3GPP2 N.S0031

Version 1.0.0

Version Date: November 2002

LMSD Step 1

Revision: 0

Revision History

Revision		Date
Rev. 0	Initial Publication	November 2002

Note

This specification is an extract of TIA TR-45.2 TIA-872.

IP NETWORK FOR CDMA2000 SPREAD SPECTRUM SYSTEMS

3GPP2 All-IP Core Network Enhancements for

Legacy MS Domain – Step-1

CONTENTS

LIST OF FIGURES

LIST OF TABLES

PREFACE

This 3GPP2 Wireless IP Network Architecture Model depicts packet mode operations and gateway information.

REVISION HISTORY

Revision	Date/Contribution	Remarks	
1.0	December, 2002	Initial Version	

1 INTRODUCTION

1.1 Scope

This recommendation supports the 3GPP2 All-IP Step-1 Evolution Path by providing Stage-1, 2, and 3 for the architecture identified in Figure 3.1 “Legacy MS Domain Support for Circuit Mode IP Transport Call Delivery”.

The Legacy MS Domain provides support for existing MSs (e.g., analog, IS-95-A, IS-95-B, IS-2000) in an IP core network environment. This domain supports the features and capabilities provided in a legacy network in a manner transparent to the user. New features and capabilities supported by the IP core network may be made available to subscribers where they are supported by the MS capabilities.

This recommendation defines the MSCe-to-MSCe IP signaling interface-"zz" used to support the Media Gateway-to-Media Gateway bearer streams interface-"yy". The “yy” interface is used as a bearer facility for legacy voice calls and is specified outside this recommendation in “P.S0002 LMSD Step-1 Specification”.

1.2 References

3GPP2

[3GPP2-1] S.R0059 3GPP2, *Legacy MS Domain – Step-1 System Requirements*.

[3GPP2-2] S.P0037 3GPP2, *All-IP Network Architecture Model version 1.1.1*.

[3GPP2-3] A.S0001-A v2.0 3GPP2, *Access Network Interfaces Interoperability Specification Revision A (3G-IOS v4.1.1) Revision A*.

[3GPP2-4] P.S0002 3GPP2, *LMSD Step-1 Specification* [tbd].

CCITT

[CCITT-1] *CCITT Recommendation G.711 (1988) Pulse Code Modulation (PCM) of Voice Frequencies*.

IETF

[IETF-1] RFC 3261, *SIP: Session Initiation Protocol*.

[IETF-2] RFC 3372, *SIP for Telephones (SIP-T): Context and Architectures*.

[IETF-3] RFC 3398, *Integrated Services Digital Network (ISDN) User Part (ISUP) to Session Initiation Protocol (SIP) Mapping*.

[IETF-4] RFC 2960, *Stream Control Transmission Protocol*.

[IETF-5] RFC 0793, *Transmission Control Protocol*.

[IETF-6] RFC 0768, *User Datagram Protocol*.

[IETF-7] RFC 0791, *Internet Protocol*.

[IETF-8] RFC 3015, *Megaco Protocol Version 1.0*.

[IETF-9] RFC 3312, *Integration of Resource Management and SIP*.

[IETF-10] RFC 3204, *MIME media types for ISUP and QSIG Objects*.

TIA/EIA-41

[41-1] ANSI/TIA/EIA-41-D, *Cellular Radiotelecommunications Intersystem Operations*, December, 1997.

[41-2] TIA/EIA/IS-737, *IS-41-C Enhancements to Support Circuit Mode Services*, (May 1998).

[41-3] TIA/EIA/IS-880, *TIA/EIA-41-D Based Network Enhancements for CDMA Packet Data Service (C-PDS), Phase-1*, (July 2002).

1.3 Terminology

This document uses the following "verbal forms" and "verbal form definitions":

a. "shall" and "shall not" identify items of interest that are to be strictly followed and from which no deviation is recommended,

b. "should" and "should not" indicate items of interest that are highly desirable and particularly suitable, without identifying or excluding other items; or (in the negative form) indicate items of interest that are not desirable, are not particularly suitable, or are not recommended but not prohibited, and

c. "may" and "may not" indicate items of interest that are optional but permissible within the limits of this recommendation.

1.4 Architectural Principles

The statements contained in this section shall guide the development of the All-IP network architecture [3GPP2-2]. While these statements are too general to be treated as specific requirements, they form a set of principles meant to govern the overall development of the All-IP network, they are:

a. The All-IP network architecture shall be independent of the underlying Layer 1 and Layer 2 protocols through the use of IP-based protocols.

b. The All-IP core network shall be independent of the access network. The core network shall have the ability to support multiple access network technologies (e.g., cable, radio access technologies, wireless LAN, DSL).

   The core network should have the ability to support access networks as they evolve and as new access technologies are identified. This implies that network functions such as call control and service control should be independent of access functions. How this independence is maintained for mobility management and location-based services (which may be dependent on access technology) is for further study.

c. A phased migration of existing networks to the All-IP network shall be possible.

d. All pertinent interfaces in the All-IP network shall be defined in an open manner.

e. The All-IP network shall promote efficient use of radio interface resources.

f. The All-IP network should be capable of supporting reliability levels equal to or better than those found in legacy networks.

g. The All-IP network shall support capabilities for rapid service creation, including service creation by the user and by third parties as well as service profile customization by end users.

h. The All-IP network should permit separate signaling and bearer paths.

i. The All-IP network architecture and protocols shall be scalable.

j. The All-IP network architecture development process shall aim to identify and reuse solutions from other initiatives within the IMT-2000 family (especially 3GPP), whenever possible and reasonable.

k. The All-IP network shall support Quality of Service equal to or better than that found in legacy networks.

l. The All-IP network architecture should be defined in terms of separate functions and clear interfaces such that it is possible to separate bearer from signaling.

m. The All-IP network shall be functionally designed to allow and encourage reduced complexity and/or resource utilization.

n. The All-IP network shall support a range of terminal types (e.g., voice-only terminals, IP Multimedia terminals, laptop computers). Not all these terminals may be able to support end-to-end IP capabilities (e.g., 2G and 3G legacy terminals).

o. The All-IP architecture shall be designed in such a way that a migration from IPv4 to IPv6 is feasible and that IPv4 and IPv6 based All-IP networks may interoperate.

1.5 Legend

This section provides a definition of the different styles of lines and rectangles used in many figures within this recommendation, as:

Dashed Line	Signaling interface,
Dashed Rectangle	Collective Network Entity and Composite Network Entity,
Heavy Dashed Line	Radio Link (air interface),
Solid Line	Circuit Bearer or Packet Bearer interface, and
Solid Rectangle	Network Entity.

1.6 Abbreviations

This section provides a definition of the abbreviations used within this recommendation, as:

ACK	Acknowledgment	**MGW**	Media Gateway
CDMA	Code Division Multiple Access	**MRFP**	Media Resource Function Processor
DB	Database	**MS**	Mobile Station
GSM	Global Systems for Mobile communications	**MSCe**	Mobile Switching Center emulation
HLRe	Home Location Register emulation	**NAM**	Network Architecture Model
IP	Internet Protocol	**PCM**	Pulse Code Modulation
IPv4	Internet Protocol Version 4	**PSTN**	Public Switched Telephone Network
IPv6	Internet Protocol Version 6	**RFC**	Request For Comments
IOS	Inter-Operability Specification	**RTP**	Real-time Transport Protocol
IS	Interim Standard	**SCPe**	Service Control Point emulation
ISUP	Integrated Services User Part	**SIP**	Session Initiation Protocol
LMSD	Legacy MS Domain	**TLDN**	Temporary Local Directory Number
LMSDS	Legacy MS Domain Support	**UDP**	User Datagram Protocol
MGCF	Media Gateway Control Function	**VLR**	Visitor Location Register

2 LMSD SYSTEM REQUIREMENTS

This section contains applicable extracts from the 3GPP2 Legacy MS Domain System Requirements [*3GPP2-1*].

The LMSD Step-1 provides support for legacy MS such that they can receive the same features using the LMSD that they receive in legacy systems. Such features include, but are not limited too, the features defined in TIA/EIA-664A and beyond.

Enhancements beyond legacy systems include:

a. separation of the MSC into a MSCe and a MGW-and-MRFP, and

b. specification of interfaces xx, yy, zz, and 39 (see Figure 3.1).

2.1 General Requirements

The general requirements for this recommendation include the existing:

a. TIA/EIA-41 signaling shall be used for call control, services, and handoff,

b. IOS-v4.1 specifications shall be used for RAN connectivity, and

c. IETF defined IP call control signaling shall be used between MSCes.

2.2 New Network Entities

2.2.1 MSCe

The MSCe (Mobile Switching Center emulation):

a. has the signaling and call control aspects of a MSC,

b. uses TIA/EIA-41 for call control and service signaling,

c. uses IP signaling to control the MRFP for tones and announcements,

d. uses IP signaling to control the MGW for bearer establishment,

e. uses IP signaling to control the MGW for bridging control,

f. uses IP signaling for bearer management control associated with interface yy, and

g. for Call Delivery translates a received E.164 TLDN into an IP address when IP bearer is to be used.

2.2.2 MGW-and-MRFP

The MGW-and-MRFP (Media Gateway and Media Resource Function Processor):

a. have the bearer aspects and switching fabric of a MSC,

b. have the tone and announcement capabilities of a MSC,

c. have the bridging capabilities of a MSC,

d. support IP bearer for Call Delivery to other LMSDs,

e. support circuit bearer for connectivity to the PSTN,

f. use IP signaling from the MSCe for tones and announcements control,

g. use IP signaling from the MSCe for bearer establishment,

h. use IP signaling from the MSCe for bridging control, and

i. the interface between the MGW and the MRFP is not specified in LMSD Step-1, but is subject for future standardization.

2.3 New Network Interfaces

2.3.1 Interface 39

Interface 39 provides IP signaling from the MSCe to the MGW-and-MRFP to control:

a. bearer resource assignment, and

b. bridging.

2.3.2 Interface xx

Interface xx provides IP signaling from the MSCe to the MGW-and-MRFP to control insertion of tones and announcements into the bearer stream.

2.3.3 Interface yy

Interface yy provides IP bearer between MGWs. The yy interface is specified in [3GPP2-4].

2.3.4 Interface zz

Interface zz provides IP signaling control associated with interface yy. This interface is between MSCes.

3 LEGACY MS DOMAIN STAGE-2

This section contains "Legacy MS Domain" Stage-2 architecture, interface definitions, detailed descriptions of entities, and message flow scenario recommendations that support the Stage-1 requirements.

3.1 LMSD Architecture

This section contains "Legacy MS Domain Support" applicable extracts from the 3GPP2 All-IP NAM (Network Architecture Model) Revision 2.0.0 with modifications agreed in TSG-N for NAM Revision 1.1.2.

The entities not in bold in the Figure 3.1 are network components that exist in legacy networks. Interfaces marked with unbolded lines indicate interfaces that exist in legacy networks and are based entirely on existing standards. The entities in bold are new to LMSD (LMSDS, MGW-and-MRFP). The LMSDS (Legacy MS Domain Support) is a network entity that includes the Mobile Switching Center emulation (MSCe), the Home Location Register emulation (HLRe) and the Service Control Point emulation (SCPe). The interfaces using bold lines (39, xx, yy, zz) indicate new interfaces in LMSD. These new interfaces may be based on existing standards and are specified in this document.

Figure 3.1 presents the network entities and associated reference points that comprise a wireless All-IP network to support the LMSD Step-1 architecture. The network entities are represented by squares and rectangles; the interfaces between network entities are reference points identifier by numbers and characters.

Note the following:

a. The network architecture model is a functional block diagram.

b. A network entity represents a group of functions, not a physical device. The physical realization is an implementation issue; a manufacturer may choose any physical implementation of network entities, either individually or in combination, as long as the implementation meets the functional requirements.

c. A reference point is a conceptual point that divides two groups of functions. It is not necessarily a physical interface. A reference point only becomes a physical interface when the network entities on either side of it are contained in different physical devices.

d. A reference point may or may not be standardized. This is a subject for further study, for each particular reference point.

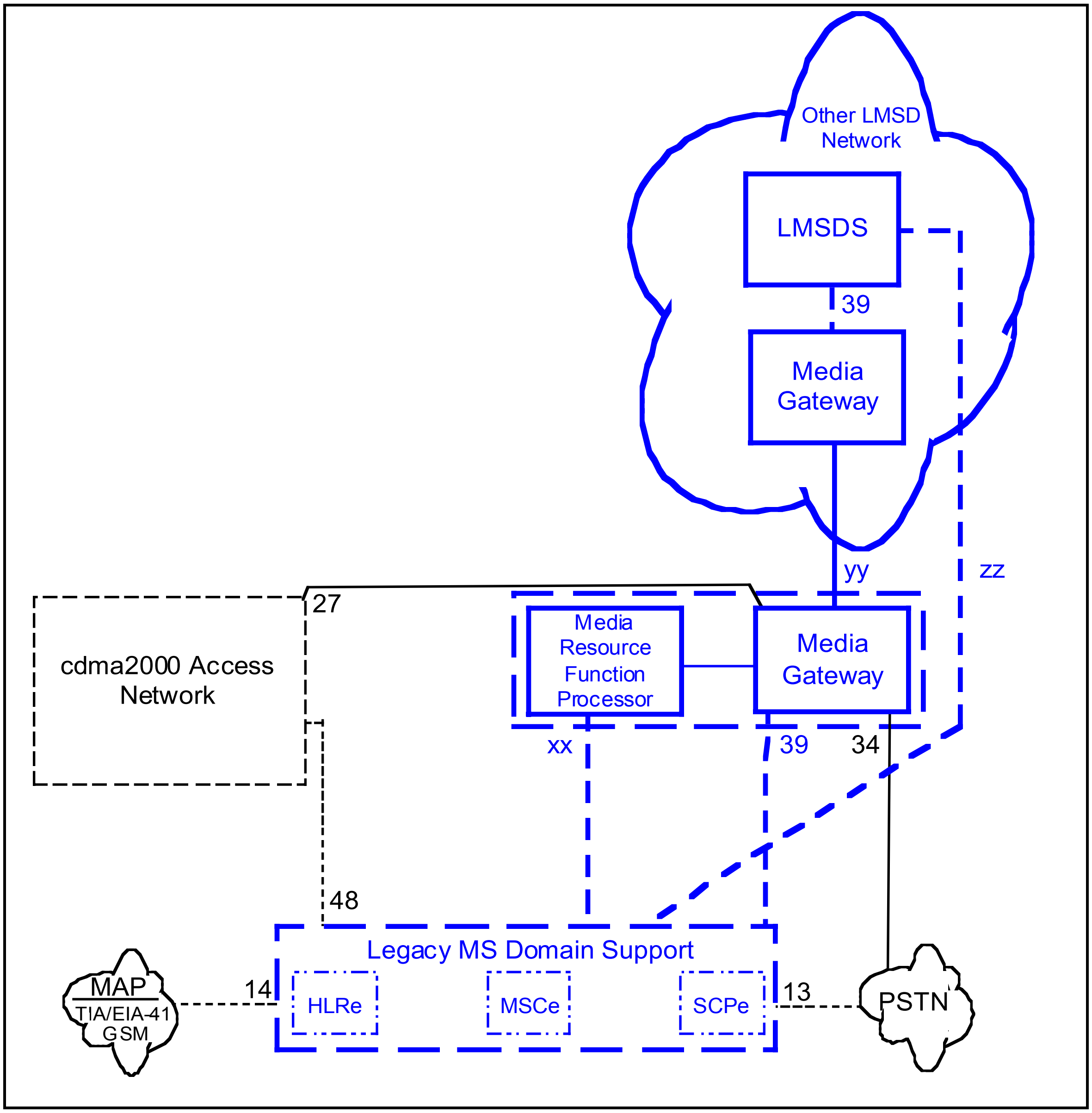

Figure 3.1 Legacy MS Domain Support for Circuit Mode IP Transport Call Delivery

3.2 Reference Points

Reference Points identify that a logical relationship exists between two Network Entities. An interface is defined across a specific Reference Point by defining the protocol and data exchanged between the entities. Zero, one or more interfaces may be defined for each Reference Point in Figure 3.1.

This section defines the various interfaces that are part of the Legacy MS Domain. The majority of the interfaces conform to existing published standards as indicated. Interface details beyond those stated in published standards specific to the Legacy MS Domain are included in this document.

The Reference Points and their associated Network Entities are:

3.2.1 Reference Point 13

This LMSDS to PSTN signaling interface conforms with ISUP messaging over SS7 as defined by:

a. ITU-T Recommendation Q.763, Q.765, and
b. ANSI ISUP T1.113 (TCAP T1.114, SCCP T1.112).

This document does not make changes to this existing interface.

3.2.2 Reference Point 14

This LMSDS to TIA/EIA-41 network signaling interface conforms with ANSI/TIA/EIA-41 Revision D, Cellular Radio Telecommunications Intersystem Operations as well as with [41-3] CDMA Packet Data Service.

This document does not make changes to this existing interface.

3.2.3 Reference Point 27 [IOS-A2]

This Media Gateway to RAN voice bearer interface conforms to A2 link specified in TIA/EIA/IS-2001, Inter-operability Specification (IOS) for CDMA 2000 Access Network Interfaces.

This document does not make changes to this existing interface.

3.2.4 Reference Point 27 [IOS-A5]

This Media Gateway to RAN circuit data bearer interface conforms to A5 link specified in TIA/EIA/IS-2001, Inter-operability Specification (IOS) for CDMA 2000 Access Network Interfaces.

This document does not make changes to this existing interface.

3.2.5 Reference Point 34

This Media Gateway to PSTN bearer interface is a switched circuit network bearer carrying PCM encoded voice as specified in [CCITT-1].

3.2.6 Reference Point 39

This LMSDS to Media Gateway signaling interface is based on [IETF-8].

The following table lists the Megaco protocol stack packages supported on Reference Point “39”.

Table 3.2.6: Megaco Package Support

Package Name	Reference	Comments
Generic.	RFC 3015, Annex E.1.	Basic set of properties.
Base Root.	RFC 3015, Annex E.2.	Defines global MGW attributes.
Basic Continuity Package.	RFC 3015, Annex E.10.	Defines events and signals for continuity test.
RTP Package.	RFC 3015, Annex E.12.	Used to support packet based multimedia data transfer by means of the Real-time Transport Protocol (RTP).
TDM Circuit Package.	RFC 3015, Annex E.13.	Used to support TDM circuit terminations.

3.2.7 Reference Point xx

This LMSDS to MRFP interface is based on [IETF-8].

The following table lists the Megaco protocol stack packages supported on Reference Point “xx”.

Table 3.2.7: Megaco Package Support

Package Name	Reference	Comments
Generic.	RFC 3015, Annex E.1.	Basic set of properties.
Base Root.	RFC 3015, Annex E.2.	Defines global MGW attributes.
Basic Continuity Package.	RFC 3015, Annex E.10.	Defines events and signals for continuity test.
RTP Package.	RFC 3015, Annex E.12.	Used to support packet based multimedia data transfer by means of the Real-time Transport Protocol (RTP).
TDM Circuit Package.	RFC 3015, Annex E.13.	Used to support TDM circuit terminations.

3.2.8 Reference Point 48 [IOS-A1]

This LMSDS to RAN signaling interface conforms to A1 link specified in TIA/EIA/IS-2001, Inter-operability Specification (IOS) for CDMA 2000 Access Network Interfaces.

This document does not make changes to this existing interface.

3.2.9 Reference Point yy

This MGW to MGW IP bearer interface is defined in [3GPP2-4].

3.2.10 Reference Point zz

The protocol stack for interface zz is shown in Figure 3.2.10. Interface zz is a signaling interface that is based on SIP-T as defined in [IETF-2] and [IETF-3]. SIP-T is transported using either TCP as defined in [IETF-5], UDP as defined in [IETF-6] or

SCTP as defined [IETF-4]. IP as defined in [IETF-7] is used as the network protocol. Layer 1 and Layer 2 are unspecified.

3.2.10.1 Working Assumptions

The IP network between MSCes is a managed network. This leads to a number of simplifications over a general SIP-T solution:

a. there are no SIP or IP based services invoked across the zz interface,

b. ISUP messages are always encapsulated so the SIP terminator never has to generate a new ISUP message based on SIP fields,

c. since ISUP messages are always encapsulated, content negotiation (via the Content Disposition header) is not needed,

d. all MSCes connected together are assumed to operate on the same variant of ISUP, and

e. since calls are delivered over a managed IP network, there is no need to consider the security of SIP messages.

f. in the LMSD Step-1 implementation, TCP is mandated as specified in [IETF-1]. UPD and SCTP are optional as specified in [IETF-1].

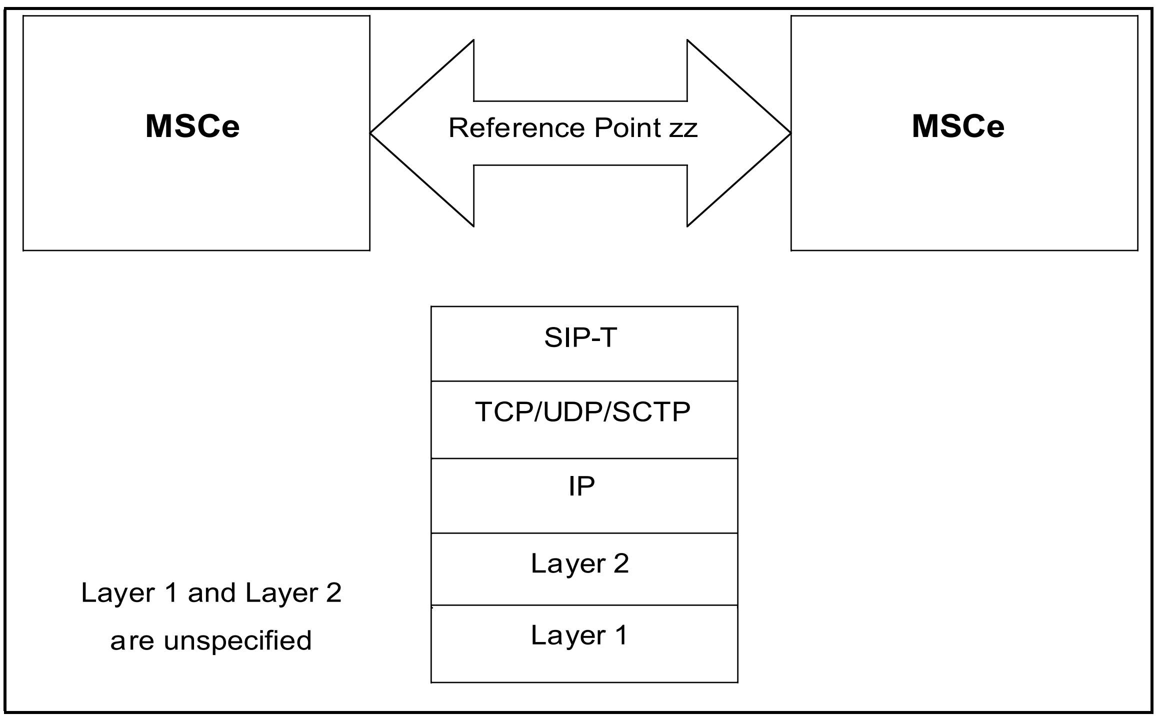

Figure 3.2.10 SIP-T Protocol Stack for Reference Point zz

3.3 Network Entities

Each network entity may be a physical device, it may form part of a physical device, or it may be distributed over a number of physical devices.

This section contains detailed descriptions for entities in the Legacy MS Domain as well as the interfaces supported by each entity. The behavior of entities conforms to existing published standards where indicated. Behavior details beyond those stated in published standards specific to the Legacy MS Domain are included in this document.

This information forms the basis for the Stage-2 message flows later in this document.

3.3.1 Legacy MS Domain Support (LMSDS)

The LMSDS consists of a collection of the Network Architecture Model components:

a. Mobile Switching Center emulation (MSCe),
b. Home Location Register emulation (HLRe), and
c. Signal Control Point emulation (SCPe).

The LMSDS supports the following interfaces:

a. ANSI-41 Network Signaling (14),
b. PSTN Signaling (13),
c. Media Gateway Signaling (39),
d. Media Resource Function Processor Signaling (xx),
e. RAN Signaling (48 [IOS-A1]), and
f. LMSDS IP Call Setup Signaling (zz).

The LMSDS has the following capabilities:

a. processes mobility management and call control messages from the ANSI-41 network and mobile stations for mobile originated and mobile terminated calls,
b. controls the establishment of voice bearers between Access Network and Media Gateway as well as the establishment of voice bearers between Media Gateway and the PSTN,
c. performs the functionality of the Visitor Location Register (VLR),
d. performs the functionality of the Home Location Register (HLR), if requested,
e. performs the functionality of the Service Control Point (SCP), if requested,
f. performs authentication of mobile stations, and
g. performs SIP-T Call Delivery to another LMSDS if the targeted LMSDS is located in the same network operator's administrative domain.

3.3.2 Media Gateway and Media Resource Function Processor

The Media Gateway and Media Resource Function Processor (MGW-and-MRFP) consists of a collection of the Network Architecture Model components:

a. Media Gateway (MGW), and
b. Media Resource Function Processor (MRFP).

The MGW-and-MRFP supports the following interfaces:

a. Media Gateway to RAN Voice Bearer (27 [IOS-A2]),
b. Media Gateway to RAN Circuit Data Bearer (27 [IOS-A5]),
c. Media Gateway to PSTN Bearer (34),
d. LMSDS to Media Gateway Signaling (39),

e. LMSDS to Media Resource Function Processor Signaling (xx), and

f. Media Gateway to Media Gateway IP Bearer (yy).

The MGW-and-MRFP has the following capabilities:

a. terminates bearer channels from the PSTN on interface 34, bearer channels from the radio network on interfaces 27 [IOS-A2] and 27 [IOS-A5], and media streams from a packet network on interface yy. These are called network terminations,

b. performs the functions of a “media gateway” as defined in [IETF-8] but is limited to supporting voice and circuit data media streams on these network terminations,

c. provides switching of the bearer channels by connecting media streams from one set of network terminations to another set of network terminations,

d. converts media in one type of network termination to the format required in another type of network termination,

e. is controlled by an external entity via interface 39 and interface xx as defined in [IETF-8],

f. uses the Media Gateway to Media Gateway IP bearer via interface yy to deliver calls received at one LMSD system that terminate at another LMSD system. The IP bearer is used in place of an inter-MSC trunk,

g. performs the functions of the Interworking Function (IWF) as specified in IS-707 between interfaces 27 [IOS-A5] and 34, and

h. injects audio announcements, tones, and performs media conferencing among media streams.

3.4 Legacy MS Domain Scenarios

This section documents the main Stage-2 scenarios for Legacy MS Domain operation. These scenarios are described using text description as well as information flow diagrams. The scenarios described in this section are meant to provide a high level Stage-2 information flow understanding and are not intended to be exhaustive.

3.4.1 Call Delivery to an Idle MS on Another MSCe

This scenario describes call delivery to an MS that is outside the serving area of the MSCe where the call originates. MSCe in the functional model described in Section 2.2 must interact with their associated HLR and VLR to obtain database information for an MS.

This scenario requires the following Megaco [IETF-8] Packages to be “mandatory”:

a. TDM Circuit Package,

b. RTP Package,

c. Basic Continuity Package,

d. Basic Root Package, and

e. Generic Package.

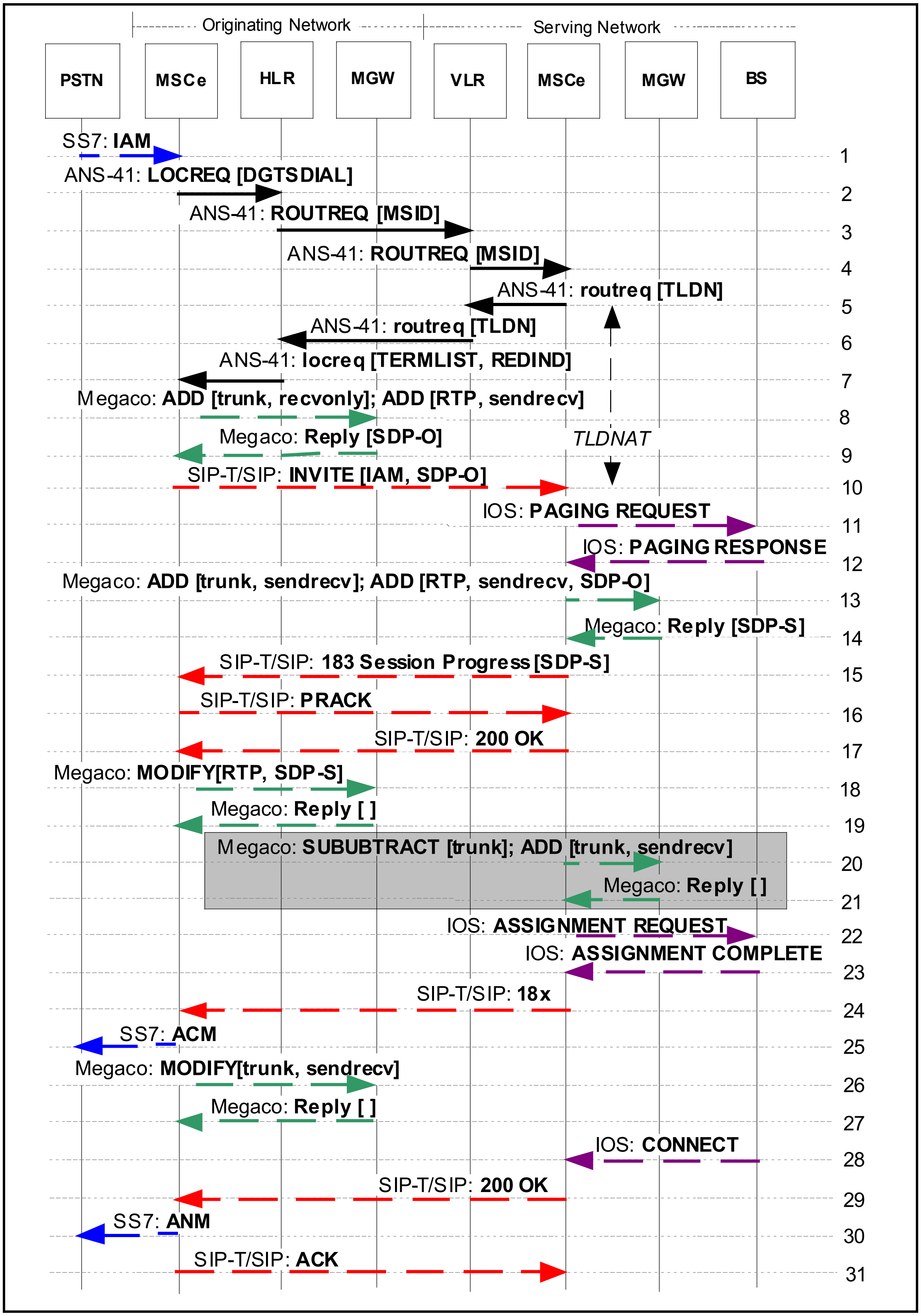

Figure 3.4.1 Call Delivery to an Idle MS on Another MSCe

1. A call origination and the dialed MS address digits (i.e., directory number) are received by the Originating MSCe.

2. The Originating MSCe sends a *LOCREQ* [41-1] to the HLR associated with the MS; this association is made through the dialed MS address digits (which may not be the MIN).

3. If the dialed MS address digits are assigned to a legitimate subscriber, the HLR sends a *ROUTREQ* [41-1] to the VLR where the MS is registered.

4. The VLR then forwards the *ROUTREQ* to the current Serving MSCe.

   In reaction to the *ROUTREQ* the Serving MSCe consults its internal data structures to determine if the MS is already engaged in a call on this MSCe-S.

5. The Serving MSCe allocates a TLDN (Temporary Local Directory Number) and returns this information to the VLR in the *routreq* [41-1]. The Serving MSCe starts timer TLDNAT.

6. The VLR sends the *routreq* to the HLR.

7. When the *routreq* is received by the HLR, it returns a *locreq* [41-1] to the Originating MSCe. The *locreq* includes routing information in the form of the *TerminationList* parameter [41-1], along with an indication of the reason for extending the incoming call (i.e., for CD) in the *DMH_RedirectionIndicator* parameter [41-1].

   The Originating MSCe translates the TLDN to an IP address.

8. The Originating MSCe establishes a context with an Originating MGW. The Megaco message consists of two ADD commands. The first ADD command establishes a termination to the PSTN communication channel (e.g., DS0 on a T1 or E1 line) that corresponds to the incoming IAM (Initial Address Message) with a mode set to *recvonly*. The termination is set to this mode for fraud prevention. The second ADD command establishes a termination for a bearer channel using RTP.

9. The Originating MGW replies to the Megaco message. The *Reply* [IETF-8] message contains the local SDP for the Originating MGW. The local SDP contains an IP address, a UDP Port number, and a list of Codecs that the Originating MGW supports for sending and receiving.

10. The Originating MSCe sends an *INVITE* [IETF-2] message to the Serving MSCe containing the *IAM* message and the SDP for the Originating MGW. The Serving MSCe will use the TLDN to make the association with the MSID received in the *ROUTREQ* message (Step-4).

11. After receiving an *INVITE* message (Step-10) the Serving MSCe sends a *Paging Request* message [3GPP2-3] to the BS to initiate a mobile terminated call setup scenario.

12. The BS constructs the *Paging Response* [3GPP2-3] message, places it in the Complete Layer 3 Information message, and sends the message to the Serving MSCe. The BS may request the Serving MSCe to allocate a preferred terrestrial circuit.

13. After receiving an *INVITE* message (Step-10) the Serving MSCe establishes a context with a Serving MGW. Note the Serving MSCe can execute Step-11 and Step-13 at the same time (i.e., parallel operations). The Megaco message consists of two *ADD* commands The first *ADD* command establishes a termination to the BS communication channel (e.g., DS0 on a T1 or E1

line) with a mode set to *sendrecv*. The second *ADD* command establishes a termination for a bearer channel using RTP and the SDP-O contains the IP address and UDP Port number for which the Serving MGW is to send the RTP packages. The SDP-O also contains a list of Codecs used for Codec negotiation.

14. The Serving MGW replies to the Megaco message. The *Reply* message contains the local SDP for the Serving MGW. The local SDP contains the RTP IP address, the RTP UDP Port number, and a list of Codecs that is supported by both the Originating MGW and the Serving MG (note the list is in preferential order). It is assumed that the Codec list contains one or more Codecs.

15. The Serving MSCe sends the Originating MSCe a *183 Session Progress* [IETF-1] message containing SDP-S.

16. The Originating MSCe sends a *PRACK* [IETF-9] message to Serving MSC in response to the *183 Session Progress* message.

17. The Serving MSCe sends a 200 OK message to Originating MSCe acknowledging the *PRACK* message.

18. Upon receiving the *183 Session Progress* message the Originating MSCe sends the Originating MGW a *Modify* [IETF-8] message to provide the RTP termination with the IP address and UDP Port number for which to send RTP packages.

19. The Originating MGW shall select the first Codec in the list supplied by SDP-S for the RTP bearer channel. If the first Codec in the list is no longer available the *Reply* message will contain an updated SDP-O and Codec negotiation between the Originating MGW and Serving MGW shall continue (these steps are not shown). The Originating MGW sends a *Reply* message to the Originating MSCe.

20. If the BS requested a preferred terrestrial circuit in the *Paging Response* message (Step-12) and the Serving MSCe can support the terrestrial circuit, the Serving MSCe shall send the Serving MGW a Megaco message to change the established context. The Megaco message consists of a *SUBTRACT* command for removing the termination to the BS and an *ADD* command to establish a termination to the BS communication channel using the BS requested preferred terrestrial circuit.

21. The Serving MGW acknowledges the Megaco message with a *Reply* message.

22. The Serving MSCe sends an *Assignment Request* [3GPP2-3] message to the BS to request assignment of radio resources after receiving a Page Response message (Step-12).

23. After the radio traffic channel and circuit have both been established, the BS sends the *Assignment Complete* message to the Serving MSCe.

24. After sending the *183 Session Progress* message (Step-15), the Serving MSCe sends a *18x* (e.g., *180 Ringing*) [IETF-1] message to the Originating MSCe.

25. The Originating MSCe sends an *ACM* (Address Complete Message) message to the PSTN.

26. The Originating MSCe sends a *Modify* command to Originating MGW. The *Modify* command modifies the PSTN communication channel to allow for both sending and receiving.

27. The Originating MGW acknowledges the *Modify* message with a *Reply* message.

28. The BS sends a *Connect* message to the Serving MSCe to indicate that the call has been answered at the MS. At this point, the call is considered stable and in the conversation state. Note that the *Connect* message is shown at Step-28 yet can actually be received by the Serving MSCe anytime after Step-23.

29. After receiving the *Connect* message from the BS the Serving MSCe sends a *200 OK* message to Originating MSCe. The message acknowledges that that the *INVITE* (Step-10) message has succeeded.

30. The Originating MSCe sends an *ANM* (Answer Message) to the PSTN.

31. Originating MSCe sends an *ACK* (Acknowledgement Message) to Serving MSCe. The *ACK* message is sent to confirm the reception of the final response (i.e., *200 OK*).

3.4.2 Call Delivery – Serving Network Fails to Respond

This scenario occurs when the serving network fails to respond the initial INVITE message for a call setup.

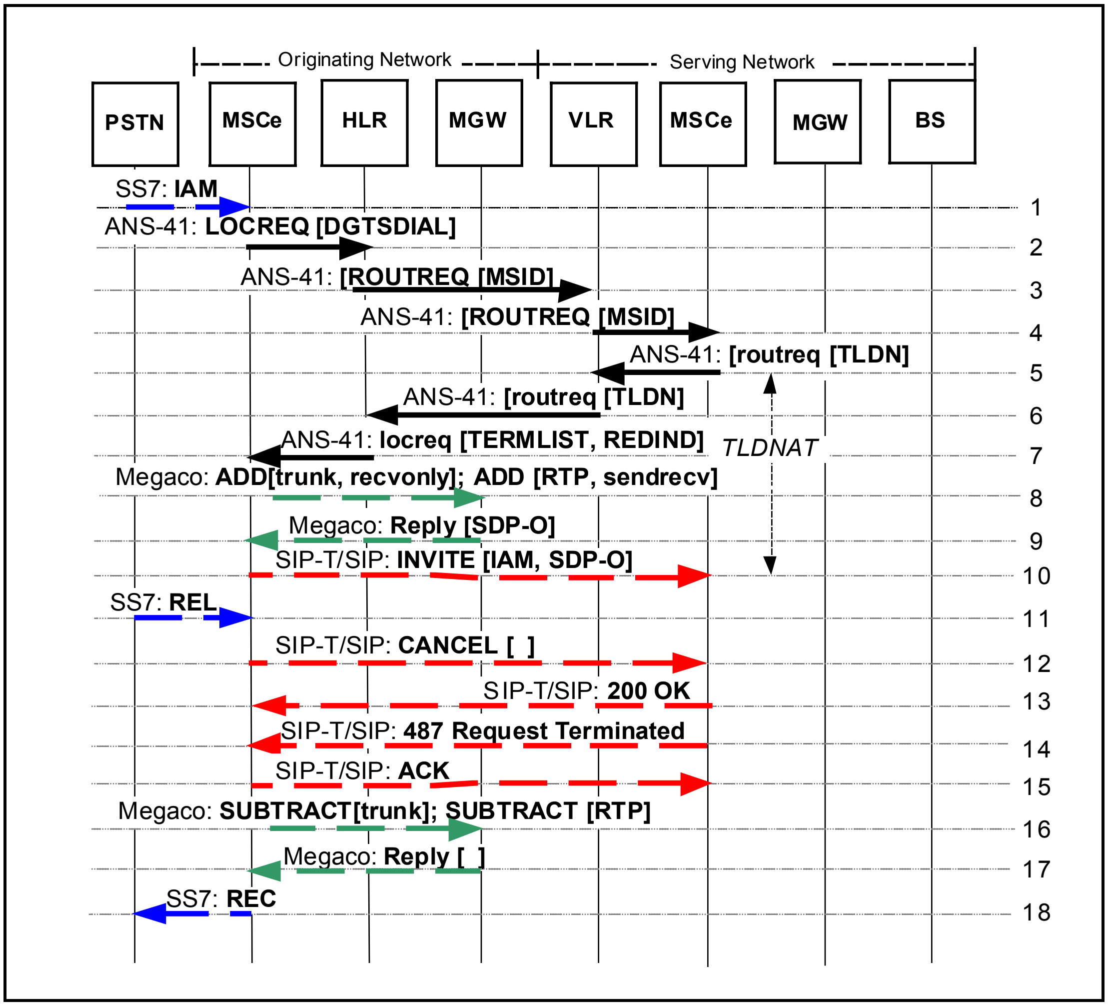

Figure 3.4.2 Call Delivery – Serving Network Fails to Respond

1-9. Same as Figure 3.4.1, Steps 1-9.

10. The Originating MSCe sends an *INVITE* message to the Serving MSCe containing the *IAM* message and the SDP for the Originating MGW. The INVITE message will stop the TLDNAT timer at the Serving MSCe.

11. The Serving Network fails to respond and a *REL* message is received from the Originating Network (e.g., calling party), the Originating Network cancels the *INVITE* request.

Note: Step-12 may occur in parallel with Step-16.

12. The Originating MSCe sends a *CANCEL* message to the Serving MSCe to cancel the call setup.

13. The *CANCEL* message is acknowledged with a 200 OK message from the Serving MSCe to cancel the call setup.

14. Acting on the CANCEL message, the Serving MSCe responds with the *487 Request Terminated* message indicating termination of the *INVITE*.

15. The Originating MSCe closes out the *INVITE* request with an *ACK* message.

Note: Step-16 may occur in parallel with Step-12.

16. The Originating MSCe removes the reserved resources from the Originating MGW. The first *SUBTRACT* command removes the trunk termination to the PSTN and the second *SUBTRACT* commend removes the RTP termination.

17. The Originating MGW responds to the Megaco *SUBTRACT* message.

18. The Originating MSCe sends a *SS7:REL* message to the PSTN.

3.4.3 CFD Invocation with No Answer or No Response to Page

This scenario describes CFD invocation due to MS not answering or not responding to page.

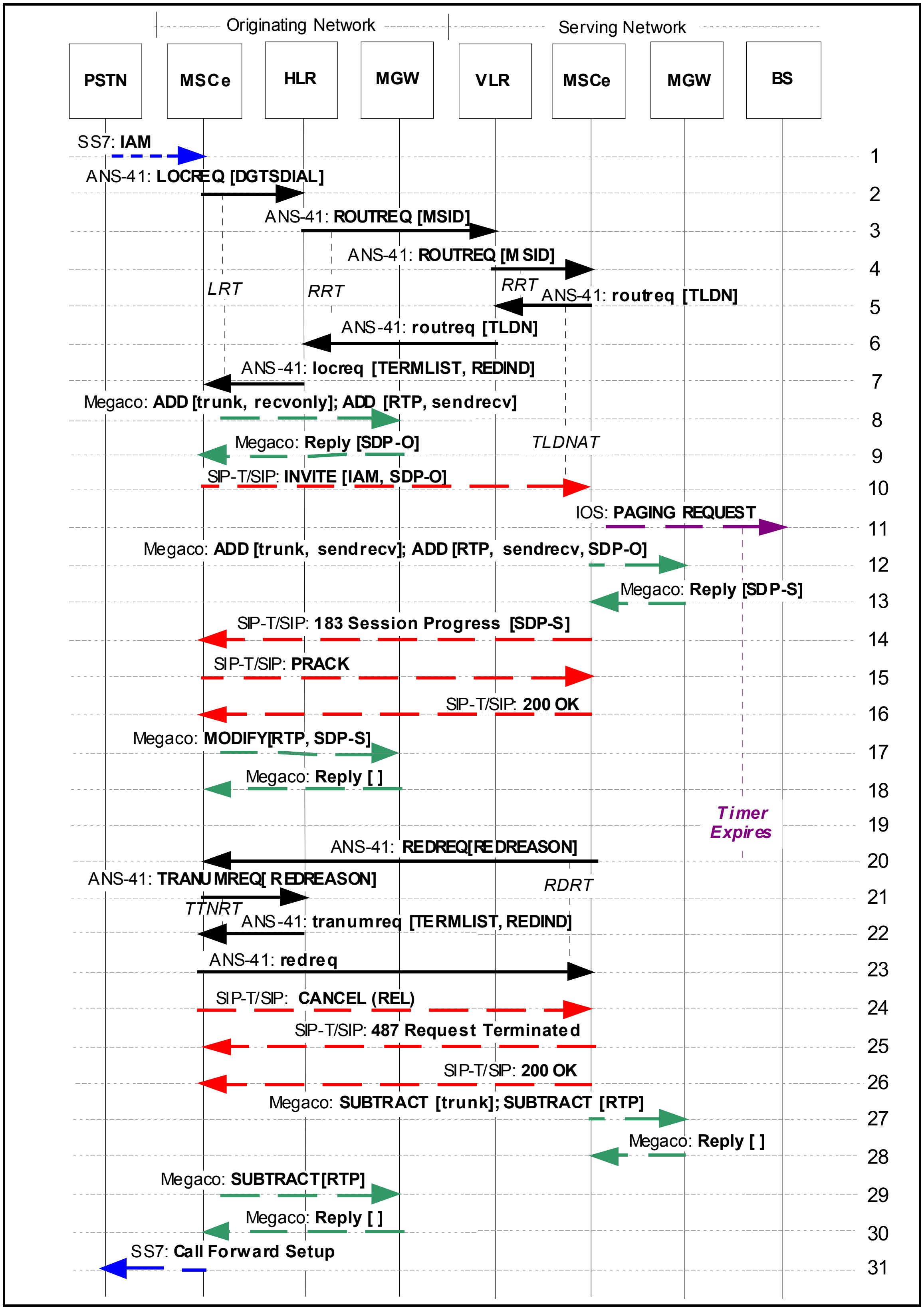

Figure 3.4.3 CFD Invocation with No Answer or No Response to Page

1-10. Same as Figure 3.4.1, Steps 1-10.

11. After receiving an INVITE message (Step-10) the Serving MSCe sends a *Paging Request* message [3GPP2-3] to the BS to initiate a mobile terminated call setup scenario.

12-18. Same as Figure 3.4.1, Steps 13-19.

19. When the inter-MSCe call is received at the Serving MSCe, the MS is paged (Step-11) and, if a page response is received, subsequently alerted. If the MS fails to respond to the page or does not answer after alerting, the Serving MSCe determines from the service profile that the MS has call forwarding active on no answer or no response to page conditions.

20. The Serving MSCe sends an *REDREQ* [41-1] message to the Originating MSCe, indicating that the call is being redirected due to a *no answer* or *no page response* condition.

21. Originating MSCe is able to redirect the call, therefore, it sends a *TRANUMREQ* [41-1] to the HLR requesting the forward-to number appropriate for this condition from the MS's service profile.

22. The HLR sends the *tranumreq* to the Originating MSCe, including the appropriate forward-to number in the *TerminationList* parameter, along with an indication of the reason for extending the incoming call (i.e., for CFD) in the *DMH_RedirectionIndicator* parameter.

23. When the *tranumreq* is received from the HLR, the Originating MSCe sends a *redreq* to the Serving MSCe.

24. The Originating MSCe releases the inter-MSCe call. The Originating MSCe sends a *CANCEL* message to Serving MSCe. In this scenario the *CANCEL* message contains a REL message.

25. The Serving MSCe sends a *487 Request Terminated* message to the Originating MSCe. The Message is a response to the *INVITE* message (Step-10).

26. The Serving MSCe answers the *CANCEL* request by sending a *200 OK* message to the Originating MSCe.

27. Upon receiving a *CANCEL* message from the Originating MSCe the Serving MSCe sends the Serving MGW a Megaco message consisting of two *SUBTRACT* commands. The first *SUBTRACT* command removes the termination to the BS communication channel (e.g., DS0 on T1 or E1 line). The second *SUBTRACT* removes the termination for the bearer channel using RTP.

28. The Serving MGW replies to the Megaco message with a *Reply* message.

29. Upon sending the *redreq* message (see Step-23) to the Serving MSCe, the Originating MSCe sends the Originating MGW a *SUBTRACT* [IETF-8] message to remove the RTP termination from the context.

30. The Originating MGW replies to the Megaco message with a *Reply* message.

31. The Originating MSCe initiates call forwarding using the specified forward-to number.

3.4.4 Call Clearing Initiated by the MS

This scenario describes call clearing that has been initiated by the MS. The MS is outside the serving area of the MSCe where the call originated.

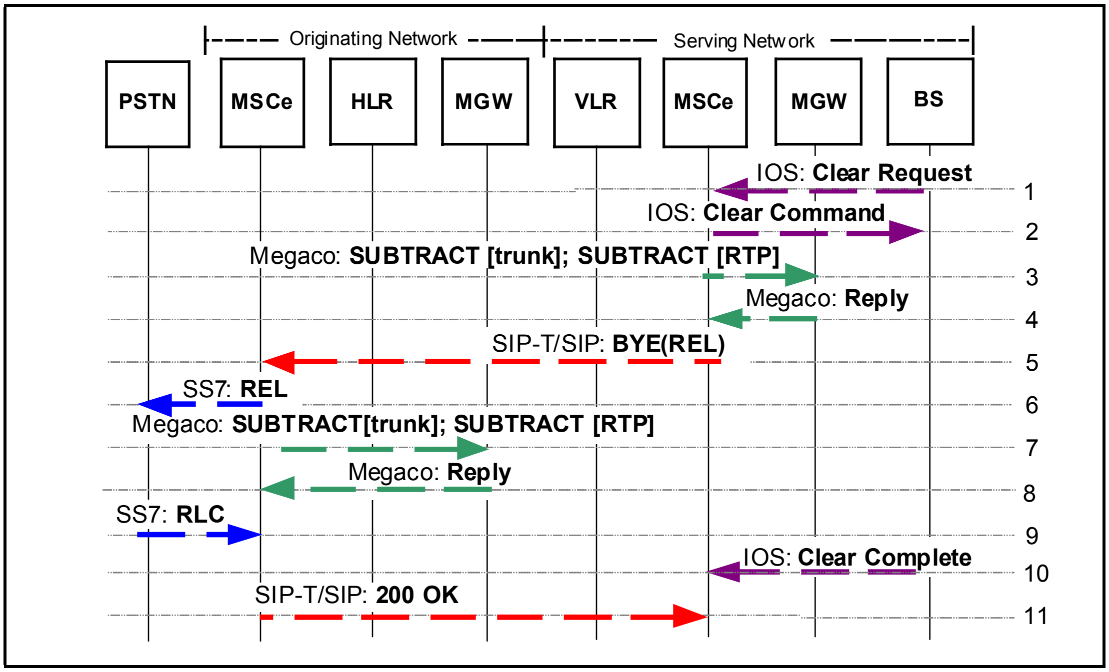

Figure 3.4.4 Call Clearing Initiated by the MS

1. The BS sends the *Clear Request* message [3GPP2-3] to the Serving MSCe to initiate the call clear transaction.

2. The Serving MSCe sends a *Clear Command* message [3GPP2-3] to the BS to instruct the BS to release the associated dedicated resource.

3. Upon receiving a *Clear Request* message from the BS the Serving MSCe sends the Serving MGW a Megaco message consisting of two *SUBTRACT* commands [IETF-8]. The first *SUBTRACT* command removes the termination to the BS communication channel (e.g., DS0 on T1 or E1 line). The second *SUBTRACT* removes the termination for the bearer channel using RTP.

4. The Serving MGW replies to the Megaco message with a *Reply* [IETF-8] message.

5. The Serving MSCe sends a *BYE* [IETF-2] message to Originating MSCe.

6. Upon receiving the *BYE* message the Originating MSCe sends a *REL* message to the PSTN.

7. Upon receiving the *BYE* message the Originating MSCe sends the Originating MGW a Megaco message consisting of two *SUBTRACT* commands [IETF-8]. The first *SUBTRACT* command removes the termination to the PSTN communication channel (e.g., DS0 on T1 or E1 line). The second *SUBTRACT* removes the termination for the bearer channel using RTP.

8. The Originating MGW replies to the Megaco message with a *Reply* message.

9. The PSTN sends a *RLC* message to the Originating MSCe. Note this message can be received by the Originating MSCe anytime after the *REL* message is sent (see Step-6).

10. The BS returns a *Clear Complete* [3GPP2-3] message to the Serving MSCe. The Serving MSCe releases the underlying transport connection. Note this message can be received by the Serving MSCe anytime after Step-2.

11. Upon receiving the *Reply* message from the Originating MGW and upon receiving the *RLC* message from the PSTN the Originating MSCe sends a *200 OK* [IETF-2] message to Serving MSCe. The message acknowledges the *BYE* message (see Step-5).

3.4.5 Call Clearing Initiated by the PSTN

This scenario describes call clearing that has been initiated by a *REL* message being sent to the Originating MSCe. The MS is outside the serving area of the MSCe where the call originated.

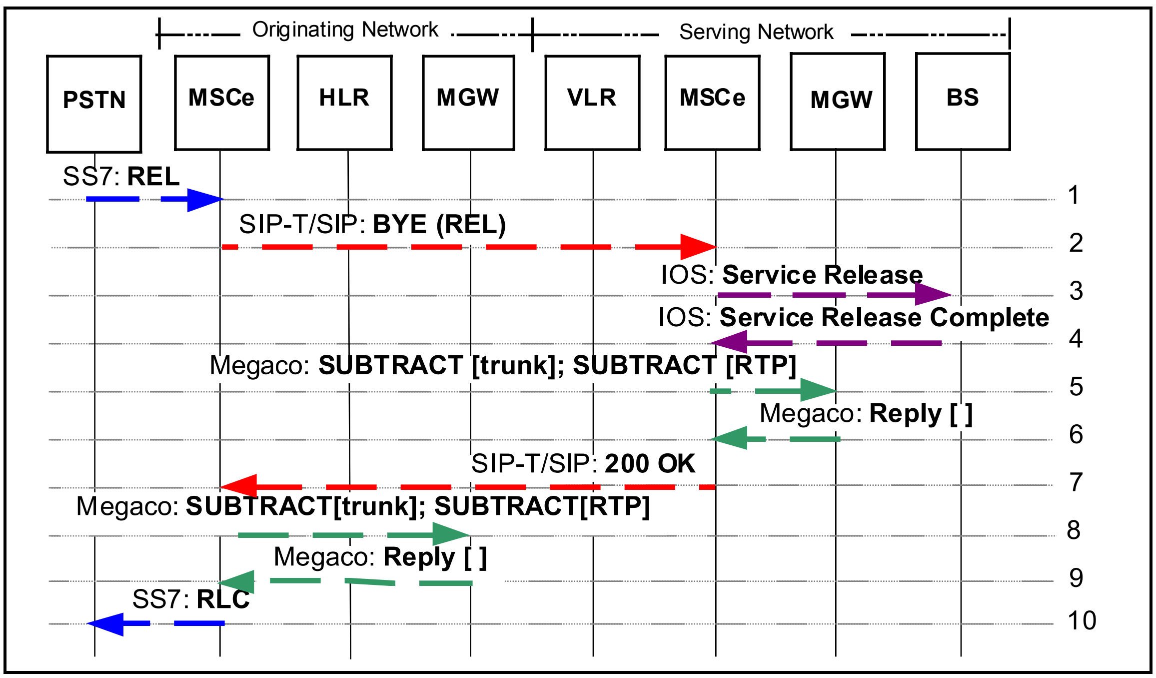

Figure 3.4.5 Call Clearing Initiated by the PSTN

1. A *REL* message is send to the Originating MSCe.

2. The Originating MSCe sends a *BYE* [IETF-2] message to Serving MSCe containing the *REL* message.

3. Upon receiving the *BYE* message, the Serving MSCe sends a *Service Release* [3GPP2-3] message to the BS to instruct the BS to release call control transaction associated with the service.

4. The BS releases the service option connection identifier, the terrestrial circuit, if allocated for the associated service and sends a *Service Release Complete* [3GPP2-3] message to the Serving MSCe.

5. Upon receiving the *BYE* message, the Serving MSCe sends the Serving MGW a Megaco message consisting of two *SUBTRACT* commands [IETF-

8]. The first *SUBTRACT* command removes the termination to the BS communication channel (e.g., DS0 on T1 or E1 line). The second *SUBTRACT* removes the termination for the bearer channel using RTP.

6. The Serving MGW replies to the Megaco message with a *Reply* [IETF-8] message.

7. Upon receiving the *Service Release Complete* message (see Step-4) and receiving the *Reply* message (see Step-6), the Serving MSCe sends a *200 OK* message to the Originating MSCe. This message acknowledges the *BYE* message (see Step-2).

8. After sending the *BYE* message the Originating MSCe sends the Originating MGW a Megaco message consisting of two *SUBTRACT* commands [IETF-8]. The first *SUBTRACT* command removes the termination to the PSTN communication channel (e.g., DS0 on T1 or E1 line). The second *SUBTRACT* removes the termination for the bearer channel using RTP.

9. The Originating MGW replies to the Megaco message with a *Reply* message.

10. The Originating MSCe sends a RLC message to the PSTN.

4 LEGACY MS DOMAIN STAGE-3

This section contains “Legacy MS Domain” Stage-3 protocol usage recommendations, detailed definition of protocol encodings, and appropriate procedure recommendations that support the Stage-1 requirements and Stage-2 message flow scenarios.

4.1 SIP-T/SIP INVITE Message

The Originating MSCe initiates the SIP session with an INVITE request. The INVITE request usually contains all the information needed to route the call.

Table 4.1 contains a list of headers required for the generation of a SIP INVITE request message.

Table 4.1: Required Headers within the INVITE Request

Header	RFC Status	Comments
Call-ID	M	Constructed as specified in [IETF-1].
Contact	M	Constructed from the Calling Party Number in the IAM (Note 1) as specified in [IETF-1].
Content Length	O	Constructed as specified in [IETF-1].
Content-Type	O	Multipart/mixed with boundary defined.
Cseq	M	Constructed as specified in [IETF-1].
Expires	O	Value set by Operator. Constructed as specified in [IETF-1].
From	M	Constructed from Calling Party Number in IAM (Note-1) as specified in [IETF-3].
Max-Forwards	M	Constructed as specified in [IETF-1].
MIME-Version	O	Set to 1.0. Constructed as specified in [IETF-1].
To	M	Constructed from the TLDN as specified in [IETF-3].
Via	M	Constructed as specified in [IETF-1].
Note 1: If the Calling Party Number is “Private” or the number is not in the IAM message a non-routable 10 digit number shall be used.		

4.1.1 Example INVITE Request

The example INVITE Request message is generated using the following assumptions:

a. the IAM Message from the PSTN contains the following information:

   i. Called Party Number = NPA-NXX-1234, and

   ii. Calling Party Number = NPA-NXX-4567,

b. the TLDN received from the Serving MSCe = 2463001,

c. IP address of Originating MSCe = 10.174.75.156,

d. Based upon the following a typical INVITE Message, as in a “Call Delivery to an Idle MS on Another MSCe” scenario (see Section 3.4.3.1), appears as:

```
INVITE sip:2463001@Serving_MSCe;user=phone SIP/2.0
To:<sip:2463001@Serving_MSCe;user=phone>
From:<sip:NPANXX1234@Originating_MSCe;user=phone>
Via:SIP/2.0/UDP Originating_MSCe;maddr=10.174.75.156
Max-Forwards: 70
MIME-Version: 1.0
Contact:<sip:NPANXX4567@10.174.75.156;user=phone>
Supported:100rel
Call-ID:123456789 @Originating MSCe
CSeq:1 INVITE

Content-Type:multipart/mixed; boundary=unique-boundary-1
Content-Length:271

--unique-boundary-1
Content-Type:application/isup; version=gr317; base=gr317

01 00 22 00 0A 03 06 0C 03 80 90 A2 06 81 10 42
36 00 01 0A 07 03 13 19 29 64 03 40 00
--unique-boundary-1
Content-Type:application/sdp; charset=ISO10646

v=0
c=IN IP4 10.174.75.156
m=audio 5004 RTP/AVP 0
a=ptime:10

--unique-boundary-1—
```

This INVITE contains a nested body that contains both SDP and an ISUP payload. This nesting is indicated by the “multipart/mixed” Content-Type indication (for more details see [IETF-10]). This INVITE message body contains the ISUP IAM message. The ISUP type [IETF-10] is indicated by the Content-Type header which is “gr317” which represents Bellcore GR-317 ISUP. The SDP contained in the message body is preceded by the second Content-Type header.

4.1.2 ISUP IAM Generation

This sub-section describes how the ISUP IAM message sent in a SIP-T INVITE request (e.g., Section 3.4.1 Call Delivery to an Idle MS on Another MSCe) by an Originating MSCe is generated.

Upon receiving a TLDN (e.g., Step 9, Figure 3.4.1) an Originating MSCe shall re-construct the IAM message received from the PSTN (e.g., Step 1, Figure 3.4.1) by replacing the Called Party Number with the TLDN value.

4.2 SIP-T/SIP Response Codes

Response Codes [IETF-1] are three digit codes followed by a descriptive phrase. The first digit of the response code defines the response type. For example all 1xx response codes are provisional (i.e., informational response indicating that the server has been contacted and is performing some further action and does not yet have a definitive response) whereas all 4xx response codes indicate a failure situation.

The MSCe shall support the Response Codes listed in Table 4.2.1. See [IETF-1] for a detailed explanation of each Response Code and additional optional Response Codes.

Table 4.2.1: Supported Response Codes

Header	Meaning	Initiation	Reception
100	Trying	Serving MSCe	Originating MSCe
180	Ringing	Serving MSCe	Originating MSCe
183	Session Progress	Serving MSCe	Originating MSCe
200	OK	Serving MSCe	Originating MSCe
		Originating MSCe	Serving MSCe
300	Multiple Choices	Serving MSCe	Originating MSCe
400	Bad Request	Serving MSCe	Originating MSCe
408	Request Timeout	Serving MSCe	Originating MSCe
415	Unsupported Media Type	Serving MSCe	Originating MSCe
481	Call Leg/Transaction does not exist	Serving MSCe	Originating MSCe
487	Request Terminated	Serving MSCe	Originating MSCe
500	Server Internal Error	Serving MSCe	Originating MSCe
504	Server Time-out	Serving MSCe	Originating MSCe
505	SIP Version not supported	Serving MSCe	Originating MSCe
513	Message too large	Serving MSCe	Originating MSCe
600	Busy Everywhere	Serving MSCe	Originating MSCe