Failure message

An I1 Failure response message is sent either by the ICS UE to the SCC AS or by the SCC AS to the ICS UE, to indicate that an error has occurred. The additional parameters included in the I1-Error message indicate the type of the error that has occurred. These are similar to SIP 4xx class failure messages.

7.2.1.6 Supplementary Services Invocation related messages

The following section details the messages that are used to request the invocation of a supplementary service.

I1 Mid Call Request message

The I1 Mid Call Message is used for the invocation of mid-call supplementary services. For example: user wishes to hold or resume a call.

I1 Redirection message

The I1 Redirection message is used by the ICS UE to inform the SCC AS of the desire to invoke a supplementary service, in response to incoming signalling. For example: desire for the called user to deflect the call to a third party. The SCC AS interworks the I1 response to the appropriate SIP response to send to the SIP AS.

I1 Notify message

The I1 Notify message may be used to notify the UE of events related to the invocation of supplementary services. For example:

- Notification that a call has been forwarded to a third party;
- Notifications related to Explicit Call Transfer; or
- Notifications related to requests to join a Conference.

7.2.1.7 Other messages

I1 Dummy message

The I1 Dummy message is only used for those specific transport-layer connections (e.g., USSD) which provide two-way-alternative interactive service. If the party which has the turn hasn't sent an application level protocol message for a specific time, an I1 Dummy message shall be delivered to the counterpart to transfer the turn with the consideration of not delaying its transmission of application protocol message.

Editor's Note: the need for an I1 Dummy message is FFS.

7.2.2 I1 message structure and common field encoding

7.2.2.1 General

7.2.2.1.1 Message Header structure

The I1 message structure is shown in figure 7.2.2.1. Each I1 messages consists of two parts, i.e. the first part referred to as the I1 message common part and the second part consisting of zero or more I1 information elements. The I1 message common part is included in every I1 message. The I1 information elements that are included in an I1 message depend on a type of I1 message being sent.

The text in this clause describes the content of the I1 message common part. The octet number 1 (shown at the top of the figure 7.2.2.1) is sent first followed by octet 2, 3, etc. Within each octet, the bit designated "bit 1" is transmitted first, followed by bits 2, 3, 4, etc.

8	7	6	5	4	3	2	1	Octet
Protocol version number				Protocol identifier				1
Message type					R	Reason		2
Reason								3
Call-Identifier (Part-1)								4
Call-Identifier (Part-2)								5
Call-Identifier (Part-2)								6
Sequence-ID								7
Information element #1								
Information element #2								

Figure 7.2.2.1: I1 message structure

7.2.2.1.2 Protocol Version information

The first octet is divided into two four-bit subfields, i.e. the Protocol identifier and the Protocol version number. The Protocol identifier for I1 protocol is "0001" and indicates that the respective message, transported across the transport-layer connection, is an I1 protocol message. The Protocol version number indicates that this is the first version of this specification and the respective value of the Protocol version number subfield is "0001".

7.2.2.1.3 Message Type and Reason

The second octet and third consists of five-bit Message type field that identifies the type of the I1 message, while the ten-bit Reason fields provide additional information about the respective I1 message, i.e., Progress reason value, as specified in table 7.2.2.1. If the three-bit Message type parameter is set to "00000", it indicates that the Reason field is used. If the five-bit Message type parameter is not set to "00000", it indicates that the Reason field is not used and it shall be ignored.

7.2.2.1.4 Call Identifier

The three octets (i.e. the octet number 4, 5, and 6) that follow the Reason type field contain the Call-Identifier field. The Call-Identifier field uniquely specify the call across all I1 interfaces (i.e. between the ICS AS and all ICS UEs connected to the ICS AS). The Call-Identifier field is divided into two subfields, i.e. the part-1 subfield consisting of one octet and the part-2 subfield consisting of two octets. The part 1 subfield is always filled by the UE, while the part-2 subfield is always filled by the ICS AS. The part-1 and part-2 subfields are analogous to the SIP tags inserted in the From and To header fields. The values of all "0" inserted in the octet 3 (i.e. in the Call-Identifier Part-1) indicates that the Call-Identifier (Part-1) subfield is empty (i.e. it has no value). Likewise, values of all "0" inserted in the octet 4 and 5 (i.e., in the Call-Identifier Part-2) indicates that the Call-Identifier Part-2 subfield is empty (i.e., it has no value). When the UE forwards the first I1 message pertaining to a call that is being established (e.g., an I1 Invite or an I1 Progress) to the ICS AS, the UE inserts a new value into the Call-Identifier (Part-1) subfield (i.e., a value that is currently not being unused). Likewise, when the ICS AS forwards the first I1 message pertaining to a call that is being established (e.g., an I1 Invite or an I1 Progress) to the UE, the ICS AS inserts a value into the part-2 subfield. When inserting a value into the Call-Identifier (Part-2) subfield, the ICS AS has to insure that the resulting Call-Identifier field is unique across all I1 interfaces. For example, the ICS AS, upon receiving the first I1 message from the ICS UE, may insert into the Call-Identifier (Part-2) subfield a value that it is currently using in some other calls, only if the resulting Call-Identifier field is unique across all I1 interfaces (i.e. between the ICS AS and all ICS UEs).

Editor's Note: It is FFS whether the Call-Identifier (Part-2) subfield needs two octets.

7.2.2.1.5 Sequence-ID

The Sequence-ID field value (i.e., the octet number 7) guarantees the proper ordering of the I1 message. The sender of the I1 message increments the Message sequence number value by one for each new I1 message forwarded to its peer. The sequence number value is expressible as an 8-bit unsigned integer. Once the count reaches the value of 2**8, it wraps around back to one.

Editor's Note: It is FFS how long the Sequence-ID should be (i.e whether to use a single octet or if two octets are needed).

7.3 Messages

7.3.1 General Messages

Table 7.3.1 summarizes the messages for I1.

Table 7.3.1: General Message types

Message	Message Type Value (5 bit) hex	Reason Value (10 bit) hex
I1 INVITE	0x1	0x000
I1 BYE	0x2	0x000
I1 REFER	0x9	0x000
I1 PROGRESS	0x00	0x64 – 0xC7
I1 SUCCESS	0x00	0xC8 – 0x12B
I1 FAILURE	0x00	0x190 – 0x1F3
I1 Dummy	0x00	0x3FF

Editor's Note: the need for the I1 Dummy message is FFS.

7.3.2 I1 INVITE – ICS UE initiated

7.3.2.1 General

This message is sent by the ICE UE to the network to establishment of a session. See table 7.3.2.1.

Message type: I1 INVITE

Direction: ICS UE to SCC AS

Table 7.3.2.1: I1 INVITE message content

Information element	Type/Reference	Presence	Format	Length
Protocol Information	Protocol Information 7.2.2.1.2	M	V	1
Message Type	Request Message - INVITE 7.2.2.2.1.2	M	V	2
Call ID	Call-Id 7.2.2.1.4	M	V	2
Message Sequence Number	Sequence-Id 7.2.2.1.5	M	V	1
To	To 7.3.2.3	M	LV	FFS
From	From 7.3.2.4	O	LV	FFS

7.3.2.2 Message Type

Identifies that the message is:

i) an I1 INVITE.

7.3.2.3 To

This information element shall be included, it identifies the logical identity of the recipient for the request according to the procedures specified in RFC 3261 [6].

Editors Note: It is FFS how the To element is to be encoded.

7.3.2.4 From

This information element shall be optionally included, it identifies the logical identity that the dialogue originates from according to the procedures specified in RFC 3261 [6].

Editors Note: It is FFS how the From element is to be encoded.

7.3.3 INVITE – SCC AS initiated

7.3.3.1 General

This message is sent by the SCC AS to the ICS UE to establishment of a session. See table 7.3.3.1.

Message type: I1 INVITE.

Direction: SCC AS to ICS UE

Table 7.3.3.1: I1 INVITE message content

Information element	Type/Reference	Presence	Format	Length
Protocol Information	Protocol Information 7.2.2.1.2	M	V	1
Message Type	Request Message - INVITE 7.2.2.2.2.2	M	V	2
CallID	Call-Id 7.2.2.1.4	M	V	2
Message Sequence Number	Sequence-Id 7.2.2.1.5	M	V	1
From	From 7.3.3.3	M	LV	FFS
SCC AS PSI DN	SCC AS PSI DN	M	LV	3-15
To	To 7.3.3.4	M	LV	FFS

7.3.3.2 Message Type

Identifies that the message is:

i) an I1 INVITE.

7.3.3.3 From

This information element shall be included; it identifies the logical identity that the dialogue originates from. It is the same as that defined in RFC 3261 [6] however no display name is included.

Editor's Note: It is FFS how the From element is to be encoded.

7.3.3.4 To

This information element shall be optionally included; it identifies the logical identity of the recipient for the request. It is the same as that defined in RFC 3261 [6].

Editor's Note: It is FFS how the To element is to be encoded.

7.3.3.5 SCC AS PSI DN

This information element shall be included; it uniquely identifies the SCC AS and session on that AS.

7.3.4 BYE – ICS UE initiated

7.3.4.1 General

This message is sent by the ICS UE to the SCC AS to establishment of a session. See table 7.3.4.1.

Message type: I1 BYE

Direction: ICS UE to SCC AS

Table 7.3.4.1: I1 BYE message content

Information element	Type/Reference	Presence	Format	Length
Protocol Information	Protocol Information 7.2.2.1.2	M	V	1
Message Type	Request Message - BYE 7.3.4.2	M	V	2
CallID	Call-Id 7.2.2.1.4	M	V	2

7.3.4.2 Message Type

Identifies that the message is:

i) an I1 BYE.

7.3.5 BYE – SCC AS initiated

7.3.5.1 General

This message is sent by the SCC AS to the ICS UE to establish of a session. See table 7.3.5.1.

Message type: I1 BYE

Direction: SCC AS to ICS UE

Table 7.3.5.1: I1 BYE message content

Information element	Type/Reference	Presence	Format	Length
Protocol Information	Protocol Information 7.2.2.1.2	M	V	1
Message Type	Request Message - BYE 7.3.5.2	M	V	2
CallID	Call-Id 7.2.2.1.4	M	V	2

7.3.5.2 Message Type

Identifies that the message is:

i) an I1 BYE.

7.3.6 I1 PROGRESS – ICS UE initiated

7.3.6.1 General

This message is sent by the ICE UE to the network to establish of a session. See table 7.3.6.1.

Message type: I1 PROGRESS

Direction: ICS UE to SCC AS

Table 7.3.6.1: I1 PROGRESS message content

Information element	Type/Reference	Presence	Format	Length
Protocol Information	Protocol Information 7.2.2.1.2	M	V	1
Message Type	Request Message – PROGRESS 7.3.6.2	M	V	2
CallID	Call-Id 7.2.2.1.4	M	V	2
Message Sequence Number	Sequence-Id 7.2.2.1.5	M	V	1

7.3.6.2 Message Type

Identifies that the message is

i) an I1 PROGRESS.

7.3.7 I1 PROGRESS – SCC AS initiated

7.3.7.1 General

This message is sent by the SCC AS to the ICS UE to establish of a session. See table 7.3.3.1.

Message type: I1 PROGRESS

Direction: SCC AS to ICS UE

Table 7.3.3.1: I1 PROGRESS message content

Information element	Type/Reference	Presence	Format	Length
Protocol Information	Protocol Information 7.2.2.1.2	M	V	1
Message Type	Request Message - PROGRESS 7.3.7.2	M	V	2
CallID	Call-Id 7.2.2.1.4	M	V	2
Message Sequence Number	Sequence-Id 7.2.2.1.5	M	V	1
SCC AS PSI DN	SCC AS PSI DN TBD	M	LV	??

7.3.7.2 Message Type

Identifies that the message is:

i) an I1 PROGRESS.

7.4 I1 information elements and functional definition

7.4.1 I1 information elements

The list of the I1 information elements is shown in table 7.4.1.

Editor"s Note: The list of I1 information elements is not complete.

Table 7.4.1 I1-information elements

I1 information element Name	Description and content (subclauses)
Error-code	7.4.2.2
From-id	7.4.2.3
Privacy	7.4.2.4
SCC-AS-id	7.4.2.5
Session-identifier	7.4.2.6
To-id	7.4.2.7
Replaces	7.4.2.8

Error-code

The Error-code information element is included in every I1-Error response message. The Error-code information element is binary encoded SIP failure response. The SIP 4xx request failure responses, the 5xx server failure responses, and the 6xx global failure responses are binary encoded and included in the Error-code information element as specified in subclause 7.4.2.1 and table 7.4.2.1. The interpretation of each binary encoded failure response is analogous to the interpretation of associated SIP failure response.

From-id

The From-id information element specifies the identity of the calling user, e.g., the calling party number. The From-id information element may contain either an E.164 or a SIP URI.

Editor's Note: The I1 protocol assumes that the I1 protocol messages will not be segmented. Hence, the size of the I1 protocol messages is constrained by the limits of the transport-layer message size, e.g. the USSD allows for a message size of 160 bytes. Therefore, it is FFS how to fit the SIP URIs into the limited-size I1 messages.

Privacy

The UE uses the Privacy information element to indicate to the SCC AS how to handle the SIP header fields when the SCC AS forwards the SIP requests and responses on behalf of the UE to the far-end UA. The Privacy information element when sent by the UE to the SCC AS contains binary encoded "priv-value" (as specified in the RFC 3323 and RFC 3325). When the SCC AS, upon receiving a Privacy information element over I1 interface, forwards a SIP request or a response to the far-end UA, the SCC AS behaves as specified in the RFC 3323 and RFC 3325 e.g. the SCC AS inserts a P-Asserted-Identity header field into SIP message as requested by the Privacy information element.

SCC-AS-id

The SCC-AS-id information element contains an URI that points to the SCC AS. When the UE sets up a CS bearer connection by sending a SETUP message to the MSC server, the UE specifies the respective URI as the called party number. Subsequently the call will be routed to the respective SCC AS via a MGCF.

Session-identifier

The Session-identifier information element is an identifier used either by the UE or the SCC AS to uniquely and globally identify a session across all interface (i.e. the I1 interface, Gm interface and the IMS). The Session identifier is dynamically allocated by the SCC AS to identify the I1 session that is being established. The SCC AS includes the Session-identifier information element in the first I1 message sent by the SCC AS to the UE. The Session-identifier information element may contain different values, e.g. the Session Transfer Identifier (STI), as specified in subclause 7.4.2.1 and associated subclause 7.4.2.1.

To-id

The To-id information element specifies the identity of the called user, e.g., the called party number. The To-id information element may contain an URI.

Editor's Note: The I1 protocol assumes that the I1 protocol messages will not be segmented. Hence, the size of the I1 protocol messages is constrained by the limits of the transport-layer message size, e.g. the USSD allows for a message size of 160 bytes. Therefore, it is FFS how to fit the SIP URIs into the limited-size I1 messages.

Replaces

The Replaces information element is used by the UE to identify an existing call or a SIP dialog that will be replaced with a call being established over the I1 interface. When the UE wants to replace an existing call or a SIP dialog with a new call, the UE sends an I1 Invite request message to the SCC AS with the Replaces information element that contains the identity of the SIP dialog or a call that will be replaced with a new call being established. In the case of UE assisted T-ADS, the SCC AS may send an I1 Invite request message to the terminating ICS UE with Replaces information element that contains the identity of the SIP dialog to change the service control for the session from Gm to I1.

7.4.2 I1 Information elements encoding

7.4.2.1 General

The structure of the I1 information elements is shown in figure 7.4.2.1.

8	7	6	5	4	3	2	1	Octet
Information Element code					Code specific			1
Information Element length (in octets)								2
Information Element body (as required)								3
								etc.

Figure 7.4.2.1: I1 information element format

Each I1 information element contains a common two-octet field followed by a variable-size body. The first octet contains the Information Element code and Code specific values. Each I1 information element is uniquely identified with the respective Information Element code (i.e., encoded with bits numbered 4, 5, to 8 of the first octet). The Code specific value (i.e., encoded with bits numbered 1, 2, and 3 of the first octet) provide additional information about respective I1 information element. For example, if the Information Element code specifies that this is a To-id I1 information element, then the Code specific value will indicate whether the Information Element body contains an E.164 number or SIP URI. The Code specific values for each respective I1 information element are described in the respective subclauses.

The second octet i.e. the Information Element length specifies the length of the I1 information element body (i.e., the number of octets following the Information Element length) in binary format. The bit number 1 of octet number 2 is the list significant bit and bit number 8 of the octet number 2 is the most significant bit. The table 7.4.2.1 specifies the Information Element code for each I1 information element.

Table 7.4.2.1: I1-information element coding

Information Element code	I1 information element Name	Reference subclause
Bits 8 7 6 5 4		
1 0 0 0 1	Error-code	7.4.2.2
1 0 0 1 1	From-id	7.4.2.3
1 0 1 0 0	Privacy	7.4.2.4
1 0 1 0 1	SCC-AS-id	7.4.2.5
1 0 1 1 0	Session-identifier	7.43.2.6
1 0 1 1 1	To-id	7.4.2.7
1 0 0 1 0	Replaces	7.4.2.8

Editor"s Note: Some I1 Information elements may be of a fixed size. Hence, it is FFS whether the Information Element length is needed for each Information element.

7.4.2.2 Error-code

Editor"s Note: How and which additional waning-codes and reason-values are encoded and included in the Error-code information element is FFS.

7.4.2.3 From-id

The purpose of the From-id information element is to identify the originator of the call. The From-id information element may contain either a SIP URI or a telephone number (e.g. international number, national number). The Code specific field, i.e., the bits 3, 2, and 1 of the octet number 1 specify the type of information contained in the From-id information element, and is used to identify the target of the call.

When the Code specific field, i.e., the bits 3, 2, and 1 of the octet number 1 is set to "001" it indicates that the From-id information element contains an E.164 (see table 7.4.2.1.1). When the From-id information element contains an international number (i.e. an E.164 number), the E.164 digit-string is included in the octet 3, octet 4, octet 5, etc. as follows:

- the bits numbers 8, 7, 6, and 5 of octet number 3 are used to binary encode the most significant digit of the E.164 digit-string;
- the bits numbers 4, 3, 2, and 1 of octet number 3 are used binary encode the next significant digit of the E.164 digit-string;
- the bits numbers 8, 7, 6, and 5 of octet number 4 are used binary encode the next significant digit of the E.164 digit-string; and so on until the entire E.164 digit-string is included in the From-id information element; and
- the bit-pattern "1111"iserted either in the bits 8, 7, 6, and 5 or bits 4, 3, 2, and 1 of any octet indicates the end of the E.164 digit-string, i.e. the bit-pattern of "1111" is used as the end-delimiter for the E.164 digit-string.

8	7	6	5	4	3	2	1	Octet
Information Element code 1 0 0 1 1					Code specific			1
Information Element length (in octets)								2
Information Element body								3
								etc.

Figure 7.4.2.3.1: From-id information element

Table 7.4.2.3.1: From-id information element

(octet 1)	Code specific
Bits	
3 2 1	
0 0 0	Unspecified
0 0 1	International number, i.e. E.164 number (Note 1)
0 1 0	SIP URI
0 1 1	SIP URI where the user part of the SIP URI contains a telephone number, i.e. SIP URI with user=phone
	Other values are reserved for future use
(octet 3)	
Bits	
8 7 6 5	the most significant digit of the E.164 digit-string
(octet 3)	
Bits	
4 3 2 1	the next significant digit of the E.164 digit-string (Note 2)
(octet 4)	
Bits	
8 7 6 5	the next significant digit of the E.164 digit-string (Note 2)
(octet 4)	
Bits	
4 3 2 1	the next significant digit of the E.164 digit-string (Note 2)

(next octet)
Bits (Note 2)
(Note 3)
Note 1 – Prefix or escape digits shall not be included. Note 2 – the next significant digits of the E.164 digit-string are included in subsequent bits 8, 7, 6, and 5 or bits 4, 3, 2. Note 3 – The E.164 digit-string terminates with delimiter "1111" in the bits 8, 7, 6, and 5 or bits 4, 3, 2, and 1 of any octet indicating the end of the E.164 digit-string.

7.4.2.4 Privacy

The ICS UE may include the Privacy information element in the I1 Invite message to indicate its privacy preferences that the SCC AS should apply to the SIP session toward the remote UE. When the SCC AS sets up a SIP session on behalf of the UE, the SCC AS sends a SIP INVITE request that includes the privacy information that the SCC AS received in the Privacy information element.

The Privacy information element when sent by the ICS UE to the SCC AS contains binary encoded "priv-value" (as specified in the RFC 3323 and RFC 3325). Note that the UE may request multiple types of privacy for the same call (see RFC 3323). Hence, the UE include all of the requested privacy types in its Privacy information element by setting the respective bits as shown in table 7.4.2.4.1.

8	7	6	5	4	3	2	1	Octet
Information Element code 1 0 1 0 0					Code specific 0 0 0			1
Information Element length (in octets)								2
Information Element body								3

Figure 7.4.2.4.1: Privacy information element

7.4.2.5 SCC-AS-id

The SCC-AS-id information element contains an URI that points to the SCC AS. The SCC-AS-id information element may contain either a SIP URI or an international telephone number (i.e. an E.164 national number). The Code specific field, i.e., the bits 3, 2, and 1 of the octet number 1 in figure 7.4.2.5.1 specify the type of information that is used to identify the SCC AS. When the SCC AS forwards a PSI DN associated with the SCC AS to the UE, the SCC AS will include the PSI DN in the SCC-AS-id information element. The PSI DN is an E.164 number.

Editor"s Note: How to include non-international numbering plans, SIP URI, and SIP URI with user=phone into the From-id information element is FFS.

When the Code specific field, i.e., the bits 3, 2, and 1 of the octet number 1 is set to "001" it indicates that the SCC-AS-id information element contains a PSI DN (i.e. an E.164 number). When the SCC-AS-id information element contains a PSI DN (i.e. an E.164 number), the E.164 digit-string is included in the octet 3, octet 4, octet 5, etc. as shown in table 7.4.2.5.1.

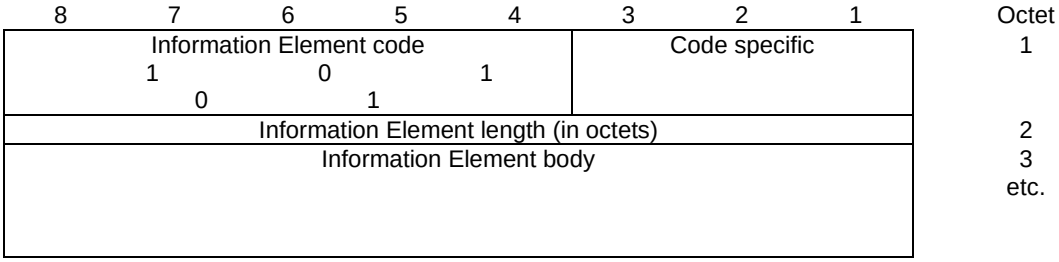

Figure 7.4.2.5.1: SCC-AS-id information element

Table 7.4.2.5.1: SCC-AS-id information element

(octet 1)	Code specific
Bits	
3 2 1	
0 0 0	Unspecified
0 0 1	PSI DN, i.e. E.164 number (Note 1)
	Other values are reserved for future use
(octet 3)	
Bits	
8 7 6 5	the most significant digit of the E.164 digit-string
(octet 3)	
Bits	
4 3 2 1	the next significant digit of the E.164 digit-string (Note 2)
(octet 4)	
Bits	
8 7 6 5	the next significant digit of the E.164 digit-string (Note 2)
(octet 4)	
Bits	
4 3 2 1	the next significant digit of the E.164 digit-string (Note 2)
(next octet)	
Bits	
	(Note 3)
Note 1 – Prefix or escape digits shall not be included.	
Note 2 – the next significant digits of the E.164 digit-string are included in subsequent bits 8, 7, 6, and 5 or bits 4, 3, 2.	
Note 3 – The E.164 digit-string terminates with delimiter "1111" in the bits 8, 7, 6, and 5 or bits 4, 3, 2, and 1 of any octet indicating the end of the E.164 digit-string.	

7.4.2.6 Session-identifier

The Session-identifier information element is used either by the ICS UE or the SCC AS to covey the identity of the session being established. The Code specific subfield, i.e., the bits 3, 2, and 1 of the octet number 1 specify the type of information that is used to identify the session across.

When a SIP dialog or an I1 session is identified with an E.164 number (e.g. with a STI), then this identifier is conveyed across the I1 interface in a Session-identifier information element. In this case, the Code specific field, i.e., the bits 3, 2, and 1 of the octet number 1 is set to "001", as shown in figure 7.4.2.6.1 and table 7.4.2.6.1

Editor's Note: It has to be clarified whether the term STI is appropriate in all cases, or whether the term STN should be used in some cases.

Editor's Note: How to include a SIP dialog identifier (i.e. the From tag, the To tag, and the Call-ID into the Session-identifier information element is FFS.

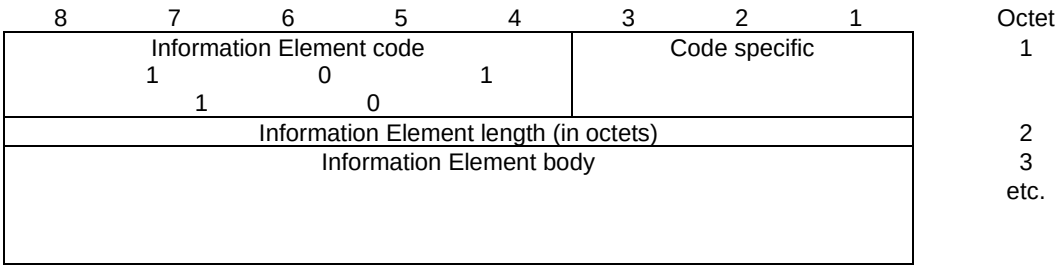

Figure 7.4.2.6.1: SCC-AS-id information element

Table 7.4.2.6.1: SCC-AS-id information element

(octet 1) Code specific Bits 3 2 1 0 0 0 Unspecified 0 0 1 Session or a dialog identified with an E.164 number (Note 1) Other values are reserved for future use
(octet 3) Bits 8 7 6 5 the most significant digit of the E.164 digit-string
(octet 3) Bits 4 3 2 1 the next significant digit of the E.164 digit-string (Note 2)
(octet 4) Bits 8 7 6 5 the next significant digit of the E.164 digit-string (Note 2)
(octet 4) Bits 4 3 2 1 the next significant digit of the E.164 digit-string (Note 2) *(next octet)* Bits (Note 3) Note 1 – Prefix or escape digits shall not be included. Note 2 – the next significant digits of the E.164 digit-string are included in subsequent bits 8, 7, 6, and 5 or bits 4, 3, 2. Note 3 – The E.164 digit-string terminates with delimiter "1111" in the bits 8, 7, 6, and 5 or bits 4, 3, 2, and 1 of any octet indicating the end of the E.164 digit-string.

7.4.2.7 To-id

The purpose of the To-id information element is to identify the called party of a call. The To-id information element may contain either a SIP URI or a telephone number (e.g. international number, national number). The Code specific field, i.e., the bits 3, 2, and 1 of the octet number 1 specify the type of information contained in the To-id information element, and is used to identify the target of the call. The To-id information element is shown in figure 7.4.2.7.1.

Editor"s Note: How to include non-international numbering plans, SIP URI, and SIP URI with user=phone into the To-id information element is FFS.

When the Code specific field, i.e., the bits 3, 2, and 1 of the octet number 1 is set to "001" it indicates that the To-id information element contains an E.164 number. When the To-id information element contains an international number (i.e. an E.164 number), the E.164 digit-string is included in the octet 3, octet 4, octet 5, etc. as shown in table 7.4.2.1.1, i.e., the Code specific field and the encoding of the E.164 digit-string included in the To-id information element is the same as for the From-id information element and specified in subclause 7.4.2.3 above.

8	7	6	5	4	3	2	1	Octet
Information Element code 1 0 1 1 1					Code specific			1
Information Element length (in octets)								2
								3
								4

Figure 7.4.2.7.1: To-id information element

7.4.2.8 Replaces

7.5 Session states and Session control procedures

7.5.1 General

This clause defines the basic session control states that an individual session may acquire. Since several sessions may exist simultaneously across the I1 interface and each session may be in a different state, the session states describe the state of a particular session rather then describing the state of the I1 interface. The procedures for session control are given in subclause 7.5.3.

7.5.2 Session states

7.5.2.1 Session originated by the ICS UE

7.5.2.1.1 Session states at ICS UE – ICS UE originated call

This subclause lists the session states that may exist at the UE for a session originated by the ICS UE.

- **null**: No session exists.
- **trying**: This state exists for an UE originated session, when the ICS UE has requested a session establishment by sending an I1Invite message but has not yet received any response.
- **proceeding**: This state exists for an UE originated session when the ICS UE has received an I1 Progress message with Progress reason set to Call progressing from the SCC AS acknowledging that the SCC AS has received the I1 Invite message.
- **alerted**: This state exists for an UE originated session when the calling ICS UE has received an I1 Progress message with Progress reason set to Ringing indicating that remote endpoint alerting has been initiated.
- **confirmed**: This state exists for an UE originated session when the ICS UE has received an I1 Success message indicating that the remote endpoint has accepted the session.

7.5.2.1.2 Session states at SCC AS – ICS UE originated call

This subclause lists the session states that may exist at the SCC AS for a session originated by the ICS UE.

- **null**: No session exists.
- **initiated**: This state exists for an UE originated session when the SCC AS has received an I1 Invite message but has not yet responded.
- **progressing**: This state exists for an UE originated session when the SCC AS has sent an I1 Progress message with Progress reason set to Call progressing acknowledging that the SCC AS has received the I1Invite message.
- **alerting**: This state exists for an UE originated session when the SCC AS has sent an I1 Progress message with Progress reason set to Ringing indicating that remote endpoint alerting has been initiated.
- **confirmed**: This state exists for an UE originated session when the SCC AS has sent an I1 Success message indicating that the call has been accepted.

7.5.2.2 Session terminated at the ICS UE

7.5.2.2.1 Session states at UE – ICS UE terminated call

This subclause lists the session states that may exist in the UE for a session terminated at the ICS UE.

- **null**: No session exists.

- **initiated**: This state exists for a session terminated at the UE when the ICS UE has received an I1Invite message but has not yet responded.

- **progressing**: This state exists for a session terminated at the UE when the ICS UE has sent an I1 Progress message with Progress reason set to Call progressing acknowledging that the ICS UE has received the I1Invite message.

- **alerting**: This state exists for a session terminated at the UE when the ICS UE has sent an I1 Progress message with Progress reason set to Ringing indicating that local alerting has been initiated but the offered call has not yet answered.

- **confirmed**: This state exists for a session terminated at the UE when the ICS UE has sent an I1 Success message indicating that the call has been accepted.

7.5.2.2.2 Session states at SCC AS – ICS UE terminated session

This subclause lists the session states that may exist in the UE for a session terminated at the ICS UE.

- **null**: No session exists.

- **trying**: This state exists for a session terminated at the ICS UE when the SCC AS has requested a session establishment by sending an I1 Invite message but has not yet received a response.

- **proceeding**: This state exists for a session terminated at the ICS UE when the SCC AS has received an I1 Progress message with Progress reason set to Call progressing from the UE acknowledging that the ICS UE has received the I1Invite message.

- **alerted**: This state exists for an UE terminated session when the SCC AS has received an I1 Progress message with Progress reason set to Ringing indicating that the UE has initiated local alerting.

- **confirmed**: This state exists for a session terminated at the UE when the SCC AS has received an I1 Success message indicating that the ICS UE has accepted the session.

7.5.2.3 Session release

7.5.2.3.1 Session states at ICS UE

This subclause lists the session states that may exist at the UE for a session released either by the ICS UE or SCC AS.

- **release-requested**: This state exists when the ICS UE has requested the SCC AS to clear the session by sending an I1 Bye message and the CS bearer has not been cleared using receipt of a DISCONNECT message, in accordance with 3GPP TS 24.008 [3]. Upon determining that the CS bearer has cleared using a DISCONNECT message or determining that a I1 Success message was received, the UE transits to a "null" state. The ICS UE attempts to clear the CS bearer if a retransmission timer fires as specified in subclause 6.2.3.1.2.

- **release-indication**: This state exists when the ICS UE has received an I1 Bye message from the SCC AS requesting the UE to clear the session. Per subclause 6.2.3.1.2, upon subsequent clearing the CS bearer using a DISCONNECT message, in accordance with 3GPP TS 24.008 [3], or upon subsequent sending of an I1 Success message, the ICS UE transits to a "null" state.

Editor"s Note: the name and length of the retransmission timer is FFS.

7.5.2.3.2 Session states at SCC AS

This subclause lists the session states that may exist at the SCC AS for a session released either by the ICS UE or SCC AS.

- **release-requested**: This state exists when the SCC AS has requested the ICS UE to clear the session by sending an I1 Bye message and the CS bearer has not been cleared. Upon determining that the CS bearer has cleared using a DISCONNECT message, in accordance with 3GPP TS 24.008 [3] and 3GPP TS 24.292 [5] or determining that a I1 Success message was received, the SCC AS transits to a "null" state. The SCC AS attempts to clear the CS bearer if a retransmission timer fires as specified in 3GPP TS 24.292 [5].

- **release-indication:** This state exists when the SCC AS has received an I1Bye message from the ICS UE requesting the SCC AS to clear the session. Upon subsequent clearing the CS bearer using a SIP BYE request sent towards the MGCF or upon subsequent sending of an I1 Success message in accordance with 3GPP TS 24.292 [5], the SCC AS transits to a "null" state.

Editor"s Note: the name and length of the retransmission timer is FFS.

7.5.3 Session control procedures

7.5.3.1 General

Before the session establishment procedures are invoked, a transport-layer connection must be established between the ICS UE and the SCC AS.

Editor"s Note: The I1 protocol message are self-identifying, i.e. the information contained in the I1 protocol message uniquely identifies the call to which the respective I1 protocol message pertains to. Hence, it is FFS whether the transport-layer connection may change during an established call or even while the call establishment and call release are in progress.

7.5.3.2 Session establishment

Editor"s Note: The I1 protocol error cases are not considered in this subclause. The I1 protocol error cases must be considered.

7.5.3.2.1 UE-originating case

7.5.3.2.1.1 Procedure at ICS UE

7.5.3.2.1.1.1 Session request

The ICS UE initiates session establishment procedure by sending an I1 Invite message to the SCC AS across the I1 interface. The I1 Invite message shall contain the I1 information elements as specified in subclause 6.2.1.2.1. Following the transmission of the I1 Invite message the session shall transit to the "trying" state. When the session enters the "trying" state, the ICS UE sets timer F to fire in T3 seconds.

If an unreliable transport-layer connection between the ICS UE and the SCC AS is used, the ICS UE sets timer E to fire in T1 seconds. For reliable transport-layer connection timer E is not used. If timer E fires while the session is still in the "trying" state, the original I1 Invite message (with the same sequence number) is retransmitted and the timer E is reset to value of MIN(2*T1, T2). If the timer E fires again, the original I1 Invite message (with the same sequence number) is retransmitted again and the timer E is reset to a MIN (4*T1, T2). This process continues so that retransmissions occur with an exponentially increasing interval that caps at T2.

Editor"s note: The values for T1, T2 and T3 will be selected.

If timer F fires while the session is still in the "trying" state, the call establishment has failed, and the ICS UE clears the session, as described in subclause 6.2.3. In addition, if an unreliable transport-layer connection between the UE and the SCC AS is used the, the ICS UE disables timer E.

7.5.3.2.1.1.2 Session proceeding

If an I1 Progress message with Progress reason set to Call progressing is received at the ICS UE while the session is in the "trying" state, the session shall transit to the "proceeding" state.

If an unreliable transport-layer connection between the ICS UE and the SCC AS is used, when the session enters the "proceeding" state the ICS UE sets the timer E to fire in T2 seconds. If timer E fires while the session is in the "proceeding" state, the original I1 Invite message (with the same sequence number) is retransmitted and the timer E is reset to a value of T2 seconds. This process continues so that retransmissions of the original I1 Invite message occur every T2 seconds.

If timer F fires while the session is in the "proceeding" state, the session establishment has failed, and the ICS UE clears the call, as described in subclause 6.2.3. In addition, if an unreliable transport-layer connection between the ICS UE and the SCC AS is used the, the ICS UE disables timer E.

Upon receiving the I1 Progress message with Progress reason set to Call progressing from the SCC AS, the ICS UE initiates the setting up of the CS bearer connection toward the SCC AS by sending a SETUP message to the MSC Server as specified in subclause 6.2.1.2.1.

NOTE: The request to set up the CS bearer connection arriving at the SCC AS indicates that the I1 Progress message with Progress reason set to Call progressing has been received by the UE. Subsequently, the SCC AS can progress the session toward the far end by sending a SIP INVITE request to the far end.

7.5.3.2.1.1.3 Alerting indication

If an I1 Progress message with Progress reason set to Ringing is received while the session is in the "proceeding" state, the session shall transit to the "alerted" state.

If an unreliable transport-layer connection between the ICS UE and the SCC AS is used, when the session enters the "alerted" state the ICS UE sets timer E to fire in T2 seconds. If timer E fires while the session is in the "alerted" state, the original I1 Invite message (with the same sequence number) is retransmitted and the timer E is reset to a value of T2 seconds. This process continues so that retransmissions of the original I1 Invite request occur every T2 seconds.

If timer F fires while the session is in the "alerted" state, the session establishment has failed, and the ICS UE clears the call, as described in subclause 6.2.3. In addition, if an unreliable transport-layer connection between the ICS UE and the SCC AS is used, the ICS UE disables timer E.

If the ICS UE receives an I1 Progress message with Progress reason set to Ringing, the ICS UE may begin a locally-generated alerting procedure.

7.5.3.2.1.1.4 Session connected

If an I1 Success message is received from the SCC AS while the session at the UE is either in the "proceeding" state or "alerted" state, the session shall transit to the "confirmed" state (i.e., the call has been established) and the timer F is disabled.

If an unreliable transport-layer connection between the ICS UE and the SCC AS was used, the timer E is disabled, hence the ICS UE stops retransmitting the I1 Invite message. In addition, the ICS UE discards any subsequent I1 Success message, if it is received over the unreliable transport-layer connection.

7.5.3.2.1.2 Procedure at SCC AS

7.5.3.2.1.2.1 Session request

Upon receiving an I1 Invite message from the ICS UE over the I1 interface, the session at the SCC AS shall transit to the "initiated" state. Once in the "initiated" state, the SCC AS shall immediately respond by sending an I1 Progress message with Progress reason set to Call progressing to the UE and the session enters the "progressing" state, The I1 Progress message with Progress reason set to Call progressing shall contain the I1 information elements as specified in subclause 6.2.1.3.1.

NOTE: The receipt of the I1 Progress message with Progress reason set to Call progressing at the UE, will trigger the UE to set up a CS bearer connection toward the SCC AS by sending a SETUP message to the MSC Server as specified in subclause 6.2.1.2.1.

7.5.3.2.1.2.2 Session progressing

If the SCC AS receives a retransmitted I1 Invite message from the ICS UE, while the call is in the "progressing" state, the SCC AS shall retransmit the previously sent I1 Progress message with Progress reason set to Call progressing to the ICS UE.

NOTE: The SCC AS receives a retransmitted I1 Invite message only if the transport-layer connection between the ICS UE and the SCC AS is an unreliable transport-layer connection. While the session is in the "progressing" state, the SCC AS may send to the ICS UE either an I1 Progress message with Progress reason set to Ringing, an I1 Success message indicating that the session has been accepted, or a new I1 Progress response with Progress reason set to Call progressing.

If timer F fires while the session is in the "progressing" state, the session establishment has failed, and the SCC AS clears the session, as described in subclause 6.2.3.

7.5.3.2.1.2.3 Alerting indication

If the SCC AS sends an I1 Progress message with Progress reason set to Ringing to the ICS UE, the session state at the SCC AS shall transit to the "alerting" state.

If the SCC AS receives a retransmitted I1 Invite message from the ICS UE, while the session is in the "alerting" state, the SCC AS shall retransmit the previously sent I1 Progress message with Progress reason set to Ringing to the ICS UE.

NOTE: The SCC AS receives a retransmitted I1 Invite message only if the transport-layer connection between the UE and the SCC AS is an unreliable transport-layer connection.

If timer F fires while the session is in the "alerting" state, the session establishment has failed, and the SCC AS clears the session, as described in subclause 6.2.3.

7.5.3.2.1.2.4 Session connected

If the SCC AS sends an I1 Success message to the ICS UE indicating that the session has been accepted, the session state at the SCC AS shall transit to the "confirmed" state.

If an unreliable transport-layer connection between the UE and the SCC AS is used, when the session enters the "confirmed" state the SCC AS sets timer G to fire in (n*T2) seconds. For reliable transport-layer connection timer G is not used. If a retransmitted I1 Invite message is received while the timer G is running, the timer G is reset to fire in (n*T2) seconds, and the I1 Success message is retransmitted. The firing of the timer G indicates that the ICS UE has received the I1 Success message and the ICS UE has stopped the retransmission of the I1 Invite message.

If timer G fires while the session is in the "confirmed" state, the timer F is disabled.

If timer F fires while the session is in the "proceeding" state, the session establishment has failed, and the SCC AS resets timer G and clears the session, as described in subclause 6.2.3.

7.5.3.2.2 UE-terminating case

7.5.3.2.2.1 Procedure at ICS UE

7.5.3.2.2.1.1 Session request

Upon receiving an I1 Invite message from the SCC AS over the I1 interface, the session at the ICS UE shall transit to the "initiated" state. Once in the "initiated" state, the ICS UE shall immediately respond by sending an I1 Progress message with Progress reason set to Call progressing to the SCC AS and enter the "progressing" state. The I1 Progress message with Progress reason set to Call progressing shall contain the I1 information elements as specified in subclause 6.2.1.2.2.

Editor"s Note: Whether the ICS UE, upon receiving an I1 Invite message from the SCC AS, may respond with either an I1 Progress message with Progress reason set to Ringing or an I1 Success message rather then with an I1 Progress message with Progress reason set to Call progressing is FFS.

NOTE: The receipt of the I1 Invite message at the UE will trigger the UE to set up a CS bearer connection toward the SCC AS by sending a SETUP message to the MSC Server as specified in subclause 6.2.1.2.1.

When the session enters the "initiated" state, the ICS UE also sets timer F to fire in T3 seconds.

7.5.3.2.2.1.2 Session progressing

If the ICS UE receives a retransmitted I1 Invite message from the SCC AS, while the session is in the "progressing" state, the ICS UE shall retransmits the previously sent I1 Progress message with Progress reason set to Call progressing to the UE.

NOTE: The UE receives a retransmitted I1 Invite message only if the transport-layer connection between the UE and the SCC AS is an unreliable transport-layer connection.

While the session is in the "progressing" state, the ICS UE may send to the SCC AS either an I1 Progress message with Progress reason set to Ringing, an I1 Success message indicating that the call has been accepted, or a new I1 Progress message with Progress reason set to Call progressing.

If timer F fires while the session is in the "progressing" state, the session establishment has failed, and the ICS UE clears the call, as described in subclause 6.2.3.

7.5.3.2.2.1.3 Alerting indication

If the ICS UE sends an I1 Progress message with Progress reason set to Ringing, the session state at the ICS UE shall transit to the "alerting" state.

If the ICS UE receives a retransmitted I1 Invite message from the SCC AS, while the session is in the "alerting" state, the ICS UE shall retransmit the previously sent I1 Progress message with Progress reason set to Ringing to the SCC AS.

NOTE: The UE receive a retransmitted I1 Invite message only if the transport-layer connection between the UE and the SCC AS is an unreliable transport-layer connection.

If timer F fires while the session is in the "alerting" state, the session establishment has failed, and the UE clears the session, as described in subclause 6.2.3.

7.5.3.2.2.1.4 Session connected

If the ICS UE sends an I1 Success message indicating that the session has been accepted, the session state at the UE transits to the "confirmed" state.

If an unreliable transport-layer connection between the UE and the SCC AS is used, the ICS UE sets timer G to fire in (n*T2) seconds. For reliable transport-layer connection timer G is not used. If an I1 Invite message is received while the timer G is running, the timer G is reset to (n*T2) seconds, and the I1 Success message is retransmitted. The firing of the timer G indicates that the SCC AS has received the Success message and has stopped the retransmission of the I1 Invite message.

If timer G fires while the session is in the "confirmed" state, the timer F is disabled.

If timer F fires while the session is in the "confirmed" state, the session establishment has failed, and the ICS UE clears the session, as described in subclause 6.2.3.

7.5.3.2.2.2 Procedure at SCC AS

7.5.3.2.2.2.1 Session request

The SCC AS initiates a session establishment procedure by sending an I1 Invite message to the UE across the I1 interface. The I1 Invite message shall contain the I1 information elements as specified in subclause 6.2.1.3.2. Following the transmission of the I1 Invite message the session shall transit to the "trying" state. When the session enters the "trying" state, the SCC AS sets timer F to fire in T3 seconds.

If an unreliable transport-layer connection between the UE and the SCC AS is used, the SCC AS sets timer E to fire in T1 seconds. For reliable transport-layer connection timer E is not used. If timer E fires while the session is still in the "trying" state, the original I1 Invite message (with the same sequence number) is retransmitted and the timer E is reset to value of MIN(2*T1, T2). If the timer E fires again, the original I1 Invite message (with the same sequence number) is retransmitted again and the timer E is reset to a MIN (4*T1, T2). This process continues so that retransmissions occur with an exponentially increasing interval that caps at T2.

If timer F fires while the session is still in the "trying" state, the session establishment has failed, and the SCC AS clears the session, as described in subclause 6.2.3. In addition, if an unreliable transport-layer connection between the UE and the SCC AS is used, the SCC AS disables timer E.

7.5.3.2.2.2.2 Call proceeding

If an I1 Progress message with Progress reason set to Call progressing is received at the SCC AS while the session is in the "trying" state, the session shall transit to the "proceeding" state.

If an unreliable transport-layer connection between the UE and the SCC AS is used, when the session enters the "proceeding" state the SCC AS sets timer E to fire in T2 seconds. If timer E fires while the session is in the "proceeding" state, the original I1 Invite message (with the same sequence number) is retransmitted and the timer E is reset to a value of T2 seconds. This process continues so that retransmissions of the original I1 Invite message occur every T2 seconds.

If timer F fires while the session is in the "proceeding" state, the session establishment has failed, and the SCC AS clears the session, as described in subclause 6.2.3. In addition, if an unreliable transport-layer connection between the UE and the SCC AS is used, the SCC AS disables timer E.

NOTE: The request to set up the CS bearer connection arriving at the SCC AS indicates that the I1 Invite message has been received by the UE.

7.5.3.2.2.2.3 Alerting indication

If an I1 Progress message with Progress reason set to Ringing is received while the session is in the "proceeding" state, the session shall transit to the "alerted" state.

If an unreliable transport-layer connection between the UE and the SCC AS is used, when the session enters the "alerted" state the SCC AS sets timer E to fire in T2 seconds. If timer E fires while the session is in the "alerted" state, the original I1 Invite message (with the same sequence number) is retransmitted and the timer E is reset to a value of T2 seconds. This process continues so that retransmissions of the original I1 Invite message occur every T2 seconds.

If timer F fires while the session is in the "alerted" state, the session establishment has failed, and the SCC AS clears the session, as described in subclause 6.2.3. In addition, if an unreliable transport-layer connection between the UE and the SCC AS is used, the SCC AS disables timer E.

7.5.3.2.2.2.4 Session connected

If an I1 Success message is received from the ICS UE while the call at the SCC AS is either in the "proceeding" state or "alerted" state, the session shall transit to the "confirmed" state (i.e., the session has been established) and the timer F is disabled.

If an unreliable transport-layer connection between the UE and the SCC AS was used, the timer E is disabled, hence the SCC AS stops retransmitting the I1 Invite message. In addition, the SCC AS discards any subsequent I1 Success message, if it is received over the unreliable transport-layer connection.

7.5.3.3 I1 service control signalling release

7.5.3.3.1 Initiating release of I1 service control signalling

The ICS UE or the SCC AS can release a I1 service control signalling session at any time irrespective of its state. The ICS UE or the SCC AS releases the I1 service control signalling session by sending an I1 Bye message across the I1 interface. The I1 Bye message shall contain the I1 information elements as specified in subclause 6.2.3.

If an I1 Success message is received while the I1 service control signalling session is in the "release-requested" state, it transits to the "null" state (i.e., the I1 service control signalling session has been released).

7.5.3.3.2 Responding to release of I1 service control signalling

If either the ICS UE or the SCC AS receives an I1 Bye message across the I1 interface, the state of the I1 service control signalling session at the recipient side of the I1 Bye message (i.e. either at the ICS UE or the SCC AS) shall

transit to the "release-indication" state. If there are more I1 service control signalling sessions, once in the "release-indication" state, the recipient side of the I1 Bye message shall immediately respond by sending an I1 Success message.

Editor's note: Either the ICS UE or the SCC AS may release the CS bearer connection when receiving a I1 Bye message by the UE sending a DISCONNECT message to the MSC Server or the SCC AS sending a SIP BYE request toward the MGCF, if there are no more I1 service control signalling sessions. Procedures for releasing the CS bearers when an I1 BYE message is received when there is one I1 service control signalling session remaining are FFS.

Annex A (informative): Change history

Change history							
Date	**TSG #**	**TSG Doc.**	**CR**	**Rev**	**Subject/Comment**	**Old**	**New**
2009-04	CT1#58	C1-092099			Initial skeleton from rapporteur	-	0.0.0
2009-04	CT1#58	C1-092097			Scope of TS 24.294	0.0.0	0.1.0
2009-06	CT1#59	C1-092980			I1 messages	0.1.0	0.2.0
2009-06	CT1#59	C1-092981			Text for introduction	0.1.0	0.2.0
2009-06	CT1#59	C1-093056			Procedures for session setup when terminated in ICS UE	0.1.0	0.2.0
2009-06	CT1#59	C1-093067			I1 protocol overview	0.1.0	0.2.0
2009-06	CT1#59	C1-093068			Text for session setup	0.1.0	0.2.0
2009-08	CT1#60	C1-093244			I1 Call States	0.2.0	0.3.0
2009-08	CT1#60	C1-093368			Procedure for adding I1 control to existing CS session (I1 augmentation)	0.2.0	0.3.0
2009-08	CT1#60	C1-093727			Corrections to I1 protocol overview	0.2.0	0.3.0
2009-08	CT1#60	C1-093728			I1 message encoding	0.2.0	0.3.0
2009-08	CT1#60	C1-093729			I1 for Supplementary Service Invocation	0.2.0	0.3.0
2009-08	CT1#60	C1-093734			I1 Call origination at UE	0.2.0	0.3.0
2009-08	CT1#60	C1-093735			I1 Call origination at SCC AS	0.2.0	0.3.0
2009-08	CT1#60	C1-093736			I1 Call terminated at UE	0.2.0	0.3.0
2009-08	CT1#60	C1-093741			Procedure for session termination with UE assisted T-ADS	0.2.0	0.3.0
2009-08	CT1#60	C1-093742			Procedure for Gm fallback to I1	0.2.0	0.3.0
2009-08	CT1#60	C1-093743			I1 protocol functionality	0.2.0	0.3.0
2009-08	CT1#60	C1-093922			I1 Refer	0.2.0	0.3.0
2009-08	CT1#60	C1-093924			I1 information elements	0.2.0	0.3.0
2009-08	CT1#60	C1-093929			I1 information element format	0.2.0	0.3.0
2009-08	CT1#60	C1-093936			I1 message structure	0.2.0	0.3.0
2009-09					Editorial fixes	0.3.0	0.3.1
2009-10	CT1#61	C1-094053			Call origination at UE	0.3.1	0.4.0
2009-10	CT1#61	C1-094056			Call termination at UE	0.3.1	0.4.0
2009-10	CT1#61	C1-094058			From-id and To-id encoding	0.3.1	0.4.0
2009-10	CT1#61	C1-094060			Replaces informat element	0.3.1	0.4.0
2009-10	CT1#61	C1-094352			Cleanup of TS 24.294	0.3.1	0.4.0
2009-10	CT1#61	C1-094502			Message Formats	0.3.1	0.4.0
2009-10	CT1#61	C1-094503			Call origination at SCC AS	0.3.1	0.4.0
2009-10	CT1#61	C1-094504			Call termination at SCC AS	0.3.1	0.4.0
2009-10	CT1#61	C1-094505			Error-code information element	0.3.1	0.4.0
2009-10	CT1#61	C1-094506			Privacy, SCC-AS-id, and Session-identifier encoding	0.3.1	0.4.0
2009-10	CT1#61	C1-094507			I1 Call release	0.3.1	0.4.0
2009-10	CT1#61	C1-094587			Alignment with TS 24.292	0.3.1	0.4.0
2009-10					Editorial fixes	0.4.0	0.4.1
2009-11	CT1#62	C1-094892			Conveying the STI to the UE	0.4.1	0.5.0
2009-11	CT1#62	C1-094893			SCC AS assigning the dynamic STI	0.4.1	0.5.0
2009-11	CT1#62	C1-094894			Conveying the STI for call termination	0.4.1	0.5.0
2009-11	CT1#62	C1-095127			Removal and correction of redundant Editor's Notes	0.4.1	0.5.0
2009-11	CT1#62	C1-095128			Functional entities	0.4.1	0.5.0
2009-11	CT1#62	C1-095133			Correction of tables	0.4.1	0.5.0
2009-11	CT1#62	C1-095135			Resolve Editor's notes with including SDP information	0.4.1	0.5.0
2009-11	CT1#62	C1-095414			Session-identifier	0.4.1	0.5.0
2009-11	CT1#62	C1-095415			Definitions	0.4.1	0.5.0
2009-11	CT1#62	C1-095460			Remove the description of the USSD in 7.1	0.4.1	0.5.0
2009-11	CT1#62	C1-095461			General behaviour of ICS UE and SCC AS	0.4.1	0.5.0
2009-11	CT1#62	C1-095462			Correction of the introduction of I1 protocol	0.4.1	0.5.0
2009-11	CT1#62	C1-095463			Session release	0.4.1	0.5.0
2009-11	CT1#62	C1-095464			On Replaces information element	0.4.1	0.5.0
2009-11	CT1#62	C1-095465			I1 Bye procedures	0.4.1	0.5.0
2009-11					Editorial fixes	0.5.0	0.5.1
2009-12	CT#46				V1.0.0 created by MCC for presentation to CT-46 for information and approval	0.5.1	1.0.0
2009-12	CT#46				V9.0.0 created by MCC after approval at CT-46	1.0.0	9.0.0

History

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