



ATIS-1000673.2002(R2012)

Bearer Independent Call Control (BICC) Capability Set 1+
(CS1+)

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ATIS-1000673.2002(R2012), *Bearer Independent Call Control (BICC) Capability Set 1+ (CS1+)*

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T1.673-2002

American National Standard for Telecommunications

**Bearer Independent Call Control (BICC)
Capability Set 1+ (CS1+)**

Secretariat

Alliance for Telecommunications Industry Solutions

Approved February 13, 2002

American National Standards Institute, Inc.

Abstract

This standard describes the adaptation of the narrowband ISDN User Part (ISUP) for the support of narrowband ISDN services independent of the bearer technology and signaling message transport technology used. The protocol defined by this standard is the call control protocol to be used between "Serving Nodes." This protocol is called the "Bearer Independent Call Control" protocol (BICC). Between Serving Nodes, the control of bearers is provided by other protocols not specified by this standard.

Foreword

The information contained in this Foreword is not part of this American National Standard (ANS) and has not been processed in accordance with ANSI's requirements for an ANS. As such, this Foreword may contain material that has not been subjected to public review or a consensus process. In addition, it does not contain requirements necessary for conformance to the standard.

This standard describes the adaptation of the narrowband ISDN User Part (ISUP) for the support of narrowband ISDN services independent of the bearer technology and signaling message transport technology used.

The protocol defined by this standard is the call control protocol to be used between "Serving Nodes." This protocol is called the "Bearer Independent Call Control" (BICC) protocol. Between Serving Nodes the control of bearers is provided by other protocols not specified by this standard.

This standard is based on T1.113-2000, *Signaling System Number 7 -- Integrated Services Digital Network (ISDN) User Part*. It represents an extension of the previous BICC, Capability Set 1 protocol, specified in T1.672-2000, *Signaling System Number 7 -- Bearer Independent Call Control, Capability Set 1*, to include the following capabilities:

- Procedures supporting user services provided in originating and destination exchanges.
- Definition of the functions of a Call Mediation Node (a functional entity that supports call service functions, but does not have any associated bearer control functional entities).
- Procedures supporting the routing and transfer of calls between networks (e.g., Exit message).
- Support for Bearer Control Tunneling.
- Support for Bearer Redirection.

This standard does not supersede T1.672-2000. BICC CS1+ is aligned with the ITU-T specification of BICC CS2, but does not include a protocol specification for the interface between Call Service functional entities and Bearer Control Functional Entities (the Call-Bearer Control protocol).

This standard contains seven chapters:

1. Chapter 1 contains a functional description of BICC Capability Set 1+.
2. Chapter 2 defines the Messages and Parameters used in BICC as a delta to T1.113.2.
3. Chapter 3 specifies BICC Formats and Codes, again as a delta to the specifications of T1.113.3.
4. Chapter 4 specifies the procedures for BICC. This chapter is complete within itself (i.e., it is not a delta to T1.113.4, as was the case in T1.672).
5. Chapter 5 specifies a revision of the Application Transport Mechanism, specified in T1.113. 7, for use in BICC.
6. Chapter 6 specifies the use of the Application Transport Mechanism by BICC to transport BICC-specific information.
7. Chapter 7 specifies BICC performance requirements as a delta to T1.113. 5.

This standard is intended for use in conjunction with T1.110-1999, *Signaling System No. 7 (SS7)—General Information*. This standard is dependent on T1.113-2000. The transportation of BICC messages depends on the use of the Signaling Transport Converters specified in T1.674-2002, *BICC CS1+: Signaling Transport Converters (STCs)*.

There are twelve annexes in this standard. Chapter 1 contains two informative annexes. Chapter 4 contains seven normative and three informative annexes. Information contained in a normative annex forms an integral part of this standard. Information contained in an informative annex is not considered part of this standard, but is rather auxiliary to the standard. Similarly, footnotes are not part of this standard.

Suggestions for improvement of this standard are welcome. They should be sent to the Alliance for Telecommunications Industry Solutions, T1 Secretariat, 1200 G Street NW, Suite 500, Washington, DC 20005.

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Chapter T1.673.1

Functional Description of the Bearer Independent Call Control (BICC) protocol CS1+

Table of Contents

1	SCOPE, PURPOSE, AND APPLICATION	1
2	NORMATIVE REFERENCES	4
3	DEFINITIONS	5
4	ABBREVIATIONS & ACRONYMS	7
5	CONVENTIONS	9
6	ARCHITECTURE	9
6.1	NETWORK MODEL.....	9
6.2	PROTOCOL MODEL.....	10
6.3	DOCUMENT STRUCTURE.....	11
7	INTRODUCTION TO BICC PROTOCOL SIGNALING PROCEDURES	11
7.1	ADDRESS SIGNALING.....	11
7.2	BASIC PROCEDURES.....	11
7.3	SIGNALING METHODS.....	11
7.4	INTERWORKING.....	12
7.4.1	BICC INTERWORKING.....	12
7.4.2	INTERWORKING WITH ISUP.....	12
7.4.3	INTERWORKING WITH OTHER SIGNALING SYSTEMS OR USER PARTS.....	12
8	CAPABILITIES SUPPORTED	12
9	FUTURE ENHANCEMENTS AND COMPATIBILITY PROCEDURE	14
9.1	VERSION COMPATIBILITY.....	15
9.2	ADDITIONAL CODING GUIDELINES FOR COMPATIBILITY OF BICC PROTOCOL VERSIONS.....	16
9.2.1	MESSAGES.....	16
9.2.2	PARAMETERS.....	16
9.3	FORWARD AND BACKWARD COMPATIBILITY FOR THE BICC APM USER APPLICATION.....	16
10	PRIMITIVE INTERFACE TO THE SIGNALING TRANSPORT SERVICE	16
A	GUIDELINES FOR USE OF INSTRUCTION INDICATORS	17
A.1	INTRODUCTION.....	17
A.2	PRIORITY OF EXECUTION.....	17
A.3	NOTIFICATION.....	17
A.4	CONSIDERATIONS.....	17
A.4.1	DISCARDING UNRECOGNIZED MESSAGES.....	17
A.4.2	ESSENTIAL SERVICES.....	18
A.4.3	NON-ESSENTIAL SERVICES.....	18
A.4.4	BROADBAND/NARROW-BAND INTERWORKING.....	18
A.4.5	PASS ON.....	18
B	BIBLIOGRAPHY	19

Table

FIGURE 1/T1.673.1 - SCOPE OF THIS STANDARD IN CASE OF AN SN.....	2
FIGURE 2/T1.673.1 - SCOPE OF THIS STANDARD IN CASE OF A CMN.....	3
FIGURE 3/T1.673.1 - NETWORK FUNCTIONAL MODEL.....	10
FIGURE 4/T1.673.1 - PROTOCOL MODEL.....	10

Table of Tables

TABLE 1/T1.673.1 - SIGNALING CAPABILITIES FOR BASIC CALL.....	13
TABLE 2/T1.673.1 - GENERIC SIGNALING PROCEDURES, SERVICES AND FUNCTIONS.....	14

American National Standard
for Telecommunications –

Functional Description of the Bearer Independent Call Control (BICC) protocol CS1+

1 Scope, Purpose, and Application

The Bearer Independent Call Control (BICC) protocol provides the signaling functions required to support narrowband ISDN services independent of the bearer technology and signaling transport technology used.

The BICC protocol uses the Signaling Transport Converter (STC) layer for signaling message transport. The STCs are defined in T1.674-2002.

Several arrangements are possible for nodes that support BICC signaling. These nodes may have an associated Bearer Control Function (BCF), in which case they are referred to as Serving Nodes (SN). A node without an associated BCF is referred to as Call Mediation Node (CMN). Between SNs, the control of bearers is provided by other protocols not specified by this standard.

Bearer control signaling can be deployed over a separate signaling transport or the bearer control protocol can be tunneled through the "horizontal" BICC protocol between peer Call Service Functions (CSFs). The Bearer Control Tunneling Protocol is specified in T1.677-2001.

In an SN, the Call Service Function and the BCF entities may be physically separated. The Call Bearer Control (CBC) signaling is used between these two entities in case of physical separation. This standard does not assume physical separation of CSF and BCF entities; CBC signaling is outside the scope of this standard.

Both SNs and CMNs are modeled using the "Half Call" modeling technique. Every call-processing scenario is thus divided between an incoming and an outgoing signaling procedure. In the scope of this standard at least one of this procedures is the BICC procedure (see Figure 1/T1.673.1 and Figure 2/T1.673.1).

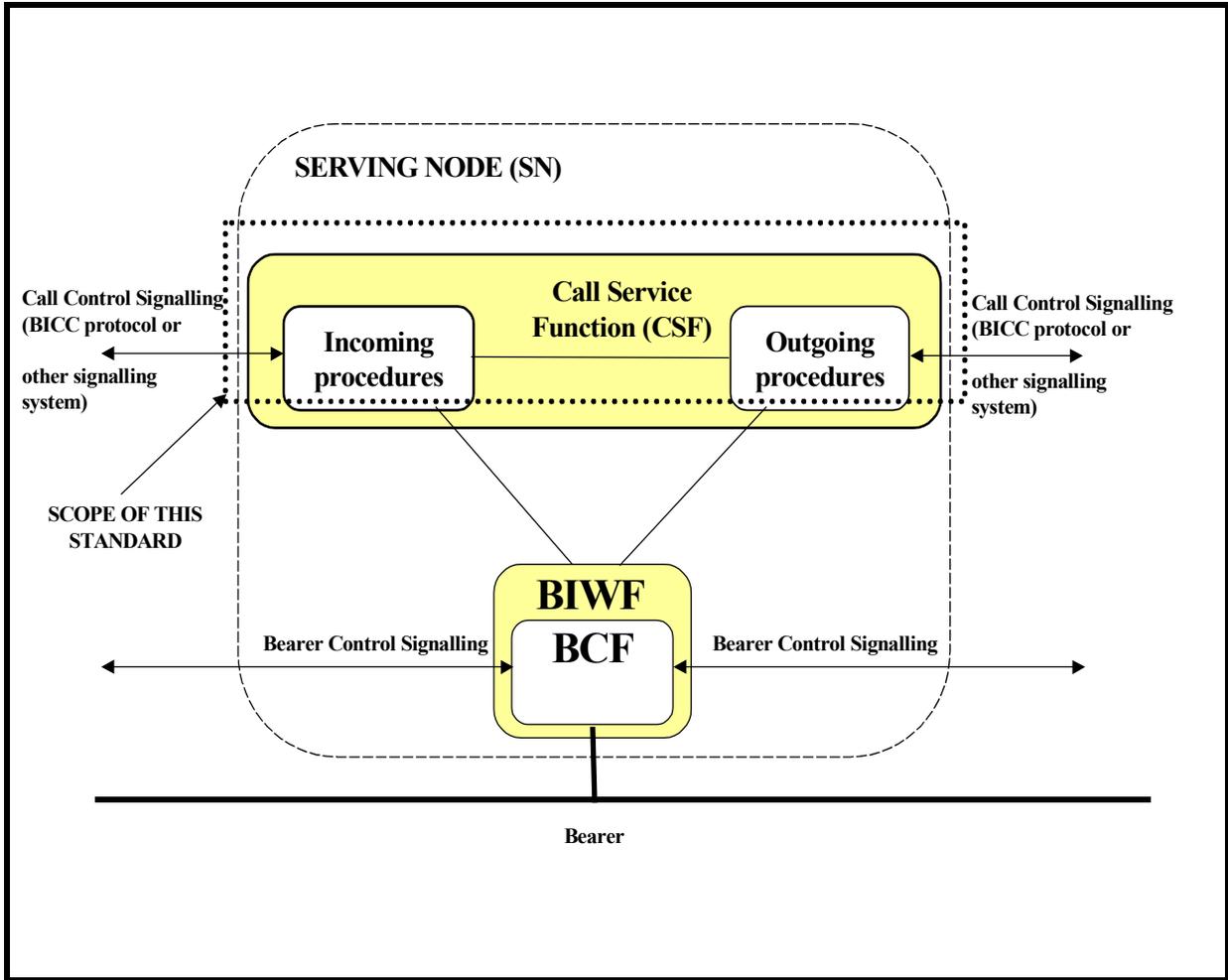


Figure 1/T1.673.1 - Scope of this Standard in case of an SN

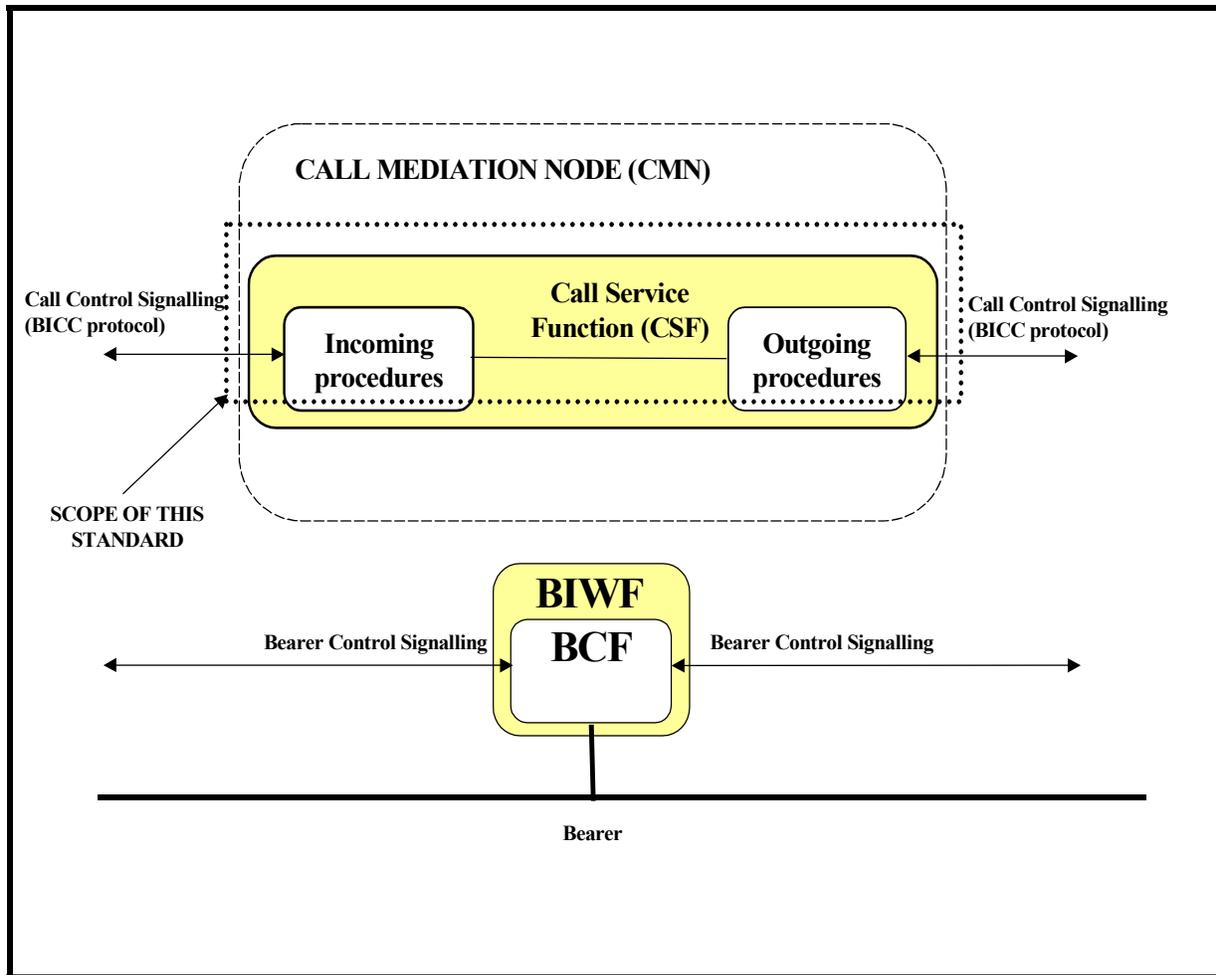


Figure 2/T1.673.1 - Scope of this Standard in case of a CMN

The BICC protocol is based on, and uses wherever applicable the same signaling procedures, information elements and message types as the ITU-T BICC protocol specified in:

- ITU-T Recommendation Q.1902.1 (2001), *BICC protocol (CS2) functional description*.¹
- ITU-T Recommendation Q.1902.2 (2001), *BICC protocol (CS2) general functions of messages and parameters*.¹
- ITU-T Recommendation Q.1902.3 (2001), *BICC protocol (CS2) formats and codes*.¹
- ITU-T Recommendation Q.1902.4 (2001), *BICC protocol (CS2) basic call procedures*.¹
- ITU-T Recommendation Q.1902.5 (2001), *Exceptions to the Application Transport Mechanism in the context of Bearer Independent Call Control*.¹
- ITU-T Recommendation Q.1902.6 (2001), *Generic signaling procedures and support of the ISDN User Part Supplementary Services with the Bearer Independent Call Control protocol*.¹
- ITU-T Recommendation Q.765.5 (2000) and Amendment 1 (2001), *Application Transport Mechanism - Bearer Independent Call Control*.¹

¹ This document is available from the International Telecommunications Union.

< <http://www.itu.int/ITU-T/> >

- ITU-T Recommendation Q.1912.1 (2001), *Interworking between Signaling System 7 ISDN User Part and the Bearer Independent Call Control Protocol*.
- ITU-T Recommendation Q.1912.2 (2001), *Interworking between selected signaling systems (PSTN access, DSS1, C5, R1, R2, TUP) and the Bearer Independent Call Control protocol*.
- ITU-T Recommendation Q.1912.4 (2001), *Interworking between DSS 2 and the Bearer Independent Call Control Protocol*.¹

The BICC protocol is flexible enough and has sufficient spare capacity to accommodate any foreseeable requirements that may be imposed by the introduction of new supplementary services and network capabilities.

The BICC protocol is specified in Chapters T1.673.1 to T1.673.7 of this American National Standard. A functional description of the BICC protocol is provided in this chapter. General functions of messages and parameters are provided in T1.673.2. BICC formats and codes are specified in T1.673.3, while basic call signaling procedures are specified in T1.673.4. Exceptions to the Application Transport Mechanism in the context of BICC are described in T1.673.5; Chapter T1.673.6 specifies the APM-user to support the transport of the bearer related information for the BICC. Performance objectives in the BICC application are provided in T1.673.7.

In addition to the basic service, this issue of the BICC protocol standard also supports a number of supplementary services and network capabilities. The BICC protocol and procedures required to support these services and network capabilities are similar to the corresponding ISDN User Part procedures defined in other American National Standards.

2 Normative References

The following listed standards contain provisions which, through reference in this text, constitute provisions of this American National Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this American National Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below.

T1.113-2000, *Signaling system no. 7 (SS7) – Integrated Services Digital Network (ISDN) user part*.²

T1.607-2000, *Integrated Services Digital Networks (ISDN) – Layer 3 Signaling Specification for Circuit Switched Bearer Services for Digital Subscriber Signaling System Number 1 (DSS1)*.²

T1.609-1999, *Interworking Between the ISDN User-Network Interface Protocol and the Signaling System No. 7 ISDN User Part*.²

T1.648-1995 (R2000), *Signaling System No. 7 (SS7) - Broadband Integrated Services Digital Network User Part (B-ISUP)*.²

T1.656-1996 (R2000), *Broadband-ISDN-Interworking between Signaling System No. 7 Broadband ISDN User Part (B-ISUP) and ISDN User Part (ISUP)*.²

T1.657-1996 (R2000), *Broadband-ISDN-Interworking between Signaling System No. 7 Broadband ISDN User Part (B-ISUP) and Digital Subscriber Signaling System No. 2 (DSS2)*.²

T1.674-2002, *BICC CS1+: Signaling Transport Converters (STCs)*.²

T1.677-2001, *BICC Bearer Control Tunneling Protocol*.²

² This document is available from the Alliance for Telecommunications Industry Solutions, 1200 G Street N.W., Suite 500, Washington, DC 20005. <<http://www.atis.org>>

3 Definitions

This standard defines the following terms:

3.1 Backbone Network Connection (BNC): Represents the edge-to-edge transport connection within the backbone network, consisting of one or more Backbone Network Connection Links (BNCL). The Backbone Network Connection represents a segment of the end-to-end Network Bearer Connection (NBC).

3.2 Backbone Network Connection Link (BNCL): Represents the transport facility between two adjacent backbone network entities containing a bearer control function.

3.3 Bearer Control Function (BCF): Note that five types of BCFs are illustrated in the composite functional model (Figure 3/T1.673.1): BCF-G, BCF-J, BCF-N, BCF-R and BCF-T.

- The Bearer Control Joint Function (BCF-J) provides the control of the bearer switching function, the communication capability with two associated call service functions (CSFs), and the signaling capability necessary to establish and release the backbone network connection.
- The Bearer Control Gateway Function (BCF-G) provides the control of the bearer switching function, the communication capability with its associated call service function (CSF-G), and the signaling capability necessary to establish and release the backbone network connection.
- The Bearer Control Nodal Function (BCF-N) provides the control of the bearer switching function, the communication capability with its associated CSF, and the signaling capability necessary to establish and release of the backbone network connection to its peer (BCF-N).
- The Bearer Control Relay Function (BCF-R) provides the control of the bearer switching function and relays the bearer control signaling requests to next BCF in order to complete the edge to edge backbone network connection
- The Bearer Control Transit Function (BCF-T) provides the control of the bearer switching function, the communication capability with its associated call service function (CSF-T), and the signaling capability necessary to establish and release the backbone network connection.

3.4 Bearer Control Segment (BCS): Represents the signaling relationship between two adjacent Bearer Control Functional entities (BCF).

3.5 Bearer Inter-Working Function (BIWF): A functional entity which provides bearer control functions (BCF) and media mapping/switching functions within the scope of a Serving Node (BCF-N, BCF-T or BCF-G) and one or more MCF and MMSF, and is functionally equivalent to a Media Gateway that incorporates bearer control.

3.6 Bearer Inter-Working Node (BIWN): A physical unit incorporating functionality similar to a BIWF.

3.7 Call Control Association (CCA): Defines the peer-to-peer signaling association between Call and Call & Bearer state machines located in different physical entities.

3.8 Call Mediation Node (CMN): A functional entity that provides CSF-C functions without an associated BCF entity.

3.9 Call Service Function (CSF): Four types of CSF are defined:

- The Call Service Nodal Function (CSF-N) provides the service control nodal actions associated with the narrowband service by interworking with narrowband and Bearer Independent Call Control (BICC) signaling, signaling to its peer CSF-N the characteristics of the call, and invoking the Bearer Control Nodal Functions (BCF-N) necessary to transport the narrowband bearer service across the backbone network.
- The Call Service Transit Function (CSF-T) provides the service transit actions necessary to establish and maintain a backbone network call (see Figure 3/T1.673.1), and its associated bearer by relaying signaling between CSF-N peers and invoking the Bearer Control Transit Functions (BCF-T) necessary to transport the narrowband bearer service across the backbone network.

- The Call Service Gateway Function (CSF-G) provides the service gateway actions necessary to establish and maintain a backbone network call and its associated bearer by relaying signaling between CSF-N peers and invoking the Bearer Control Gateway Functions (BCF-G) necessary to transport the narrowband bearer service between backbone networks.
- The Call Service Co-ordination Function (CSF-C) provides the call co-ordination and mediation actions necessary to establish and maintain a backbone network call by relaying signaling between CSF-N peers. The CSF-C has no association with any BCF. It is only a call control function.

3.10 Constructor: An information element type, the contents of which consists of other information elements as described in T1.673.6.

3.11 Gateway Serving Node (GSN): A functional entity that provides gateway functionality between two network domains. This functional entity contains one or more call service gateway functions (CSF-G), and one or more BIWFs. GSNs interact with other GSNs in other backbone network domains, and other ISNs and TSNs within its own backbone network domain. The network signaling flows for a GSN are equivalent as those for a TSN.

3.12 Interface Serving Node (ISN): A functional entity that provides the interface with non-BICC networks and terminal equipment. This functional entity contains one or more call service nodal functions (CSF-N), and one or more BIWFs that interact with the non-BICC networks and terminal equipment and its peers within the broadband backbone network.

3.13 List of Supported Codecs: List of codecs conveyed between two SNs. It includes all the codecs that are supported from the SN initiating codec negotiation procedures, up to the SN sending the message including the list of codecs.

3.14 List of Available Codecs: This list contains all the codecs that can be used for the call set-up and in the active phase of the call.

3.15 Media Control Function (MCF): A functional entity that interacts with the BCF to provide the control of the bearer and MMSF. The precise functionality is outside the scope of BICC.

3.16 Media Mapping/Switching Function (MMSF): An entity providing the function of controlled interconnection of two bearers and optionally the conversion of the bearer from one technology and adaptation/encoding technique to another.

3.17 Serving Node (SN): A generic term referring to ISN, GSN, or TSN nodes.

3.18 Signaling Transport Layers (STL): Any suite of protocol layers currently specified to provide Transport and/or Network Layer services to the BICC. Their functions, protocol and service primitives are outside the scope of this specification.

3.19 Signaling Transport Converter (STC): A protocol layer between the STL and BICC. This layer enables the BICC protocol to be independent of the STL being used.

3.20 Simple: An information element type, as described in T1.673.6.

3.21 Switching Node (SWN): A functional entity that provides the switching functions within the broadband backbone network. This functional entity contains a bearer control state machine (BCF-R). SWNs interact with other SWNs within their own backbone network domain. The SWNs BCF-R also interacts with the BCF-N functions contained in BIWF entities.

3.22 Switched Circuit Network (SCN): A generic term for any network that uses circuit switching technology (i.e., ISDN, PSTN, PLMN...).

3.23 Terminal Equipment (TE): Represents the customer's access equipment used to request and terminate network associated connectivity services.

3.24 Transit Serving Node (TSN): A functional entity that provides transit functionality between ISNs and GSNs. This functional entity contains one or more call service functions (CSF-T), and one or more BIWFs. TSNs interact with other TSNs, GSNs, and ISNs within their own backbone network domain.

4 Abbreviations & Acronyms

ACM	Address Complete Message
AEI	Application Entity Invocation
APM	Application Transport Mechanism
APP	Application Transport Parameter
ASE	Application Service Element
ATII	Application Transport Instruction Indicators
ATM	Asynchronous Transfer Mode
BAT	Bearer Association Transport
BCF	Bearer Control Function
BCF-G	Bearer Control Gateway Function
BCF-J	Bearer Control Joint Function
BCF-N	Bearer Control Nodal Function
BCF-T	Bearer Control Transit Function
BCS	Bearer Control Segment
BICC	Bearer Independent Call Control
B-ISDN	Broadband ISDN
B-ISUP	Broadband ISUP
BIWF	Bearer InterWorking Function
BIWN	Bearer Inter-Working Node
BNC	Backbone Network Connection
BNC-ID	Backbone Network Connection Identifier
BNCL	Backbone Network Connection Link
CBC	Call Bearer Control
CCA	Call Control Association
CD	Call Deflection
CFB	Call Forwarding Busy
CFNR	Call Forwarding No Reply
CFU	Call Forwarding Unconditional
CIC	Call Instance Code
CLIP	Calling Line Identification Presentation
CLIR	Calling Line Identification Restriction
CMN	Call Mediation Node
CNIP	Calling Name Identification Presentation
CNIR	Calling Name Identification Restriction
COT	Continuity message
CPG	Call Progress message

CSF	Call Service Function
CSF-C	Call Service Coordination Function
CSF-G	Call Service Gateway Function
CSF-N	Call Service Nodal Function
CSF-T	Call Service Transit Function
CW	Call Waiting
DPC	Destination Point Code
DSS 1	Digital Subscriber System No.1
DSS 2	Digital Subscriber System No.2
DTMF	Dual Tone Multi Frequency
ECS	Emergency Calling Services
ECT	Explicit Call Transfer
EH	Errors Handling
FC	Flexible Calling
GRS	Group Reset message
GSN	Gateway Serving Node
IAM	Initial Address Message
ISDN	Integrated Services Digital Network
ISN	Interface Serving Node
ISUP	ISDN User Part
kbps	Kilobits per second
LSB	Least Significant Bit
MCF	Media Control Function
MLPP	Multi-Level Precedence and Pre-emption
MMSF	Media Mapping/Switching Function
MSB	Most Significant Bit
MTP	Message Transfer Part
MTP3	Message Transfer Part level 3 (Narrowband)
MTP3b	Message Transfer Part level 3 (Broadband)
MWICN	Message Waiting Indicator Control & Notification
NBC	Network Bearer Connection
NCT	Normal Call Transfer
NI	Network Indicator (in SIO), or Network Interface (in specification model)
OPC	Originating Point Code
PLMN	Public Land Mobile Network
PSTN	Public Switched Telephone Network
REL	Release message
RLC	Release Complete message
ROSE	Remote Operations Service Element

RSC	Reset CIC message
SACF	Single Association Control Function
SAM	Subsequent Address Message
SAO	Single Association Object
SCN	Switched Circuit Network
SI	Service Indicator
SIO	Service Information Octet
SLS	Signaling Link Selection
SN	Serving Node
STC	Signaling Transport Converter
STL	Signaling Transport Layers
SWN	Switching Node
TAR	Temporary Alternative Routing
TE	Terminal Equipment
TSN	Transit Serving Node
UUS	User-to-User Signaling

5 Conventions

1. The name of each element of the following classes of terms is capitalized:
 - Indicators;
 - Parameters;
 - Information elements; and
 - Messages.

Examples: Called Party Number parameter, Initial Address message.

2. The definition of a parameter value is written in *italics* and is put between quotation marks.

Example: Nature of Address value 0000011 – “*national (significant) number.*”

3. All message names are BICC messages unless explicitly stated otherwise.

Example: The “IAM message” is the IAM message in BICC, whereas an IAM message in ISUP is referred to as an “ISUP IAM message.”

6 Architecture

6.1 Network model

Figure 3/T1.673.1 shows the complete functional model of a network using the BICC protocol for call control signaling.

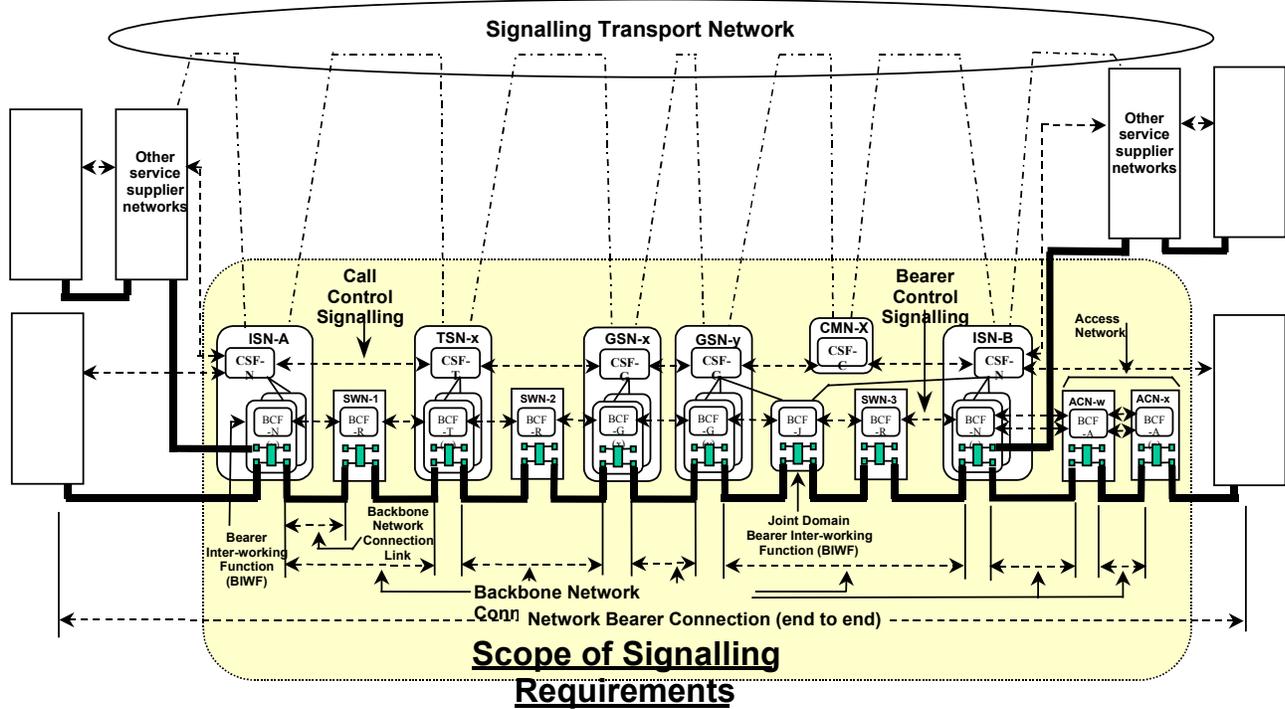


Figure 3/T1.673.1 - Network Functional model

6.2 Protocol model

Figure 4/T1.673.1 shows the protocol model adopted for this standard.

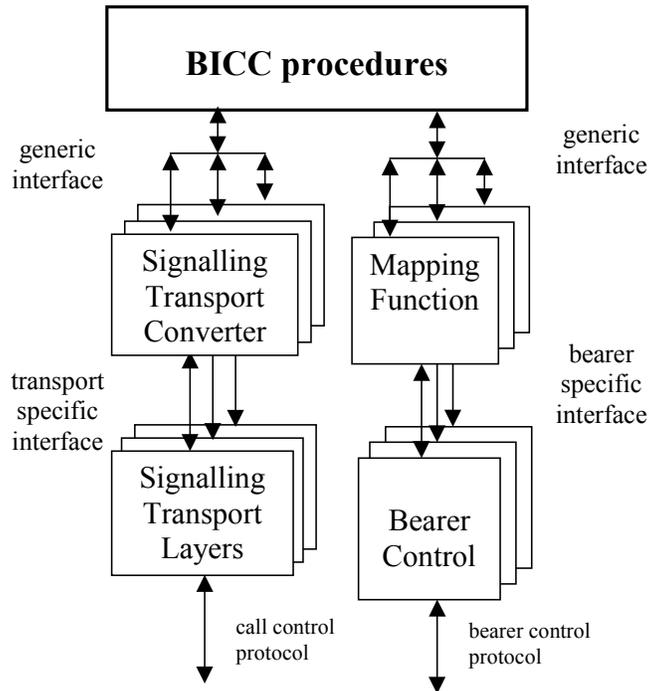


Figure 4/T1.673.1 - Protocol model

The protocol aspects of the functional model in Figure 3/T1.673.1 are provided by the elements of the protocol model in Figure 4/T1.673.1.

- The BICC procedures block includes the functions of the CSF element in the functional model.
- The protocol functions of the BCF element of the functional model are distributed between the Mapping Function, and Bearer Control blocks in Figure 4/T1.673.1. The other functions included in the BCF element (e.g., control of switching functions) are not shown in Figure 4/T1.673.1.
- Where the BICC description refers to sending/receiving bearer signaling events to/from the BCF, this relates to use of the generic interface to the mapping function block in Figure 4/T1.673.1.
- Where the BICC description refers to sending/receiving BICC messages, this relates to the use of the generic interface to the Signaling Transport Converter, see T1.674-2002.

6.3 Document structure

This chapter provides a functional description of the BICC protocol, independent of the bearer technology employed. This is the block labeled BICC procedures in Figure 4/T1.673.1. It also uses the generic interface to the blocks labeled Mapping Functions and Signaling Transport Converter.

The blocks in Figure 4/T1.673.1 labeled Mapping Function are defined in additional publications³ that are to be provided for each bearer technology to describe specific adaptation for that technology.

The blocks in Figure 4/T1.673.1 labeled Signaling Transport Converter are defined in T1.674-2002, which describes the general and transport specific issues relating to the signaling transport service.

7 Introduction to BICC protocol signaling procedures

7.1 Address signaling

In general, the call set-up procedure described is standard for both speech and non-speech applications using *en bloc* address signaling.

7.2 Basic procedures

The basic call control procedure is divided into three phases: call set-up, the data/conversation phase, and call clear-down. Messages on the signaling link are used to establish and terminate the different phases of a call. Standard in-band supervisory tones and/or recorded announcements are returned to the caller on appropriate connection types to provide information on call progress. Calls originating from ISDN terminals may be supplied with more detailed call progress information by means of additional messages in the access protocol supported by a range of messages in the network.

7.3 Signaling methods

Only link-by-link signaling method is used in this standard. It is primarily used for messages that need to be examined at each SN/CMN. The link-by-link method may also be used for messages of end point significance.

³ See Bibliography in Annex B/T1.673.1.

7.4 Interworking

7.4.1 BICC interworking

In call control interworking between two (BICC) protocols, the call control provides the interworking logic.

Peer-to-peer interworking takes place between two SNs/CMNs that support different implementations of the same protocol.

Interworking is realized following interpretation of the protocol information received by either SN/CMN.

For this purpose only one BICC protocol implementation may be present in an SN/CMN and peer to peer compatibility of versions can be assured, as described in clause 9.

7.4.2 Interworking with ISUP

The BICC protocol is an adaptation of the ISUP protocol definition, but it is not peer-to-peer compatible with ISUP (see Annex F of T1.673.4).

The goal is to keep the BICC and ISUP protocols as closely aligned as possible. This will avoid extensive call control interworking and provide consistency of end-to-end functionality in mixed BICC/ISUP networks. The compatibility mechanism (see clause 9) provides for independent introduction of new capabilities in either protocol.

7.4.3 Interworking with other signaling systems or user parts

The examples included in this standard are typical only and should not be used as a definitive interworking guide. Interworking between BICC and other signaling systems and user parts is a combination of the BICC-ISUP interworking according to Annex F/T1.673.4 and the relevant standards specifying the interworking between ISUP and those other signaling systems and user parts (Annexes G and H of T1.673.4).

8 Capabilities supported

Table 1/T1.673.1 lists the signaling capabilities supported by BICC for basic call. Table 2/T1.673.1 lists the generic signaling procedures, supplementary services, and some additional functions/services supported by BICC.

Table 1/T1.673.1 - Signaling capabilities for basic call

Function/service	Support
Speech/3.1 kHz audio	√
64 kbit/s unrestricted	√
Multirate connection types (Note 1)	√
N × 64 kbit/s connection types	√
<i>En bloc</i> address signaling	√
Transit network selection	√
Continuity indication	√
Forward transfer	√
Simple segmentation	√
Tones and announcements	√
Suspend and resume	√
Signaling procedures for connection type allowing fallback capability	√
Simplified echo control signaling procedures	√
Automatic repeat attempt	√
Blocking and unblocking	√
CIC group query	√
Dual seizure	√
Reset	√
Receipt of unreasonable signaling information	√
Compatibility procedure (BICC and BAT APM user application)	√
ISDN User Part signaling congestion control	Note 2
Automatic congestion control	√
Unequipped CIC	√
ISDN User Part availability control	Note 3
MTP pause and resume	Note 2
Overlength messages	√
Temporary Alternative Routing (TAR)	√
Hop counter procedure	√
Calling geodetic location procedure	√
Inter-nodal traffic group identification	√
Codec negotiation and modification procedures	√
Joint BIWF support	√
Global Call Reference procedure	√
Out of band transport of DTMF tones and information	√

√ represents support.

NOTE 1 - Multirate connection types are 2 × 64, 384, and 1 536 kbit/s.

NOTE 2 - If BICC is deployed on an MTP3 or MTP3b signaling transport service, these functions are provided by the STC sublayer as described in T1.674-2002.

NOTE 3 - If BICC is deployed on an MTP3 or MTP3b signaling transport service, an equivalent procedure is provided by the STC sublayer as described in T1.674-2002.

Table 2/T1.673.1 - Generic signaling procedures, services and functions

Function/service	Support
Generic signaling procedures	
Generic address transfer	√
Generic digit transfer	√
Notification procedure	√
Service activation	√
Remote Operations Service Element (ROSE) capability	√
Network specific facilities	√
Pre-release information transport	√
Application Transport Mechanism (APM)	√
Release to Pivot	√
Facility Request to Pivot	√
Bearer redirection	√
Supplementary services	
Normal Call Transfer (NCT)	√
Emergency Calling Services (ECS)	√
Message Waiting Indicator Control & Notification (MWICN)	√
Calling Name Identification Presentation (CNIP)	√
Calling Name Identification Restriction (CNIR)	√
Flexible Calling (FC)	√
Calling Line Identification Presentation (CLIP)	√
Calling Line Identification Restriction (CLIR)	√
Call Forwarding Busy (CFB)	√
Call Forwarding No Reply (CFNR)	√
Call Forwarding Unconditional (CFU)	√
Call Deflection (CD)	√
Explicit Call Transfer (ECT)	√
Call Waiting (CW)	√
Call HOLD (HOLD)	√
Multi-Level Precedence and Preemption (MLPP) (Note 1)	√
User-to-User Signaling (UUS)	√
Additional functions/services	
Support of Local Number Portability (LNP)	√

√ represents support.

NOTE 1 - Only transiting of MLPP information is supported.

9 Future enhancements and compatibility procedure

Requirements for additional protocol capabilities, such as the ability to support new supplementary services, will result from time to time in the need to add to or modify existing protocol elements, and thus to create a new protocol version.

In order to ensure adequate service continuity, the insertion of a new protocol version into one part of a network should be transparent to the remainder of the network. Compatible interworking between protocol versions is optimized by adhering to the following guidelines when specifying a new version:

- 1) Existing protocol elements (i.e., procedures, messages, parameters and codes) should not be changed unless a protocol error needs to be corrected or it becomes necessary to change the operation of the service that is being supported by the protocol.
- 2) The semantics of a message, a parameter, or of a field within a parameter should not be changed.
- 3) Established rules for formatting and encoding messages should not be modified.
- 4) The addition of parameters to the mandatory part of an existing message should not be allowed.
- 5) A parameter may be added to an existing message, as long as it is allocated to the optional part of the message.
- 6) The addition of new octets to an existing mandatory fixed length parameter should be avoided. If needed, a new optional parameter should be defined containing the desired set of existing and new information fields.
- 7) The sequence of fields in an existing variable length parameter should remain unchanged. New fields may be added at the end of the existing sequence of parameter fields. If a change in the sequence of parameter fields is required, a new parameter should be defined.
- 8) The all-zeros code point should be used exclusively to indicate an unallocated (spare) or insignificant value of a parameter field. This avoids an all-zeros code, sent by one protocol version as a spare value, to be interpreted as a significant value in another version.
- 9) The compatibility mechanism described in 9.1 applies to this and future versions of the BICC protocol.

Rules 1) to 8) apply, in addition to principles that allow this and future versions of the BICC protocol to directly interwork with each other, to maintain protocol and service compatibility, including end-to-end transparency. This is further outlined below.

The compatibility mechanism at a Serving Node acts as at an ISUP exchange, and thus the introduction of BICC into a network using ISUP signaling does not degrade the ability to introduce new signaling versions into the network (e.g., an ISN receiving an unrecognized ISUP parameter will handle it according to T1.113.4, subclause 2.9.5, Compatibility rules, passing it on to BICC if required).

9.1 Version compatibility

From the CS1 version of the BICC onwards, compatibility between versions will be guaranteed, in the sense that any two versions can be interconnected directly with each other, and the following requirements are fulfilled:

- i) *Protocol compatibility*: Calls between any two BICC versions do not fail for the reason of "not satisfying" protocol requirements.
- ii) *Service and functional compatibility*: This feature may be considered as compatibility typically between originating and destination SNs. Services and functions available at these SNs, but possibly not yet taken into account in the intermediate SNs/CMNs, are supported, provided they require only transparency of the intermediate SNs/CMNs. If this is not the case, a controlled call rejection or service rejection is required.
- iii) *Resource control and management compatibility*: For these functions, occurring only link-by-link, at least a backward notification is needed, if correct handling is not possible.

The compatibility mechanism is common for all BICC protocol versions from CS1 onwards. It is based on forward compatibility information associated with new signaling information.

The compatibility method eases the network operation (e.g., for the typical case of a BICC protocol mismatch during a network upgrading) to interconnect two networks on a different functional level, for networks using a different subset of the same BICC capability set, etc.

9.2 Additional coding guidelines for compatibility of BICC protocol versions

The following guidelines are mandatory.

9.2.1 Messages

All new messages -- not used by BICC CS1 (see T1.672-2000) -- use only parameters coded according to the coding rules for the parameters of the optional part of BICC messages. They always contain a Message Compatibility Information Parameter.

Messages received and not recognized will be handled as described in T1.673.4.

9.2.2 Parameters

As a general principle, mixing information for different application associations (requiring different functional entity actions) inside a new BICC parameter should be avoided, so that the behavior of cooperating nodes can be defined using the compatibility mechanism.

Unrecognized parameter handling procedures can be found in 13.4.3/T1.673.4.

9.3 Forward and Backward Compatibility for the BICC APM user application

BICC uses an APM user application to transfer signaling information. The Bearer Association Transport (BAT) APM user ASE is used to provide a transport mechanism for this information. In order to provide forward and backward compatibility within BICC, a compatibility mechanism is introduced for the information elements transferred by this mechanism. Compatible interworking between BAT ASE versions is optimized by adhering to the same guidelines when specifying a new version as outlined above for the BICC protocol.

This compatibility mechanism remains unchanged for all capability sets and/or subsets of the BICC protocol defined in this standard. It is based on compatibility information sent with all signaling information related to the BAT APM user application. Formats and codes used by this compatibility mechanism can be found in T1.673.6, and relevant procedures are described in T1.673.4.

10 Primitive Interface to the signaling transport service

The BICC protocol uses the STC layer for message transport, and thus the generic transport interface as described in T1.674-2002.

Annex A/T1.673.1
(informative)

A Guidelines for use of instruction indicators

A.1 Introduction

Instruction indicators are used to indicate to an SN/CMN receiving unrecognized information what action should be taken due to this information being unrecognized. Unrecognized information may be a message or one or more parameters within a message; unrecognized values within a parameter cause the parameter itself to be treated as unrecognized. Instruction indicators are only examined once the message or parameter has been detected as unrecognized.

A.2 Priority of execution

When processing instruction indicators, a certain order is implied by the type of actions that can be specified. The following list indicates a decreasing order of processing priority:

- –Transit at intermediate exchange indicator;
- Broadband/narrow-band interworking indicator;
- –Release call indicator;
- –Discard message, with or without notification, based on the notification indicator;
- –Discard parameter, with or without notification, based on the notification indicator; and
- –Pass on not possible indicator.

Only ISNs where interworking with B-ISUP is performed examine the broadband/narrow-band interworking indicator in place of the conventional release call, discard message, or discard parameter indicators.

A.3 Notification

The notification indicator is not strictly tied to the order of processing of the other indicators. It is recommended that notification is only required when information is discarded: this minimizes the amount of Confusion messages which may be generated along the call path for a particular piece of unrecognized information (this would not be the case if each SN passing information on, also generated Confusion messages).

The notification (Confusion message) contains a Cause indicators parameter with a Cause value indicating if the unrecognized information was a message or parameter(s); the Diagnostic field contains the message or parameter name code(s).

A.4 Considerations

A.4.1 Discarding unrecognized messages

Message Compatibility Information may indicate "*discard message*," for those messages which do not affect the basic state of the protocol, otherwise there would be a misalignment between the states of the two protocol machines. This would normally result in the release of the call due to timer expiry.

This would also be the case if an SN/CMN generates Parameter Compatibility Information indicating "*discard message*". Particular care must be taken in this case, because it becomes possible that messages such as Answer may be discarded.

A.4.2 Essential services

If a service is essential to a call and the information related to that service is unrecognized, then the call should be released.

A.4.3 Non-essential services

If the service is not essential to a call and the information related to that service is unrecognized, then the information should be discarded. A notification should be requested if an explicit indication needs to be generated when the service is not provided; this notification can then result in the explicit service rejection/notification being generated by the SN/CMN which recognizes the contents of the diagnostic field of the cause parameter contained in the confusion message (this is an SN/CMN which was capable of generating the information which is notified as being unrecognized).

A.4.4 Broadband/narrow-band interworking

Services -- such as many of the supplementary services -- are developed to operate in both the broadband and the narrow-band networks; these services should have the broadband/narrow-band interworking indicator set to "pass on."

However, some information which may relate more to the nature of the networks -- such as the broadband bearer capability -- should not be passed from the broadband to the narrow-band network; hence, the broadband/narrow-band interworking indicator should be set to "*Release call*" if the bearer service is one which cannot be supported in the narrow-band. In other cases it may be set to "*discard*" or "*pass on*" dependent on whether the ability of broadband services transiting the narrow-band is supported.

A.4.5 Pass on

Pass on allows unrecognized information to be passed through an SN/CMN that is acting as an end node.

The pass on not possible indicator must be examined when pass on has been requested, but it is not possible to pass on the information. Pass on is not possible when the protocol on the other side of the SN has a different syntax (message and parameter structure) to BICC (B-ISUP or N-ISUP), or the policing actions performed in the SN prohibit the passing of unrecognized information. When it has been determined that pass on is not possible, another action must be performed, such as release of the call or discarding of the information.

Annex B/T1.673.1
(informative)

B Bibliography

T1.TR.71-2001, *Signaling Requirements for the support of Narrowband services via Broadband transport technologies, Capability Set 1+*.²

T1.TR.63-2000, *Operation of the Bearer Independent Call Control (BICC) protocol with Digital Subscriber Signaling system No. 2 (DSS2)*.²

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Chapter T1.673.2

General Functions of Messages and Parameters

Table of Contents

1 SCOPE, PURPOSE, AND APPLICATION1

2 EXCEPTIONS TO T1.113.2.....1

American National Standard
for Telecommunications –

General Functions of Messages and Parameters

1 Scope, Purpose, and Application

This chapter describes the elements of signaling information used by the Bearer Independent Call Control (BICC) protocol and their function. The encoding of these elements, the format of the messages in which they are conveyed and their application in the BICC signaling procedures are described in Chapters T1.673.3 and T1.673.4. This chapter is written as a delta to T1.113.2-2000. Refer to T1.673.3 for the applicability of ISUP messages and parameters to the BICC protocol.

2 Exceptions to T1.113.2

General note: in the descriptions of messages and parameters, replace “circuit” with “CIC value.”

1. *Continuity message* (replace T1.113.2, subclause 1.14 with): A message sent in the forward direction indicating that the establishment of the bearer is complete up to and including the SN sending the COT message.
2. *Continuity Indicators parameter* (replace T1.113.2, subclause 2.36A with): Information sent in the forward direction indicating that the establishment of the bearer is complete up to and including the SN sending the COT message.
3. *Hop Counter parameter*, T1.113.2, subclause 2.43E. Replace “ISUP interexchange circuits” with “call control associations”.
4. *Call Instance Code*: Information identifying the instance of call control signaling.
5. *Continuity indicator* (replace T1.113.2, subclause 2.35 with): Information sent in the forward direction indicating whether or not a continuity message is to be expected.
6. *Global Call Reference*: Information sent in the forward direction to uniquely identify a call and correlate activities associated with that call.
7. *Inter-Nodal Traffic Group Identifier*: Information sent in the forward direction identifying to which logical traffic group the call belongs. This identifier is of significance only between two adjacent nodes.
8. *Outgoing Trunk Group Number* (replace T1.113.2, subclause 2.58c with): Information sent in the backward direction to represent the internodal traffic group used to complete an outgoing call from the gateway SN/CMN originating an Exit message. This information has the same format as the outgoing trunk group number defined in T1.113.

Chapter T1.673.3

Formats and Codes

Table of Contents

1	SCOPE, PURPOSE AND APPLICATION	1
2	EXCEPTIONS TO T1.113.3.....	1
2.1	MESSAGE FORMAT	1
2.2	CIC ALLOCATION	1
2.3	MESSAGES.....	1
2.3.1	MESSAGE EXCEPTIONS	1
2.3.2	MESSAGE RENAMING	2
2.4	PARAMETERS AND PARAMETER CODINGS	2
2.4.1	PARAMETER EXCEPTIONS.....	2
2.4.2	PARAMETER RENAMING.....	2
2.4.3	PARAMETER CODING	3
2.5	ADDITIONAL PARAMETERS	4
2.5.1	GLOBAL CALL REFERENCE.....	4
2.5.2	INTER-NODAL TRAFFIC GROUP IDENTIFIER	5

Table of Figures

FIGURE 1/T1.673.3 - CIC FIELD	1
FIGURE 2/T1.673.3 - GLOBAL CALL REFERENCE	4
FIGURE 3/T1.673.3 - INTER-NODAL TRAFFIC GROUP IDENTIFIER	5

Table of Tables

TABLE 1/T1.673.3 - RENAMED MESSAGES	2
TABLE 2/T1.673.3 - RENAMED PARAMETERS.....	3

American National Standard
for Telecommunications –

Formats and Codes

1 Scope, Purpose and Application

This chapter is written as a delta to T1.113.3-2000.

2 Exceptions to T1.113.3

2.1 Message format

The format of the message at the BICC to STC interface is according to T1.113.3 with the following exceptions:

1. The Routing Label, as in Figure 1/T1.113.3 and Figure 3/T1.113.3, is not passed from BICC to STC.
2. The Circuit Identification Code format in Figure 2/T1.113.3 is modified, as shown in Figure 1/T1.673.3. The Call Instance Code (CIC) in the BICC protocol is used to identify a signaling relation between peer BICC entities, and associate all the Protocol Data Units to that relation.

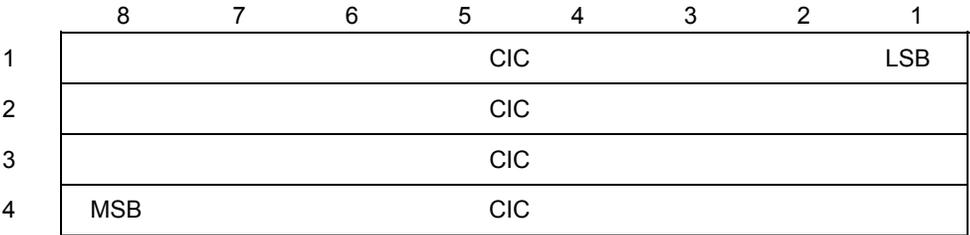


Figure 1/T1.673.3 - CIC field

2.2 CIC allocation

Bilateral agreement is required with regard to the CIC values provisioned.

NOTE - The number of CICs provisioned between a pair of adjacent nodes represents the number of concurrent calls that can exist between those two nodes.

2.3 Messages

2.3.1 Message exceptions

The messages defined in Table 3/T1.113.3 and Table 3A/T1.113.3 are used with the following exceptions:

1. Blocking message is not used.
2. Blocking Acknowledgement message is not used.

3. Circuit Validation Response message is not used.
4. Circuit Validation Test message is not used.
5. Continuity Check Request message is not used.
6. Loop Back Acknowledgement message is not used.
7. Overload message is not used.
8. Pass Along message is not used.
9. Unblocking message is not used
10. Unblocking Acknowledgement message is not used.
11. User Part Available message is not used.
12. User Part Test message is not used.

2.3.2 Message renaming

The following ISUP messages are renamed in BICC as shown. Their codepoints are the same as in T1.113.3.

Table 1/T1.673.3 - Renamed Messages

ISUP message	BICC message
Circuit Group (Un)Blocking (Ack)	CIC Group (Un)Blocking (Ack)
Circuit Group Reset (Ack)	CIC Group Reset (Ack)
Circuit Query	CIC Query
Circuit Reservation	CIC Reservation
Circuit Reservation Ack	CIC Reservation Ack
Circuit Response	CIC Response
Reset Circuit	Reset CIC
Unequipped Circuit Identification Code	Unequipped CIC

2.4 Parameters and parameter codings

2.4.1 Parameter exceptions

T1.113.3 parameter definitions apply with the following exceptions:

1. *Call Reference parameter*, T1.113.3 subclause 3.5, is used in BICC only in MTP3 and MTP3b based signaling networks.
2. *Circuit Assignment Map parameter*, T1.113.3 subclause 3.10B, is not used.
3. *Circuit Group Characteristics Indicator parameter*, T1.113.3 subclause 3.10A, is not used.
4. *Circuit Identification Name parameter*, T1.113.3 subclause 3.11A, is not used.
5. *Circuit Validation Response Indicator parameter*, T1.113.3 subclause 3.11C, is not used.
6. *Common Language Location Identification (CLLI) Code parameter*, T1.113.3 subclause 3.13A, is not used.
7. *Connection Request parameter*, T1.113.3 subclause 3.15, is not used.
8. *Signaling Point Code parameter*, T1.113.3 subclause 3.30 is not used.

2.4.2 Parameter renaming

The following parameters are renamed in BICC as shown. Their codepoints are the same as in T1.113.3.

Table 2/T1.673.3 - Renamed Parameters

ISUP parameter	BICC parameter
Circuit Group Supervision Message Type	CIC Group Supervision Message Type
Circuit State Indicator	CIC State Indicator

2.4.3 Parameter coding

T1.113.3 parameter field names and codes apply with the following exceptions:

1. *Backward Call Indicators* (T1.113.3, clause 3.3)

bits HG: End-to-end method indicator
 0 0 no end-to-end method available
 0 1 reserved in BICC
 1 0 reserved in BICC
 1 1 reserved in BICC

bits PO: SCCP method indicator
 0 0 no indication (default)
 0 1 reserved in BICC
 1 0 reserved in BICC
 1 1 reserved in BICC

2. *CIC Group Supervision Message Type* (T1.113.3, clause 3.11)

bits BA: CIC group blocking type indicator
 0 1 reserved in BICC

3. *Continuity Indicators* (T1.113.3, clause 3.16)

bit A: Continuity indicator
 0 reserved in BICC
 1 Continuity

4. *Forward Call Indicators* (T1.113.3, clause 3.20)

bits CB: End-to-end method indicator (note)
 0 0 no end-to-end method available
 0 1 reserved in BICC
 1 0 reserved in BICC
 1 1 reserved in BICC

bits KJ: SCCP method indicator
 0 0 no indication
 0 1 reserved in BICC
 1 0 reserved in BICC
 1 1 reserved in BICC

5. *Hop Counter* (T1.113.3, clause 3.20): The hop counter subfield contains the binary representation of the number of contiguous call control associations that are allowed to complete the call.

6. *Nature of Connection Indicators* (T1.113.3, clause 3.24):

bits	DC:	Continuity indicator
	0 0	no COT to be expected
	0 1	Reserved in BICC
	1 0	COT to be expected
	1 1	spare

7. *Range and Status parameter* (T1.113.3, clause 3.27): The range is extended to 255. The number of status bits is extended to 256, numbered 0 to 255. As a consequence, the maximum length of the parameter is extended to 34 octets in Tables 20/T1.113.3 and 21/T1.113.3.

2.5 Additional parameters

2.5.1 Global Call Reference

Parameter Name Code: 1010 0100

The format of the global call reference parameter field is shown in Figure 2/T1.673.3.

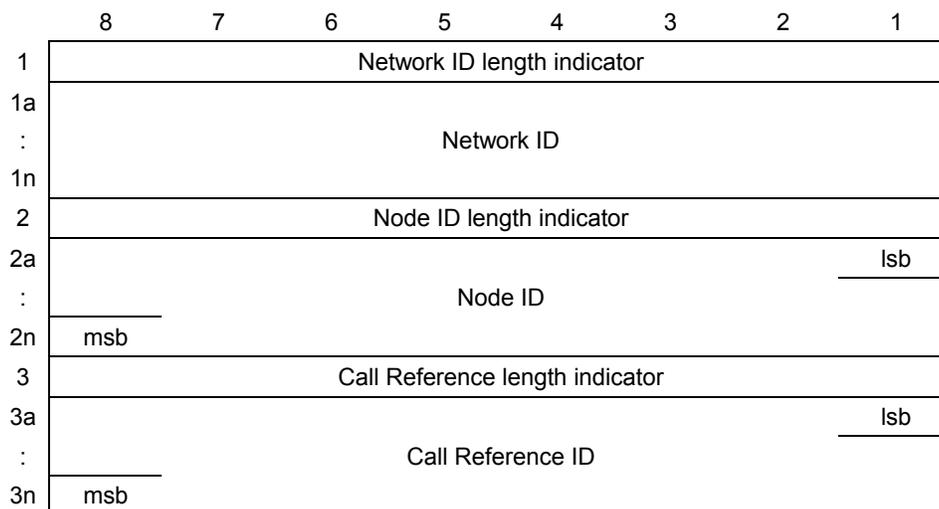


Figure 2/T1.673.3 - Global Call Reference

The following codes are used in the subfields of the global call reference parameter field:

1. *Network ID*: The Network ID contains the value field (coded according to ASN.1 BER) of an object identifier identifying the network. This means that the tag and length fields are omitted. An example of such an object identifier can be the following:

{itu-t (0) administration (2) national regulatory authority (x) network (y)}

The value for x is the value of the national regulatory authority (one of the Data Country Codes associated to the country as specified in ITU-T Recommendation X.121 shall be used for "national regulatory authority), the value for y is under the control of the national regulatory authority concerned.

2. *Node ID*: A binary number that uniquely identifies within the network the node which generates the call reference.
3. *Call Reference ID*: A binary number used for the call reference of the call. This is generated by the node for each call.

The Global Call Reference parameter is added to Table 14/T1.113.3 (IAM) for the purpose of BICC.

2 5.2 Inter-Nodal Traffic Group Identifier

Parameter Name Code: 1010 0011

The format of the Traffic Group Identifier parameter field is shown in Figure 3/T1.673.3.

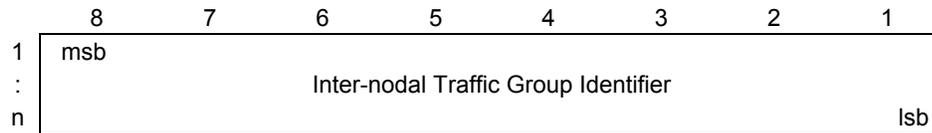


Figure 3/T1.673.3 - Inter-Nodal Traffic Group Identifier

The Inter-nodal Traffic Group Identifier carries a binary value representing the traffic group for the call.

The Inter-nodal Traffic Group Identifier parameter is added to Table 14/T1.113.3 (IAM) for the purpose of BICC.

Chapter T1.673.4

Bearer Independent Call Control Protocol CS1+ -- Signaling Procedures

Table of Contents

1	SCOPE, PURPOSE AND APPLICATION	1
2	NORMATIVE REFERENCES	1
3	DEFINITIONS	1
4	ABBREVIATIONS & ACRONYMS	1
5	CONVENTIONS.....	3
6	GENERAL.....	3
6.1	INTRODUCTION TO DOCUMENT STRUCTURE	3
6.2	MESSAGES, PARAMETERS AND INFORMATION ELEMENTS	3
6.3	USE OF APPLICATION TRANSPORT MECHANISM.....	4
6.3.1	INTRODUCTION.....	4
6.3.2	APPLICATION TRANSPORT INSTRUCTION INDICATORS.....	4
6.3.3	HANDLING OF ADDRESSING INFORMATION	4
6.3.4	BAT ASE AT A CMN	5
6.4	BEARER CONTROL TUNNELING	5
6.4.1	BEARER CONTROL TUNNELING PROCEDURE	5
7	SUCCESSFUL BASIC CALL SET-UP	5
7.1	INTRODUCTION.....	5
7.2	FORWARD ADDRESS SIGNALING – <i>EN BLOC</i> OPERATION	6
7.2.1	ACTIONS REQUIRED AT THE ORIGINATING SN	6
7.2.1.1	OUTGOING SELECTION.....	6
7.2.1.2	OUTGOING SIGNALING PROCEDURE	7
7.2.1.2.1	INITIAL ADDRESS MESSAGE.....	7
7.2.1.2.2	INTERNAL THROUGH CONNECTION OF THE BEARER PATH.....	8
7.2.1.2.3	NETWORK PROTECTION TIMER	9
7.2.2	ACTIONS REQUIRED AT AN INTERMEDIATE SN.....	9
7.2.2.1	COMMON PROCEDURES	9
7.2.2.1.1	INCOMING SIGNALING PROCEDURE AND OUTGOING SELECTION	9
7.2.2.1.2	OUTGOING SIGNALING PROCEDURE	9
7.2.2.1.2.1	INITIAL ADDRESS MESSAGE.....	9
7.2.2.1.2.2	INTERNAL THROUGH CONNECTION OF THE BEARER PATH.....	10
7.2.2.2	ACTIONS REQUIRED AT AN INTERMEDIATE NATIONAL SN.....	11
7.2.2.3	ACTIONS REQUIRED AT AN INTERMEDIATE INTERNATIONAL SN.....	11
7.2.3	ACTIONS REQUIRED AT AN INTERMEDIATE CMN	11
7.2.3.1	COMMON PROCEDURES	11
7.2.3.1.1	INCOMING SIGNALING PROCEDURE AND OUTGOING SELECTION	11
7.2.3.1.2	OUTGOING SIGNALING PROCEDURE	11
7.2.3.1.2.1	INITIAL ADDRESS MESSAGE.....	11
7.2.3.2	ACTIONS REQUIRED AT AN INTERMEDIATE NATIONAL CMN.....	12
7.2.3.3	ACTIONS REQUIRED AT AN INTERMEDIATE INTERNATIONAL CMN	12
7.2.4	ACTIONS REQUIRED AT AN OUTGOING GATEWAY SN	12
7.2.4.1	COMMON PROCEDURES	12
7.2.4.1.1	INCOMING SIGNALING PROCEDURE AND OUTGOING SELECTION	12
7.2.4.1.2	OUTGOING SIGNALING PROCEDURE	12
7.2.4.1.2.1	INITIAL ADDRESS MESSAGE.....	12
7.2.4.1.2.2	INTERNAL THROUGH CONNECTION OF THE BEARER PATH.....	13
7.2.4.1.2.3	NETWORK PROTECTION TIMER	13
7.2.4.2	ACTIONS REQUIRED AT AN OUTGOING NATIONAL GATEWAY SN.....	13
7.2.4.3	ACTIONS REQUIRED AT AN OUTGOING INTERNATIONAL GATEWAY SN	14
7.2.5	ACTIONS REQUIRED AT AN OUTGOING GATEWAY CMN	14
7.2.5.1	COMMON PROCEDURES	14

7.2.5.1.1	INCOMING SIGNALING PROCEDURE AND OUTGOING SELECTION	14
7.2.5.1.2	OUTGOING SIGNALING PROCEDURE	14
7.2.5.1.2.1	INITIAL ADDRESS MESSAGE.....	14
7.2.5.2	ACTIONS REQUIRED AT AN OUTGOING NATIONAL GATEWAY CMN.....	14
7.2.5.3	ACTIONS REQUIRED AT AN OUTGOING INTERNATIONAL GATEWAY CMN	14
7.2.6	ACTIONS REQUIRED AT AN INCOMING GATEWAY SN	15
7.2.6.1	COMMON PROCEDURES	15
7.2.6.1.1	INCOMING SIGNALING PROCEDURE AND OUTGOING SELECTION	15
7.2.6.1.2	OUTGOING SIGNALING PROCEDURE	15
7.2.6.1.2.1	INITIAL ADDRESS MESSAGE.....	15
7.2.6.1.2.2	INTERNAL THROUGH CONNECTION OF THE BEARER PATH.....	16
7.2.6.1.2.3	NETWORK PROTECTION TIMER.....	16
7.2.6.2	ACTIONS REQUIRED AT AN INCOMING NATIONAL GATEWAY SN.....	16
7.2.6.3	ACTIONS REQUIRED AT AN INCOMING INTERNATIONAL GATEWAY SN	16
7.2.7	ACTIONS REQUIRED AT AN INCOMING GATEWAY CMN	16
7.2.7.1	COMMON PROCEDURES	16
7.2.7.1.1	INCOMING SIGNALING PROCEDURE AND OUTGOING SELECTION	16
7.2.7.1.2	OUTGOING SIGNALING PROCEDURE	17
7.2.7.1.2.1	INITIAL ADDRESS MESSAGE.....	17
7.2.7.2	ACTIONS REQUIRED AT AN INCOMING NATIONAL GATEWAY CMN	17
7.2.7.3	ACTIONS REQUIRED AT AN INCOMING INTERNATIONAL GATEWAY CMN	17
7.2.8	ACTIONS REQUIRED AT THE DESTINATION SN.....	17
7.2.9	CALLED PARTY NUMBER FOR OPERATOR CALLS	18
7.2.10	CALLED NUMBER FOR CALLS TO TESTING AND MEASURING DEVICES	18
7.3	FORWARD ADDRESS SIGNALING - <i>OVERLAP</i> OPERATION.....	18
7.4	OUTGOING BEARER SET-UP PROCEDURE	18
7.4.1	PER-CALL BEARER SET-UP IN FORWARD DIRECTION	20
7.4.2	PER-CALL BEARER SET-UP IN BACKWARD DIRECTION.....	21
7.4.3	PER-CALL BEARER SET-UP USING BEARER CONTROL TUNNELING -- FAST SET-UP.....	21
7.4.4	PER-CALL BEARER SET-UP USING BEARER CONTROL TUNNELING -- DELAYED FORWARD	22
7.4.5	PER-CALL BEARER SET-UP USING BEARER CONTROL TUNNELING -- DELAYED BACKWARD	23
7.5	INCOMING BEARER SET-UP PROCEDURE.....	23
7.5.1	PER-CALL BEARER SET-UP IN FORWARD DIRECTION	23
7.5.2	PER-CALL BEARER SET-UP IN BACKWARD DIRECTION.....	25
7.5.3	PER-CALL BEARER SET-UP USING BEARER CONTROL TUNNELING -- FAST SET-UP.....	25
7.5.4	PER-CALL BEARER SET-UP USING BEARER CONTROL TUNNELING -- DELAYED FORWARD	26
7.5.5	PER-CALL BEARER SET-UP USING BEARER CONTROL TUNNELING -- DELAYED BACKWARD	27
7.6	CONTINUITY MESSAGE	27
7.6.1	ACTIONS REQUIRED AT THE ORIGINATING SN	27
7.6.2	ACTIONS REQUIRED AT AN INTERMEDIATE SN.....	28
7.6.2.1	OUTGOING SIGNALING PROCEDURE.....	28
7.6.2.2	INCOMING SIGNALING PROCEDURE	28
7.6.3	ACTIONS REQUIRED AT A CMN.....	28
7.6.4	ACTIONS REQUIRED AT THE DESTINATION SN.....	28
7.6.4.1	INCOMING SIGNALING PROCEDURE	28
7.7	ADDRESS COMPLETE MESSAGE	29
7.7.1	ACTIONS REQUIRED AT THE DESTINATION SN.....	29
7.7.2	ACTIONS REQUIRED AT AN INTERMEDIATE SN/CMN	29
7.7.2.1	COMMON PROCEDURES	29
7.7.2.2	ACTIONS REQUIRED AT AN INTERMEDIATE NATIONAL SN/CMN.....	30
7.7.2.3	ACTIONS REQUIRED AT AN INTERMEDIATE INTERNATIONAL SN/CMN	30
7.7.3	ACTIONS REQUIRED AT AN OUTGOING GATEWAY SN/CMN	30
7.7.4	ACTIONS REQUIRED AT AN INCOMING GATEWAY SN/CMN	30
7.7.5	ACTIONS REQUIRED AT THE ORIGINATING SN	30
7.7.6	INTERNAL THROUGH-CONNECTION OF THE BEARER PATH AND AWAITING ANSWER INDICATION AT THE DESTINATION SN	31
7.8	ANSWER MESSAGE.....	31
7.8.1	ACTIONS REQUIRED AT THE DESTINATION SN.....	31
7.8.2	ACTIONS REQUIRED AT AN INTERMEDIATE SN/CMN	31
7.8.2.1	COMMON PROCEDURES	31
7.8.2.2	ACTIONS REQUIRED AT AN INTERMEDIATE NATIONAL SN/CMN.....	32
7.8.2.3	ACTIONS REQUIRED AT AN INTERMEDIATE INTERNATIONAL SN/CMN	32

7.8.3	ACTIONS REQUIRED AT AN OUTGOING GATEWAY SN/CMN	32
7.8.4	ACTIONS REQUIRED AT AN INCOMING GATEWAY SN/CMN	32
7.8.5	ACTIONS REQUIRED AT THE ORIGINATING SN	32
7.8.6	RETURN OF ANSWER FROM AUTOMATIC TERMINALS.....	32
7.9	ACCESS TRANSPORT PARAMETER	32
7.10	STORAGE AND RELEASE OF INITIAL ADDRESS MESSAGE INFORMATION	33
8	ADDITIONAL SET-UP PROCEDURES.....	33
8.1	INTRODUCTION.....	33
8.2	CALL PROGRESS	33
8.2.1	ACTIONS REQUIRED AT THE DESTINATION SN	34
8.2.2	ACTIONS REQUIRED AT AN INTERMEDIATE SN/CMN	34
8.2.3	ACTIONS REQUIRED AT THE ORIGINATING SN	34
8.3	CODEC NEGOTIATION	34
8.3.1	SN INITIATING CODEC NEGOTIATION.....	35
8.3.2	SN TRANSITING CODEC NEGOTIATION.....	35
8.3.3	SN TERMINATING CODEC NEGOTIATION	36
8.3.4	OUTGOING BEARER SET-UP PROCEDURE	36
8.3.4.1	PER-CALL BEARER SET-UP IN FORWARD DIRECTION	36
8.3.4.2	PER-CALL BEARER SET-UP IN BACKWARD DIRECTION.....	36
8.3.5	INCOMING BEARER SET-UP PROCEDURE.....	37
8.3.5.1	PER-CALL BEARER SET-UP IN FORWARD DIRECTION	37
8.3.5.2	PER-CALL BEARER SET-UP IN BACKWARD DIRECTION.....	37
8.3.6	ABNORMAL CASES.....	38
8.3.6.1	CODEC UNAVAILABILITY	38
8.3.6.2	SN INITIATING CODEC NEGOTIATION.....	38
8.3.6.3	CODEC NEGOTIATION IN A SN TRANSITING CODEC NEGOTIATION	38
8.4	ECHO CONTROL.....	38
8.4.1	GENERAL	38
8.4.2	PROCEDURES	39
8.4.2.1	FORWARD DIRECTION	39
8.4.2.1.1	ACTIONS AT THE ORIGINATING SN.....	39
8.4.2.1.2	ACTIONS AT AN INTERMEDIATE SN	39
8.4.2.1.3	ACTIONS AT THE DESTINATION SN	40
8.4.2.2	BACKWARD DIRECTION	40
8.4.2.2.1	ACTIONS AT THE DESTINATION SN	40
8.4.2.2.2	ACTIONS AT AN INTERMEDIATE SN	40
8.4.2.2.3	ACTIONS AT THE ORIGINATING SN.....	41
8.5	PROPAGATION DELAY PROCEDURE.....	41
8.6	SIGNALING PROCEDURES FOR CONNECTION TYPE ALLOWING FALLBACK	41
8.6.1	ACTIONS IN THE FORWARD DIRECTION	41
8.6.1.1	ACTIONS AT THE ORIGINATING SN.....	41
8.6.1.2	ACTIONS AT AN INTERMEDIATE SN/CMN.....	42
8.6.1.2.1	SUCCEEDING NETWORK DOES HAVE THE CAPABILITY OF PERFORMING FALLBACK.....	42
8.6.1.2.2	SUCCEEDING NETWORK DOES NOT HAVE THE CAPABILITY OF PERFORMING FALLBACK.....	42
8.6.1.3	ACTIONS AT THE DESTINATION SN	42
8.6.2	ACTIONS IN THE BACKWARD DIRECTION – FALLBACK INDICATED BEFORE ANSWER	42
8.6.2.1	ACTIONS AT THE DESTINATION SN	42
8.6.2.2	ACTIONS AT AN INTERMEDIATE SN/CMN	42
8.6.2.2.1	SUCCEEDING NETWORK DOES HAVE THE CAPABILITY OF PERFORMING FALLBACK.....	42
8.6.2.2.2	SUCCEEDING NETWORK DOES NOT HAVE THE CAPABILITY OF PERFORMING FALLBACK.....	43
8.6.2.3	ACTIONS AT THE ORIGINATING SN.....	43
8.6.3	ACTIONS IN THE BACKWARD DIRECTION – FALLBACK INDICATED AT ANSWER	43
8.6.3.1	ACTIONS AT THE DESTINATION SN	43
8.6.3.2	ACTIONS AT AN INTERMEDIATE SN/CMN	43
8.6.3.3	ACTIONS AT THE ORIGINATING SN.....	43
8.6.4	ACTIONS IN THE BACKWARD DIRECTION – FALLBACK DOES NOT OCCUR	43
8.6.5	ECHO CONTROL FOR CONNECTION TYPES ALLOWING FALLBACK.....	44
8.6.6	COMPLETION OF THE INTERNAL BEARER PATH	44
8.7	TRANSIT NETWORK SELECTION	44
8.8	SUPPORT FOR TEMPORARY ALTERNATIVE ROUTING (TAR).....	44
8.9	HOP COUNTER PROCEDURE	44

8.9.1	ACTIONS AT THE ORIGINATING SN.....	44
8.9.2	ACTIONS AT AN INTERMEDIATE SN/CMN (INCLUDES FORWARDING SN/CMN).....	45
8.9.3	ACTIONS AT THE DESTINATION SN	46
8.10	CHARGE INFORMATION	46
8.11	ACCESS DELIVERY INDICATION.....	46
8.12	INFORMATION MESSAGES.....	47
8.12.1	REQUESTING INFORMATION	47
8.12.2	SENDING SOLICITED INFORMATION	47
8.12.3	RECEIVING A SOLICITED INFORMATION MESSAGE	47
8.13	CALL COLLECT REQUEST PROCEDURE	47
8.14	CALLING PARTY NUMBER.....	47
8.15	CALLING GEODETIC LOCATION PROCEDURE	48
8.15.1	INTRODUCTION.....	48
8.15.2	TRANSFER OF GEODETIC INFORMATION.....	48
8.16	INTER-NODAL TRAFFIC GROUP IDENTIFICATION	48
8.16.1	SENDING INTER-NODAL TRAFFIC GROUP IDENTIFICATION	48
8.16.2	RECEIVING INTER-NODAL TRAFFIC GROUP IDENTIFICATION.....	48
8.17	CARRIER SELECTION INFORMATION	49
8.18	GLOBAL CALL REFERENCE.....	49
8.19	BEARER CONTROL UNIT IDENTIFIER (BCU-ID)	49
8.19.1	GENERAL	49
8.19.2	ACTIONS AT A SN.....	49
8.19.3	ACTIONS AT A CMN	50
8.19.4	SELECTION OF BCU-ID	50
8.19.5	FORWARD/BACKWARD BEARER ESTABLISHMENT	51
8.19.5.1	BCU-ID SENDING NODE	51
8.19.5.1.1	FORWARD DIRECTION	51
8.19.5.1.2	BACKWARD DIRECTION	51
8.19.5.2	BCU-ID RECEIVING NODE.....	51
8.20	OUT OF BAND TRANSPORT OF DTMF AND TONE INFORMATION	51
8.20.1	INTRODUCTION.....	51
8.20.2	PROCEDURES	51
8.20.2.1	NO SIGNAL INSERTION IN BEARER	51
8.20.2.2	SIGNAL INSERTION IN BEARER	52
8.A	EXIT MESSAGE.....	53
8.A.1	ACTIONS AT A SENDING GATEWAY SN/CMN	53
8.A.2	ACTIONS AT AN INTERMEDIATE SN/CMN	53
8.A.3	ACTIONS AT AN ORIGINATING SN OR RECEIVING GATEWAY SN/CMN	53
8.B	CARRIER IDENTIFICATION	53
8.C	JURISDICTION INFORMATION	53
8.D	EGRESS SERVICE	54
8.E	TRANSFER OF NETWORK SIGNALING INFORMATION.....	54
8.E.1	ACTIONS BY THE CSF AT AN SN WHICH INITIATES A MESSAGE WITH A NETWORK TRANSPORT PARAMETER	54
8.E.2	ACTIONS AT THE INTERMEDIATE AND GATEWAY SN/CMN	54
8.E.3	ACTIONS AT THE SN WHICH TERMINATES A MESSAGE WITH A NETWORK TRANSPORT PARAMETER.....	54
9	UNSUCCESSFUL CALL SET-UP	54
9.1	INTRODUCTION.....	54
9.2	ACTIONS AT A CSF INITIATING A RELEASE MESSAGE	55
9.3	ACTIONS AT AN INTERMEDIATE SN/CMN	55
9.4	ACTIONS AT THE CONTROLLING SN/CMN (I.E., THE SN/CMN CONTROLLING THE CALL)	56
9.4.1	ACTIONS AT A CONTROLLING SN.....	56
9.4.2	ACTIONS AT A CONTROLLING CMN	56
9.5	TONES AND ANNOUNCEMENTS	56
9.5.1	TONES AND ANNOUNCEMENTS AT AN SN	56
9.5.2	TONES AND ANNOUNCEMENTS AT A CMN	57
9.6	ADDRESS INCOMPLETE	57
9.A	NUMBER PORTABILITY.....	57
10	MID-CALL PROCEDURES.....	58
10.1	INTRODUCTION.....	58
10.2	SUSPEND AND RESUME	58

10.2.1	SUSPEND	58
10.2.2	RESUME.....	58
10.2.3	EXPIRATION OF TIMER T6.....	59
10.3	FORWARD TRANSFER MESSAGE	59
10.4	CODEC MODIFICATION/MID-CALL CODEC NEGOTIATION PROCEDURES	59
10.4.1	SN INITIATING CODEC MODIFICATION	60
10.4.2	SN TERMINATING CODEC MODIFICATION	61
10.4.3	SN TRANSITING CODEC MODIFICATION	62
10.4.4	SN INITIATING MID-CALL CODEC NEGOTIATION	64
10.4.5	SN TERMINATING MID-CALL CODEC NEGOTIATION	65
10.4.6	SN TRANSITING MID-CALL CODEC NEGOTIATION.....	66
10.4.7	ABNORMAL CODEC MODIFICATION/MID-CALL CODEC NEGOTIATION CASES	68
10.4.7.1	FAILED MODIFICATION/MID-CALL CODEC NEGOTIATION	68
10.4.7.2	EXPIRY OF CODEC MODIFICATION TIMER (T42)	68
10.4.7.3	EXPIRY OF MID-CALL CODEC NEGOTIATION TIMER (T43)	68
10.4.7.4	PROCEDURE INCOMPATIBILITY	69
10.4.7.5	COLLISION OF CODEC MODIFICATION/MID-CALL CODEC NEGOTIATION PROCEDURES	69
11	NORMAL CALL RELEASE	69
11.1	INTRODUCTION.....	69
11.2	RELEASE INITIATED BY A CALLING PARTY.....	69
11.3	RELEASE INITIATED BY A CALLED PARTY.....	70
11.4	RELEASE INITIATED BY THE NETWORK.....	70
11.5	RELEASE SENDING PROCEDURE.....	70
11.6	RELEASE RECEPTION PROCEDURE	71
11.7	COLLISION OF RELEASE MESSAGES	71
11.8	CHARGING.....	71
12	NETWORK FEATURES	72
12.1	INTRODUCTION.....	72
12.2	SIMPLE SEGMENTATION	72
12.3	PRE-RELEASE INFORMATION TRANSPORT.....	73
12.4	AUTOMATIC REPEAT ATTEMPT.....	73
12.5	BLOCKING AND UNBLOCKING OF CIC VALUES.....	74
12.5.1	INTRODUCTION.....	74
12.5.2	CIC GROUP BLOCKING PROCEDURES	74
12.5.3	INTERACTIONS BETWEEN CIC BLOCKING AND CALL SET-UP PROCEDURES	75
12.5.4	ABNORMAL CIC GROUP BLOCKING PROCEDURES	75
12.6	CIC QUERY	77
12.6.1	GENERAL	77
12.6.2	INTERPRETATION OF CIC STATES	77
12.6.3	AUDITING PROCEDURE.....	78
12.6.3.1	ERROR IN CALL-PROCESSING STATES.....	78
12.6.3.2	ERROR IN MAINTENANCE STATES	79
12.7	SUPPORT FOR HARD TO REACH NETWORK MANAGEMENT FUNCTIONS	85
12.8	AUTOMATIC CONGESTION CONTROL	85
12.8.1	RECEIPT OF A RELEASE MESSAGE CONTAINING AN AUTOMATIC CONGESTION LEVEL PARAMETER	85
12.8.2	ACTIONS TAKEN DURING OVERLOAD	85
12.9	SIGNALING TRANSPORT OUT-OF-SERVICE AND IN-SERVICE INDICATIONS	86
12.10	SIGNALING TRANSPORT CONGESTION INDICATIONS	86
13	ABNORMAL CONDITIONS	86
13.1	INTRODUCTION.....	86
13.2	DUAL SEIZURE	86
13.2.1	UNGUARDED INTERVAL	87
13.2.2	DETECTION OF DUAL SEIZURE.....	87
13.2.3	PREVENTIVE ACTION.....	87
13.2.4	ACTION TO BE TAKEN ON DETECTION OF DUAL SEIZURES.....	87
13.3	RESET OF CICs.....	88
13.3.1	RESET CIC PROCEDURE.....	88
13.3.2	GROUP RESET PROCEDURE.....	89

13.3.3	ABNORMAL GROUP RESET PROCEDURES.....	90
13.4	RECEIPT OF UNREASONABLE SIGNALING INFORMATION	90
13.4.1	HANDLING OF MESSAGE FORMAT ERRORS.....	90
13.4.2	HANDLING OF UNEXPECTED MESSAGES	91
13.4.3	GENERAL REQUIREMENTS ON RECEIPT OF UNRECOGNIZED MESSAGES AND PARAMETERS	92
13.4.4	PROCEDURES FOR THE HANDLING OF THE UNRECOGNIZED MESSAGES OR PARAMETERS	96
13.4.4.1	UNRECOGNIZED MESSAGES.....	96
13.4.4.2	UNRECOGNIZED PARAMETERS	97
13.4.4.3	UNRECOGNIZED PARAMETER VALUES	99
13.4.5	PROCEDURES FOR THE HANDLING OF RESPONSES INDICATING UNRECOGNIZED INFORMATION HAS BEEN SENT.....	99
13.4.5.1	TYPE A CSFs	99
13.4.5.2	TYPE B CSFs	100
13.4.6	PROCEDURES FOR HANDLING UNREASONABLE PARAMETERS.....	101
13.4.7	HANDLING OF THE BICC_ERROR INDICATION PRIMITIVE.....	101
13.4.8	COMPATIBILITY FOR THE BICC APM USER APPLICATION	101
13.4.8.1	GENERAL REQUIREMENTS ON RECEIPT OF UNRECOGNIZED INFORMATION ELEMENTS	101
13.4.8.2	PROCEDURES FOR THE HANDLING OF UNRECOGNIZED INFORMATION ELEMENTS	103
13.4.8.2.1	UNRECOGNIZED INFORMATION ELEMENTS	103
13.4.8.2.2	UNRECOGNIZED FIELDS.....	104
13.4.8.3	PROCEDURES FOR THE HANDLING OF A RESPONSE INDICATING UNRECOGNIZED INFORMATION HAS BEEN SENT.....	104
13.4.8.4	HANDLING OF UNEXPECTED VALUES	104
13.5	UNEQUIPPED CIC MESSAGE	105
13.6	OVERLENGTH MESSAGES	105
13.7	TIMER EXPIRIES	106
13.7.1	FAILURE IN THE RESET CIC PROCEDURE.....	106
13.7.2	FAILURE IN THE GROUP RESET PROCEDURE	106
13.7.3	FAILURE IN THE BLOCKING/UNBLOCKING SEQUENCE	106
13.7.4	FAILURE TO RECEIVE A RELEASE COMPLETE MESSAGE – TIMER T1 AND T5	106
13.7.5	FAILURE TO RECEIVE A RESPONSE TO AN INFORMATION REQUEST MESSAGE	107
13A	GENERIC SIGNALING PROCEDURES AND SUPPORT OF ISDN SUPPLEMENTARY SERVICES.....	107
13A.1	SOLICITING INFORMATION.....	107
13A.2	SPECIAL PROCESSING REQUEST	107
13A.2.1	ACTIONS REQUIRED AT THE INITIATING CSF	107
13A.2.2	ACTIONS REQUIRED AT AN INTERMEDIATE CSF	107
13A.2.3	ACTIONS REQUIRED AT THE SPECIAL PROCESSING CSF	107
13A.2.4	ABNORMAL CONDITIONS.....	108
13A.3	TRANSFER OF SUPPLEMENTARY SERVICES NOTIFICATION INFORMATION	108
13A.3.1	ACTIONS AT THE CSF WHICH INITIATES MESSAGES WITH NOTIFICATION INFORMATION	108
13A.3.2	ACTIONS AT AN INTERMEDIATE OR GATEWAY CSF	108
13A.3.3	ACTIONS AT THE CSF WHICH TERMINATES MESSAGES WITH NOTIFICATION INFORMATION.....	108
13A.4	ACM TO CPG MAPPING	108
13A.5	GENERIC DIGIT TRANSFER.....	109
13A.6	USER NETWORK INTERACTION	109
13A.6.1	ACTIONS AT A CONTROLLING SN.....	109
13A.6.2	ACTION AT AN INTERMEDIATE OR GATEWAY SN/CMN	110
13A.6.3	ACTION AT THE ORIGINATING SN.....	110
13A.7	NETWORK EXCESSIVE DELAY.....	110
13A.7.1	ACTIONS AT A CONTROLLING SN.....	110
13A.7.2	ACTION AT AN INTERMEDIATE OR GATEWAY SN	111
13A.7.3	ACTION AT AN ACM CONTROLLING SN.....	111
13A.7.4	ACTION AT THE ORIGINATING SN.....	111
13A.8	SERVICE ACTIVATION	111
13A.8.1	SERVICE ACTIVATION PROCEDURE	112
13A.9	REMOTE OPERATIONS CAPABILITY	112
13A.9.1	GENERAL DESCRIPTION	112
13A.9.2	REMOTE OPERATIONS PROCEDURE	112
13A.9.3	ERROR PROCEDURES	113
13A.10	FACILITY MESSAGE	114
13A.11	NETWORK SPECIFIC FACILITIES	115
13A.12	BEARER REDIRECTION	115
13A.12.1	INTRODUCTION.....	115

13A.12.2	INTERACTION WITH SERVICES INVOKING BEARER REDIRECTION	116
13A.12.3	CUT-THROUGH OF NEW BEARER CONNECTION	118
13A.12.4	USE OF BAT ASE	118
13A.12.5	PROCEDURES	118
13A.12.5.1	INDICATION OF BEARER REDIRECTION CAPABILITY	118
13A.12.5.2	BEARER REDIRECTION TAKES PLACE IN THE SAME DIRECTION AS THE CALL	119
13A.12.5.2.1	ACTIONS AT A CC-ANCHOR NODE	119
13A.12.5.2.1.1	NEGOTIATION OF BEARER REDIRECTION CAPABILITIES	119
13A.12.5.2.1.2	SETUP OF NEW CALL LEG AND BEARER CONNECTION	119
13A.12.5.2.1.3	RELEASE OF OLD CALL LEG AND BEARER CONNECTION	120
13A.12.5.2.2	ACTIONS AT A BC-ANCHOR	120
13A.12.5.2.2.1	NEGOTIATION OF BEARER REDIRECTION CAPABILITIES	120
13A.12.5.2.2.2	SETUP OF NEW BEARER CONNECTION	121
13A.12.5.2.2.2.1	HANDLING OF APP PARAMETERS	121
13A.12.5.2.2.2.2	CONFIRMATION AND CUT-THROUGH OF THE NEW BEARER CONNECTION	121
13A.12.5.2.2.3	RELEASE OF OLD BEARER CONNECTION	122
13A.12.5.2.3	ACTIONS AT AN INTERMEDIATE NODE WHICH IS NOT A BC-ANCHOR OR CC-ANCHOR NODE	122
13A.12.5.2.4	ACTIONS AT A REDIRECTING-TO NODE	122
13A.12.5.2.5	ACTIONS AT A REDIRECTING-FROM NODE	122
13A.12.5.3	REDIRECTION TAKES PLACE IN THE OPPOSITE DIRECTION TO THE ORIGINAL CALL SETUP	122
13A.12.5.4	SPECIAL CASES	123
13A.12.5.4.1	HANDLING OF MULTIPLE BEARER REDIRECTION REQUESTS	123
13A.12.5.4.2	TEMPORARY REJECT	123
13A.12.5.4.3	BEARER REDIRECTION ABANDONED BY CC-ANCHOR NODE	123
13A.12.5.4.3.1	ACTIONS AT THE CC-ANCHOR NODE	123
13A.12.5.4.3.2	ACTIONS AT THE BC-ANCHOR NODE	124
13A.12.5.4.4	BEARER REDIRECTION FAILURE AT BC-ANCHOR NODE	124
13A.12.5.4.4.1	ACTIONS AT THE BC-ANCHOR NODE	124
13A.12.5.4.4.2	ACTIONS AT THE CC-ANCHOR NODE	124
13A.12.5.4.5	UNEXPECTED BEARER REDIRECTION REQUEST	124
13A.12.5.4.6	UNEXPECTED NEW CONNECTION IDENTIFIER	124
13A.12.5.5	INTERACTION WITH FACILITY REQUEST TO PIVOT (T1.668-1999)	125
13A.12.5.6	INTERACTION WITH RELEASE TO PIVOT (T1.661-2000)	125
A	TIMERS	126
B	PROCEDURES FOR RE-USE OF IDLE BEARERS (NETWORK OPTION)	128
B.1	INTRODUCTION	128
B.2	PROCEDURES	128
B.2.1	OUTGOING BEARER SET-UP PROCEDURES	128
B.2.1.1	RE-USE OF FORWARD IDLE BEARER	128
B.2.1.2	RE-USE OF BACKWARD IDLE BEARER	129
B.2.2	INCOMING BEARER SET-UP PROCEDURES	129
B.2.2.1	RE-USE OF FORWARD IDLE BEARER	129
B.2.2.2	RE-USE OF BACKWARD IDLE BEARER	129
B.2.3	CONTINUITY MESSAGE	130
B.2.4	CODEC NEGOTIATION	130
B.2.6	RELEASE PROCEDURE	130
C	TEST CALLS	131
D	SEMI-AUTOMATIC CIC TURN-UP PROCEDURE	132
D.1.	INTRODUCTION	132
D.2	PROCEDURE FOR PUTTING CICs INTO SERVICE	132
D.3	TEST PROCEDURES	133
E	PROCEDURES FOR USE OF STRUCTURED AAL1 BEARERS (NETWORK OPTION)	134
E.1	INTRODUCTION	134
E.2	PROCEDURES	134
E.2.3	CODEC NEGOTIATION	134
E.2.4	RELEASE PROCEDURE	134

F	INTERWORKING BETWEEN SIGNALING SYSTEM 7 ISDN USER PART AND THE BEARER INDEPENDENT CALL CONTROL PROTOCOL.....	135
F.1	SCOPE.....	135
F.2	INTERWORKING WITH ISUP AT AN ISN.....	135
F.2.1	GENERAL.....	135
F.2.2	INCOMING ISUP, OUTGOING BICC, (INCOMING ISN).....	136
F.2.2.1	SUCCESSFUL BASIC CALL SET-UP.....	136
F.2.2.1.1	FORWARD ADDRESS SIGNALING.....	136
F.2.2.1.2	CONTINUITY MESSAGE.....	136
F.2.2.1.3	THROUGH CONNECTION OF THE BEARER PATH.....	136
F.2.2.1.4	CONNECTION TYPE ALLOWING FALLBACK.....	137
F.2.2.1.4.1	ACTIONS IN THE FORWARD DIRECTION.....	137
F.2.2.1.4.1.1	SUCCEEDING NETWORK DOES HAVE THE CAPABILITY OF PERFORMING FALLBACK.....	137
F.2.2.1.4.1.2	SUCCEEDING NETWORK DOES NOT HAVE THE CAPABILITY OF PERFORMING FALLBACK.....	137
F.2.2.1.4.2	ACTIONS IN THE BACKWARD DIRECTION.....	137
F.2.2.1.4.2.1	SUCCEEDING NETWORK DOES HAVE THE CAPABILITY OF PERFORMING FALLBACK.....	137
F.2.2.1.4.2.2	SUCCEEDING NETWORK DOES NOT HAVE THE CAPABILITY OF PERFORMING FALLBACK.....	137
F.2.2.2	CALL RELEASE.....	137
F.2.3	INCOMING BICC, OUTGOING ISUP, (OUTGOING ISN).....	138
F.2.3.1	SUCCESSFUL CALL SET-UP.....	138
F.2.3.1.1	FORWARD ADDRESS SIGNALING.....	138
F.2.3.1.2	THROUGH CONNECTION OF THE BEARER PATH.....	139
F.2.3.1.3	CONNECTION TYPE ALLOWING FALLBACK.....	139
F.2.3.1.3.1	ACTIONS IN THE FORWARD DIRECTION.....	139
F.2.3.1.3.1.1	SUCCEEDING NETWORK DOES HAVE THE CAPABILITY OF PERFORMING FALLBACK.....	139
F.2.3.1.3.1.2	SUCCEEDING NETWORK DOES NOT HAVE THE CAPABILITY OF PERFORMING FALLBACK.....	139
F.2.3.1.3.2	ACTIONS IN THE BACKWARD DIRECTION – FALLBACK INDICATED BEFORE ANSWER.....	139
F.2.3.1.3.2.1	SUCCEEDING NETWORK DOES HAVE THE CAPABILITY OF PERFORMING FALLBACK.....	139
F.2.3.1.3.2.2	SUCCEEDING NETWORK DOES NOT HAVE THE CAPABILITY OF PERFORMING FALLBACK.....	140
F.2.3.1.3.3	ACTIONS IN THE BACKWARD DIRECTION – FALLBACK INDICATED AT ANSWER.....	140
F.2.3.2	CALL RELEASE.....	140
G	INTERWORKING BETWEEN SELECTED SIGNALING SYSTEMS (PSTN ACCESS, DSS1, MF) AND THE BEARER INDEPENDENT CALL CONTROL PROTOCOL.....	141
G.1	SCOPE.....	141
G.2	GENERAL CONSIDERATIONS.....	142
G.3	INTERWORKING WITH ACCESS SIGNALING SYSTEMS.....	142
G.3.1	PSTN ACCESS SIGNALING SYSTEM.....	142
G.3.2	ISDN ACCESS SIGNALING SYSTEM DSS1.....	143
G.3.3	MULTIPLEXED ACCESS SIGNALING SYSTEMS.....	143
G.4	INTERWORKING WITH THE MF NETWORK SIGNALING SYSTEM.....	143
G.4.1	GENERAL.....	143
G.4.1.1	INTERWORKING SPECIFICATIONS.....	143
G.4.1.2	RETURN OF ADDRESS COMPLETE MESSAGE IN INTERWORKING SITUATIONS.....	143
G.4.1.3	INTERNAL THROUGH CONNECTION OF THE BEARER PATH.....	144
G.4.1.4	ALERTING OF THE CALLED PARTY.....	144
G.4.2	NUMBER PORTABILITY.....	144
G.4.3	HOP COUNTER.....	144
G.4.4	JURISDICTION INFORMATION.....	144
G.4.5	CIC RESERVATION.....	144
G.4.5.1	ACTIONS AT THE ISN INITIATING CIC RESERVATION.....	145
G.4.5.2	ACTIONS AT THE SN RECEIVING A CIC RESERVATION MESSAGE.....	145
G.4.5.3	INTERWORKING OF ANSWER INDICATION.....	145
G.4.5.4	INTERWORKING WITH FACILITY/SERVICE SELECTIVE SIGNALING.....	146
G.4.5.5	INTERACTIONS.....	146
G.4.5.6	ADDITIONAL HANDLING OF UNEXPECTED MESSAGES.....	146
H	INTERWORKING BETWEEN B-ISDN ACCESS SIGNALING SYSTEM DSS2 FOR 64 KBPS ISDN CIRCUIT MODE SERVICES AND THE BEARER INDEPENDENT CALL CONTROL PROTOCOL.....	147
H.1	SCOPE.....	147
H.2	INTERWORKING WITH BROADBAND ACCESS SIGNALING SYSTEMS.....	148

H.2.1	B-ISDN ACCESS SIGNALING SYSTEM DSS2 FOR 64 KBPS ISDN CIRCUIT MODE SERVICES	148
I	MESSAGE FLOW EXAMPLES	149
I.1	INTRODUCTION TO MESSAGE FLOWS	149
I.2	CONTENTS	149
J	GENERIC BCF FUNCTIONS.....	169
J.1	INTRODUCTION.....	169
J.2	BNC-ID.....	169
J.2.1	BNC-ID USAGE DURING CALL AND BEARER SET-UP.....	169
J.2.2	BNC-ID USAGE FOR IDLE BEARER RE-USE PROCEDURE (NETWORK OPTION).....	169
J.2.3	BNC-ID USAGE FOR STRUCTURED AAL1 BEARERS	170
J.3	BEARER RELEASE CONTROL	170
J.4	BIWF ADDRESS	170
J.5	BNC CHARACTERISTICS.....	170
K	HOP COUNTER PROCEDURE LOGIC DIAGRAM.....	171

Table of Figures

FIGURE 1/T1.673.4 - OVERVIEW OF CODEC MODIFICATION AND MID-CALL NEGOTIATION	60
FIGURE 2/ T1.673.4 - CC-ANCHOR AND REDIRECTING-FROM NODES COMBINED	117
FIGURE 3/T1.673.4 - CC-ANCHOR AND REDIRECTING-TO NODES COMBINED	117
FIGURE F.1/T1.673.4 - SCOPE OF THIS ANNEX.....	135
FIGURE G.1/T1.673.4 - SCOPE OF THIS ANNEX	141
FIGURE G.2/T1.673.4 - COVERAGE OF SIGNALING INTERWORKING CASES	142
FIGURE H.1/T1.673.4 - SCOPE OF THIS ANNEX	147
FIGURE H.2/T1.673.4 - COVERAGE OF SIGNALING INTERWORKING CASES	148
FIGURE I.1/T1.673.4 - FORWARD ESTABLISHMENT OF BACKBONE NETWORK CONNECTION, NO NOTIFICATION OF BEARER CONNECT REQUIRED.....	151
FIGURE I.2/T1.673.4 - FORWARD ESTABLISHMENT OF BACKBONE NETWORK CONNECTION, NOTIFICATION OF BEARER CONNECT IS REQUIRED	152
FIGURE I.3/T1.673.4 - BACKWARD ESTABLISHMENT OF BACKBONE NETWORK CONNECTION	153
FIGURE I.4/T1.673.4 - PER-CALL BEARER SET-UP USING BEARER CONTROL TUNNELING - FAST SET-UP (FORWARD)	154
FIGURE I.5/T1.673.4 - PER-CALL BEARER SET-UP USING BEARER CONTROL TUNNELING - DELAYED FORWARD	155
FIGURE I.6/T1.673.4 - PER-CALL BEARER SET-UP USING BEARER CONTROL TUNNELING - DELAYED BACKWARD	156
FIGURE I.7/T1.673.4 - USE OF IDLE BACKBONE NETWORK CONNECTION, ESTABLISHED IN THE FORWARD DIRECTION	157
FIGURE I.8/T1.673.4 - USE OF IDLE BACKBONE NETWORK CONNECTION, ESTABLISHED IN THE BACKWARD DIRECTION	158
FIGURE I.9/T1.673.4 - MULTI-NETWORK EXAMPLE: CONNECT FORWARD, PLUS NOTIFICATION, FOLLOWED BY CONNECT FORWARD, NO NOTIFICATION, FOLLOWED BY CONNECT BACKWARD, RE-USE OF IDLE BEARER	159
FIGURE I.10/T1.673.4 - FORWARD ESTABLISHMENT OF BACKBONE NETWORK CONNECTION, (PLUS NOTIFICATION OF BEARER CONNECT), WITH CODEC NEGOTIATION.....	160
FIGURE I.11/T1.673.4 - BACKWARD ESTABLISHMENT OF BACKBONE NETWORK CONNECTION, WITH CODEC NEGOTIATION....	161
FIGURE I.12/T1.673.4 - CODEC MODIFICATION	162
FIGURE I.13/T1.673.4 - MID-CALL CODEC NEGOTIATION.....	163
FIGURE I.14/T1.673.4 - CODEC MODIFICATION COLLISION	164
FIGURE I.15/T1.673.4 - MID-CALL CODEC NEGOTIATION COLLISION	164
FIGURE I.16/T1.673.4 - COLLISION BETWEEN MID-CALL CODEC NEGOTIATION AND CODEC MODIFICATION.....	165
FIGURE I.17/T1.673.4 - COLLISION BETWEEN MID-CALL CODEC NEGOTIATION AND CODEC MODIFICATION (ERROR FOLLOWING COLLISION RESOLUTION)	166
FIGURE I.18/T1.673.4 - FORWARD CALL AND BEARER RELEASE - FORWARD BEARER SET-UP	167

FIGURE I.19/T1.673.4 - FORWARD CALL AND BEARER RELEASE - BACKWARD BEARER SET-UP 167
FIGURE I.20/T1.673.4 - FORWARD CALL RELEASE - BEARERS NOT RELEASED 168
FIGURE I.21/T1.673.4 - FORWARD CALL AND BEARER RELEASE - GATEWAY INTERWORKING BETWEEN FORWARD AND BACKWARD
BEARER SET-UP 168

FIGURE K.1/T1.673.4 - HOP COUNTER PROCEDURE LOGIC DIAGRAM..... 171

Table of Tables

TABLE 1/T1.673.4 - BAT PRIMITIVE INTERFACE 4
TABLE 2/T1.673.4 - CIC QUERY STATE ACTIONS (SHEET 1 OF 5) 80
TABLE 3/T1.673.4 – ON RECEIPT OF MESSAGE COMPATIBILITY INFORMATION PARAMETER 95
TABLE 4/T1.673.4 – ON RECEIPT OF PARAMETER COMPATIBILITY INFORMATION PARAMETER 95
TABLE 5A/T1.673.4 – HANDLING OF RESPONSES INDICATING UNRECOGNIZED INFORMATION HAS BEEN SENT 100

TABLE A.1/T1.673.4 – TIMERS IN THE BICC BASIC CALL PROTOCOL..... 126

FIGURE F.1/T1.673.4 - SCOPE OF THIS ANNEX..... 135

American National Standard
for Telecommunications –

Bearer Independent Call Control Protocol -- Signaling Procedures

1 Scope, purpose and application

This chapter describes Capability Set 1+ (CS1+) of the Bearer Independent Call Control (BICC) signaling procedures for the support of narrowband ISDN services independent of the bearer technology and signaling message transport technology used.

This chapter defines the procedures at the Call Service Functions (CSFs) within originating/destination Serving Nodes (SNs) (ISNs interworking with an access signaling system), intermediate SNs (TSNs), incoming/outgoing gateway SNs (GSNs) and Call Mediation Nodes (CMNs). Actions common for all types of SN/CMN are described once. Different or additional actions required at a specific type of SN/CMN are specified in a separate subclause.

The format of this chapter follows the format of ITU-T Recommendation Q.1902.4 wherever possible. However, certain (sub) clauses of that Recommendation are not applicable to North American networks (e.g., propagation delay procedure), or are not applicable to this American National Standard (e.g., description of international Service Nodes). Relevant indications are given where appropriate.

Additional clauses specific to the format of this American National Standard are identified by a number followed by a letter (e.g., 13A). Additional subclauses specific to the format of this American National Standard, while the clause itself is not specific, are identified by the clause number followed by a "." and a letter (e.g., 8.A).

Chapter T1.673.1 provides an overview of the BICC protocol.

2 Normative References

See chapter T1.673.1

3 Definitions

See chapter T1.673.1.

4 Abbreviations & Acronyms

ACC	Automatic Congestion Control
ACM	Address Complete Message
APM	Application Transport Mechanism
APP	Application Transport Parameter

ASE	Application Service Element
ATII	Application Transport Instruction Indicators
BAT	Bearer Association Transport
BCF	Bearer Control Function
BCU-ID	Bearer Control Unit Identifier
BICC	Bearer Independent Call Control
BIWF	Bearer InterWorking Function
BNC-ID	Backbone Network Connection Identifier
CCPN	Call Completion to a Portable Number
CIC	Call Instance Code
CL	Congestion Level
CMN	Call Mediation Node
COT	Continuity message
CPG	Call Progress message
CS1+	Capability Set 1+
CSF	Call Service Function
DTMF	Dual-Tone Multi-Frequency
EH	Errors Handling
GAP	Generic Address Parameter
GRS	Group Reset message
GSN	Gateway Serving Node
IAM	Initial Address Message
ISDN	Integrated Services Digital Network
ISN	Interface Serving Node
ISUP	ISDN User Part
MTP	Message Transfer Part
NSF	Network Specific Facilities
PDU	Protocol Data Unit
PRI	Pre-Release Information
REL	Release message
RLC	Release Complete message
RSC	Reset CIC message
SACF	Single Association Control Function
SAM	Subsequent Address Message
SAO	Single Association Object
SN	Serving Node
STC	Signaling Transport Converter
TAR	Temporary Alternative Routing
TMU	Transmission Medium Used
TSN	Transit Serving Node
UDI-TA	Unrestricted Digital Information with Tones and Announcements
USI	User Service Information
USI'	User Service Information Prime

5 Conventions

See chapter T1.673.1.

6 General

6.1 Introduction to document structure

The following clauses of this chapter of this American National Standard define the basic call procedures for the BICC protocol. The procedures described are the protocol procedures applicable at the CSF at the various node types. The specific applicability of procedures to the different node types is indicated within the heading titles and/or explicit qualifying text within the subclauses. If no such indication is given, the specified procedures are generally applicable.

The term "gateway SN" is used to refer to the node type elsewhere termed a GSN.

The term "intermediate SN" is used to refer to the node type elsewhere termed a TSN. Additionally this term is sometimes used to also include GSNs, as common procedures often apply. Where procedures are specified for intermediate SNs, this covers gateway SNs unless specific gateway SN procedures are also provided. Corresponding terminology is also applied to CMNs.

The term "originating/destination SN" is used to refer to an ISN where interworking with an access signaling system takes place.

The structure of the following clauses is:

- Clause 7 defines the minimum set of procedures required to set-up a BICC call.
- Clause 8 defines additional procedures that can be applied during set-up of a call.
- Clause 9 defines procedures that apply when a call cannot be set-up as requested.
- Clause 10 defines procedures that apply after successful call set-up, before initiation of call release.
- Clause 11 defines procedures for call release.
- Clause 12 defines procedures not specifically related to any single call, or needed due to characteristics of the underlying signaling network.
- Clause 13 defines procedures for handling abnormal conditions.
- Clause 13A defines generic signaling procedures and support of ISDN supplementary services.

6.2 Messages, parameters and information elements

The BICC signaling information (messages and parameters) referred to in the following clauses are described in chapters T1.673.2 and T1.673.3. Additionally, BICC signaling entities use information elements transferred via an application of the Application Transport mechanism (see T1.113.7-2000). These information elements are defined in T1.673.6.

6.3 Use of Application Transport Mechanism

6.3.1 Introduction

This subclause describes how BICC uses the transport mechanism defined in T1.673.6.

The BICC procedures require transfer of information between peer BICC signaling entities (CSFs). The Bearer Association Transport (BAT), APM-user ASE is used to provide a transport mechanism for this information. The interface between this American National Standard and the BAT ASE is provided by the following primitive elements:

Table 1/T1.673.4 - BAT primitive interface

Primitive name	Types	Direction (Note)
BICC_Data	Indication/Request	→/←
BICC_Error	Indication	→
NOTE – Primitive flow from BAT to BICC (via SACF): → Primitive flow from BICC to BAT (via SACF): ←		

The BICC_Data primitives are used to transport BICC specific information elements between peer BICC entities. The BICC_Error primitive reports errors back to BICC if there are problems at the BAT level.

The handling of the BICC_Error primitive, and the treatment of unrecognized information elements is described in 13.4.

6.3.2 Application Transport Instruction Indicators

The Application Transport Instruction Indicators (ATII) shall be sent in the BICC_Data request primitive in order to provide the correct handling of error cases, e.g., if the BAT context is unidentified at the receiving node.

The ATII shall be set as follows:

- bit A: Release call indicator
 - 1 release call
- bit B: Send notification indicator
 - 0 do not send notification

6.3.3 Handling of Addressing Information

Implicit addressing shall be used (see T1.113.7).

6.3.4 BAT ASE at a CMN

According to the role of the CMN, the BAT ASE may be deployed on this node. If the CMN supports the BAT ASE, it will be considered as an addressed node, since the implicit APM addressing mechanism is used. The application procedures at CMN node may pass on the information unchanged.

6.4 Bearer control tunneling

The bearer control tunneling mechanism transports bearer control PDUs from the BCF at one SN to the BCF at the adjacent SN, by means of encapsulation within the BICC messages.

6.4.1 Bearer control tunneling procedure

Bearer control tunneling shall be used for a call if the BICC_data primitive associated with the IAM, or the first backward APM message includes the Bearer Control Tunneling information element set to *"tunneling to be used."* The absence of the Bearer Control Tunneling information element in the IAM or in the first backward APM (if *"tunneling to be used"* was not indicated in the IAM) specifies that the bearer control tunneling shall not be used.

A CSF receiving a bearer control PDU from the BCF shall encapsulate it into a Bearer Control Information information element within a BICC_data request primitive.

The BICC_data request primitive is issued, either:

1. As a part of CSF procedures specified elsewhere in this American National Standard, e.g., bearer set-up procedures (7.4, 7.5); or
2. Independent of other specified CSF procedures - on demand, as determined by BCF procedures.

The Bearer Control Information is passed across the BICC signaling, CSF to CSF. At the receiving CSF, the bearer control PDU within a Bearer Control Information information element in a BICC_data indication primitive is passed to the BCF.

The procedures for receipt and processing and generation of these PDUs are the responsibility of the BCF. The CSF procedures do not examine the contents of the Bearer Control Information information elements.

This mechanism can be used during the bearer set-up procedures (see 7.4 and 7.5), and at any other time in the call up to the sending/receipt of REL.

7 Successful basic call set-up

7.1 Introduction

This clause describes the minimal set of CSF procedures used for the set-up of a basic call. Additional procedures may also be used during basic call set-up – these are described in later clauses of this chapter.

CSF procedures are described for each SN/CMN type, and a common set of procedures are provided to support the set-up of bearer connections at SNs.

Several options are included for the handling of bearers -- in general:

1. A bearer connection is set-up and released for each call set-up and release. The bearer set-up is initiated in the forward direction.
2. A bearer connection is set-up and released for each call set-up and release. The bearer set-up is initiated in the backward direction.
3. The bearer connection is not released at the end of the call, but is maintained, and can be re-used for a subsequent call. (Re-use of idle bearers is a network option, see Annex B/T1.673.4).

7.2 Forward address signaling – *En bloc* operation

7.2.1 Actions required at the originating SN

7.2.1.1 Outgoing selection

When the CSF at the originating SN has received the complete selection information from the calling party, and has determined that the call is to be routed to another CSF, the outgoing signaling procedure (see 7.2.1.2) is initiated. (A BIWF may be selected at this point -- depending on the characteristics of the incoming access type, the BIWF may also be pre-determined).

The selection of the route will depend on the transit network selection (if applicable), called party number, connection type required, and the network signaling capability required. This selection process may be performed at the CSF or with the assistance of a remote database.

The connection types allowed are:

- Speech;
- 3.1 kHz audio;
- 64 kbit/s unrestricted;
- 64 kbit/s UDI-TA;
- 384 kbit/s unrestricted;
- 1427 kbit/s unrestricted;
- 1536 kbit/s unrestricted;
- 1920 kbit/s unrestricted; and
- $N \times 64$ kbit/s unrestricted ($N = 2-24$).

The network signaling capabilities allowed are:

- ISDN-User Part/BICC preferred;
- ISDN-User Part/BICC required; and
- ISDN-User Part/BICC not required (any signaling system).

7.2.1.2 Outgoing signaling procedure

7.2.1.2.1 Initial Address Message

A free CIC value is selected and the Outgoing bearer set-up procedure (see 7.4) is invoked to send an IAM and perform bearer set-up to the next SN. The IAM is populated with call control information as follows:

- a) The information used to determine the routing of the call by the CSF will be included in the IAM (as Called Party Number, User Service Information¹ and Forward Call Indicators parameters) to enable correct routing at intermediate CSFs.
- b) *Called Party Number parameter*: The sending sequence of address information on international calls will be the country code (not sent to international incoming gateway SNs), followed by the national (significant) number. On national connections, the address information may be the local number or the national (significant) number as required by the network operator concerned. For calls to international operator positions (code 11 and code 12), refer to ITU-T Recommendation Q.107. For calls to national operator positions, by operators, existing standard digit codes will be used.
- c) *User Service Information parameter*: The information received from or determined by the access interface is used to set the value of the User Service Information parameter, see the relevant interworking specification, e.g., Annexes G/T1.673.4 and H/T1.673.4.
- d) *Forward Call Indicators parameter*: The CSF will set the fields of the Forward Call Indicators parameter to indicate:
 - i) “No end-to-end method available”;
 - ii) “No interworking encountered”;
 - iii) “ISDN-User Part/BICC used all the way”;
 - iv) network signaling capability required (ISDN-User Part/BICC Preference indicator).

The ISDN-User Part/BICC Preference indicator is set according to the bearer service and supplementary service(s) requested. The exact setting depends on the service demand conditions and may be different depending on individual cases. In principle, if the service demand requires ISDN-User Part/BICC to be essential then the indicator is set to “required,” if the service required is optional but preferred it is set to “preferred,” otherwise it is set to “not required.” The indicator is set to either “required” or “preferred,” or “not required,” according to the most stringent condition required by one or more of the parameters in the IAM.

See also the relevant interworking specification, e.g., Annexes G/T1.673.4 and H/T1.673.4.

- e) *The Nature of Connection Indicators parameter*:
 - i) The Satellite Indicator is set appropriately based on the characteristics of the selected outgoing network connection.
 - ii) The Continuity Indicator is set to “no COT to be expected” if the incoming bearer is established, or may be set to “COT to be expected” if the incoming bearer is not established yet (see relevant interworking specification).
 - iii) The Echo Control Indicator is set according to Echo Control procedures (see 8.4).
- f) The CSF will include BAT ASE data as required by 7.4.

¹ The Transmission Medium Requirement parameter in ITU-T Recommendation Q.1902.4 is not specified for U.S. networks.

- g) The CSF may also include other parameters required by procedures specified in clause 8 or the relevant interworking specification, e.g., Annexes G/T1.673.4 and H/T1.673.4. An example is the Access Transport parameter.
- h) The CSF may include the calling party number, which shall be made available to other networks, if available. If a user-provided calling party number is available and has passed screening, it is sent in the Calling Party Number parameter. If a user-provided calling party number is available but failed screening or was not screened, it is sent in the Generic Address parameter. In the latter case and when no user-provided number is available, a network-provided calling party number is sent in the Calling Party Number parameter.
- i) The CSF may include other information related to supplementary services and network utilities.
- j) *Information related to Number portability:* The CSF at the originating SN using the Call Completion to a Portable Number (CCPN) network capability and acting as the initiating node may include a Generic Address Parameter (GAP) containing the ported number dialed by the calling party (that is, the Type of Address of the GAP is coded with “*ported number*”) when the number dialed by the calling party is translated to a different routing number. The translated number is populated in the Called Party Number parameter, and the Forward Call Indicators parameter shall be set to “*number translated.*”

If the number dialed by the calling party is not translated to a different routing number, the CSF at the originating SN acting as an initiating node shall set the Forward Call Indicators parameter to “*number translated.*” The Called Party Number parameter shall remain unchanged and the “ported number” GAP will not be included in the IAM.
- k) *Information related to the dialed number:* The CSF may include a GAP containing the number dialed by the calling party (that is, the Type of Address of the GAP is coded with “*dialed number*”), when the number dialed by the calling party is translated to a different number.

The IAM may be subject to Simple Segmentation (see 12.2).

High Probability of Completion calls, Multi-level Precedence and Preemption calls, and calls dialed as “911” shall use the higher of the two IAM priorities as specified in T1.111-2001.

7.2.1.2.2 Internal through connection of the bearer path

Internal through connection of the bearer path may be completed in the backward direction at the originating SN when the Outgoing bearer set-up procedure (see 7.4) is successfully completed.

NOTE - As an additional condition the through connection of the internal bearer path in the backward direction will be completed when the incoming bearer is also available. (This is dependent on the characteristics of the incoming access type).

In addition, if the Outgoing bearer set-up procedure is performing “Per-call bearer set-up in the forward direction,” with Connect Type “*notification not required,*” the bearer path may be connected in the backward direction when the Bearer Set-up request has been sent by the Outgoing bearer set-up procedure.

For a speech, 3.1 kHz audio, or unrestricted digital information with tones and announcements (UDI-TA) call, internal through connection of the bearer path shall be completed in the backward direction at the originating SN no later than at receipt of an Address Complete Message.

For any call, through connection of the internal bearer path in both directions shall be completed no later than at receipt of an interworking indication or an Answer message (see 7.7.6).

7.2.1.2.3 Network protection timer

When the CSF has sent the IAM the awaiting address complete timer (T7) is started. If timer T7 expires the call is released and an indication is returned to the calling subscriber.

7.2.2 Actions required at an intermediate SN

This subclause describes the CSF actions to be performed at an intermediate SN.

7.2.2.1 Common procedures

7.2.2.1.1 Incoming signaling procedure and outgoing selection

The CSF at an intermediate SN, on receipt of an IAM will analyze the Called Party Number and the other routing information (see 7.2.1.1) to determine the routing of the call.

If the call can be routed using the connection type specified in the User Service Information parameter a BIWF may be selected and the Outgoing signaling procedure (see 7.2.2.1.2), is started. The BIWF selected -- at this time, or later in the set-up procedure -- shall be able to support the bearer set-up direction indicated by the Action indicator, support the received BNC characteristics, as included in the BICC_data indication primitive associated with the IAM, and support bearer control tunneling if required. Other information elements, if received, shall be taken into account. The Incoming bearer set-up procedure (see 7.5) is started when a BIWF has been selected.

If the call cannot be routed as a BICC call, interworking may take place or the call will fail.

In the case of congestion, the CSF may send a Release Message (including Automatic Congestion Level parameter) to the preceding CSF indicating congestion and initiating release of the call at that CSF. The Release Message shall include the cause indicators parameter with cause value 42, "*switching equipment congestion*." Refer to 12.8 for automatic congestion control procedures.

7.2.2.1.2 Outgoing signaling procedure

7.2.2.1.2.1 Initial Address Message

A free CIC value is selected, and the Outgoing bearer set-up procedure (see 7.4) is invoked to send an IAM and perform bearer set-up to the next CSF.

When constructing the IAM the CSF may modify signaling information received from the preceding CSF:

- a) The Satellite Indicator in the Nature of Connection Indicators parameter should be incremented if the characteristics of the selected outgoing network connection indicate satellite usage. Otherwise, the indicator is passed on unchanged.

- b) The Continuity Indicator in the Nature of Connection Indicators parameter shall be set to indicate “*COT to be expected.*”
- c) The Echo Control Indicator in the Nature of Connection Indicators parameter shall be set according to the Echo Control procedures (see 8.4).
- d) Signaling procedures in clause 8 may modify parameters.
- e) BAT ASE data is not necessarily passed on transparently.
- f) The most significant digits in the Called Party Number may be amended or omitted.
- g) *Information related to Number Portability:* The actions at the CSF at the intermediate SN acting as an initiating node are the same as at the CSF at an originating SN acting as an initiating node. Otherwise, no action is required at the CSF at the intermediate SN. In particular, the CSF at the intermediate SN that receives an IAM with the Forward Call Indicators parameter set to “*number translated*” shall not act as the initiating node.
- h) *Information related to the dialed number:* The CSF may include a GAP containing the number dialed by the calling party (that is, the Type of Address of the GAP is coded with “*dialed number*”) when the number dialed by the calling party is translated to a different called number.

If the IAM received for a call at the CSF contains a “dialed number” GAP, the CSF shall not modify the “dialed number” GAP but shall pass the parameter as received.

Other signaling information is passed on transparently, e.g., the Access Transport Parameter, etc.²

Signaling procedures in clause 8 may add parameters.

The IAM may be subject to Simple Segmentation (see 12.2).

7.2.2.1.2.2 Internal through connection of the bearer path

The internal bearer path may be connected in both directions when both of the following conditions are satisfied:

- The Incoming bearer set-up procedure is successfully completed; and
- The Outgoing bearer set-up procedure is successfully completed.

In addition, if the Outgoing bearer set-up procedure is performing “Per-call bearer set-up in the forward direction,” with Connect Type “*notification not required,*” the bearer path may be connected in both directions when both of the following conditions are satisfied:

- The Incoming bearer set-up procedure has been successfully completed, and;
- The Bearer Set-up request has been sent by the Outgoing set-up procedure.

² Certain signaling information may be passed on to other networks based on bilateral agreements.

For a speech, 3.1 kHz audio, or UDI-TA call, internal through connection of the bearer path shall be completed in the backward direction at the intermediate SN no later than at receipt of an Address Complete Message.

For any call, through connection of the internal bearer path in both directions shall be completed no later than at receipt of an interworking indication or an Answer message (see 7.7.6).

7.2.2.2 Actions required at an intermediate national SN

Subclause 7.2.2.1 applies.

7.2.2.3 Actions required at an intermediate international SN

[Not applicable to this Standard.]

7.2.3 Actions required at an intermediate CMN

This subclause describes the CSF actions to be performed at an intermediate CMN.

7.2.3.1 Common procedures

7.2.3.1.1 Incoming signaling procedure and outgoing selection

The CSF at an intermediate CMN, on receipt of an IAM, will analyze the Called Party Number and the other routing information (see 7.2.1.1) to determine the routing of the call.

If the call can be routed using the connection type specified in the User Service Information parameter, the Outgoing signaling procedure (see 7.2.3.1.2) is started.

7.2.3.1.2 Outgoing signaling procedure

7.2.3.1.2.1 Initial Address Message

A free CIC value is selected, and the IAM is sent to the next CSF.

When constructing the IAM, the CSF may modify signaling information received from the preceding CSF. Subclause 7.2.2.1.2.1 applies with the following exceptions:

- a) The Satellite Indicator in the Nature of Connection Indicators parameter should be passed on unchanged.
- b) The Continuity Indicator in the Nature of Connection indicators parameter shall be passed on unchanged.

7.2.3.2 Actions required at an intermediate national CMN

Subclause 7.2.3.1 applies.

7.2.3.3 Actions required at an intermediate international CMN

[Not applicable to this Standard.]

7.2.4 Actions required at an outgoing gateway SN

This subclause describes the CSF actions to be performed at an outgoing gateway SN. This may be an outgoing gateway at a point of interconnection between two networks.

7.2.4.1 Common procedures

7.2.4.1.1 Incoming signaling procedure and outgoing selection

The CSF at an outgoing gateway SN, on receipt of an IAM, will analyze the Called Party Number and the other routing information (see 7.2.1.1) to determine the routing of the call.

The CSF routes the call using the connection type specified in the User Service Information parameter.

If the call can be routed, a BIWF may be selected and the Outgoing signaling procedure (see 7.2.4.1.2), is started. The BIWF selected -- at this time, or later in the set-up procedure -- shall be able to support the bearer set-up direction indicated by the Action indicator, support the received BNC characteristics, as included in the BICC_data indication primitive associated with the IAM, and support bearer control tunneling if required. Other information elements, if received, shall be taken into account. The Incoming bearer set-up procedure (see 7.5) is started when a BIWF has been selected.

If the call cannot be routed as a BICC call, interworking may take place or the call will fail.

7.2.4.1.2 Outgoing signaling procedure

7.2.4.1.2.1 Initial Address Message

A free CIC value is selected, and the Outgoing bearer set-up procedure (see 7.4) is invoked to send an IAM and perform bearer set-up to the next CSF.

When constructing the IAM, the CSF may modify signaling information received from the preceding CSF:

- a) The most significant digits in the called party number may be amended or omitted.
- b) [Not applicable to North American networks.]
- c) If a new connection type is provided as a result of the outgoing selection procedure (see 7.2.4.1.1), the User Service Information parameter is modified to the new connection type.

- d) The Satellite Indicator in the Nature of Connection Indicators parameter should be incremented if the characteristics of the selected outgoing network connection indicates satellite usage. Otherwise, the indicator is passed on unchanged.
- e) The Continuity Indicator in the Nature of Connection indicators parameter shall be set to indicate “COT to be expected.”
- f) [Not applicable to North American networks.]
- g) Signaling procedures in clause 8 may modify parameters.
- h) BAT ASE data is not necessarily passed on transparently.
- i) *Information related to Number Portability:* The actions at the CSF at an outgoing gateway SN acting as an initiating node are the same as at the CSF at an originating SN acting as an initiating node. Otherwise, no action is required at the CSF at an outgoing gateway SN. In particular, the CSF at an outgoing gateway SN that receives an IAM with the Forward Call Indicators parameter set to “*number translated*” shall not act as the initiating node.
- j) *Information related to the dialed number:* The CSF may include a GAP containing the number dialed by the calling party (that is, the Type of Address of the GAP is coded with “*dialed number*”), when the number dialed by the calling party is translated to a different called number.

If the IAM received for a call at the CSF contains a “dialed number” GAP, the CSF shall not modify the “dialed number” GAP but shall pass the parameter as received.

Other signaling information is passed on transparently, e.g., the Access Transport Parameter, etc³.

Signaling procedures in clause 8 may add parameters.

The IAM may be subject to Simple Segmentation (see 12.2).

7.2.4.1.2.2 Internal through connection of the bearer path

Subclause 7.2.2.1.2.2 applies.

7.2.4.1.2.3 Network protection timer

Subclause 7.2.1.2.3 applies.

7.2.4.2 Actions required at an outgoing national gateway SN

Subclause 7.2.4.1 applies.

³ Certain signaling information may be passed on to other networks based on bilateral agreements.

7.2.4.3 Actions required at an outgoing international gateway SN

[Not applicable to this Standard.]

7.2.5 Actions required at an outgoing gateway CMN

This subclause describes the CSF actions to be performed at an outgoing gateway CMN. This may be an outgoing gateway at a point of interconnection between two networks.

7.2.5.1 Common procedures

7.2.5.1.1 Incoming signaling procedure and outgoing selection

The CSF at an outgoing gateway CMN, on receipt of an IAM will analyze the Called Party Number and the other routing information (see 7.2.1.1) to determine the routing of the call.

If the call can be routed using the connection type specified in the User Service Information parameter, the Outgoing signaling procedure (see 7.2.5.1.2) is started.

7.2.5.1.2 Outgoing signaling procedure

7.2.5.1.2.1 Initial Address Message

A free CIC value is selected, and the IAM is sent to the next CSF.

When constructing the IAM, the CSF may modify signaling information received from the preceding CSF. Subclause 7.2.4.1.2.1 applies with the following exceptions:

- a) [Not applicable to North American networks.]
- b) The User Service Information parameter shall be passed on unchanged.
- c) The Satellite Indicator in the Nature of Connection Indicators parameter should be passed on unchanged.
- d) The Continuity Indicator in the Nature of Connection indicators parameter shall be passed on unchanged.

7.2.5.2 Actions required at an outgoing national gateway CMN

Subclause 7.2.5.1 applies.

7.2.5.3 Actions required at an outgoing international gateway CMN

[Not applicable to this Standard.]

7.2.6 Actions required at an incoming gateway SN

This subclause describes the CSF actions to be performed at an incoming gateway SN. This may be an incoming gateway SN at a point of interconnection between two networks.

7.2.6.1 Common procedures

7.2.6.1.1 Incoming signaling procedure and outgoing selection

The CSF at an incoming gateway SN, on receipt of an IAM, will analyze the Called Party Number and the other routing information (see 7.2.1.1) to determine the routing of the call.

If the call can be routed using the connection type specified in the User Service Information parameter, a BIWF may be selected, and the Outgoing signaling procedure (see 7.2.6.1.2), is started. The BIWF selected -- at this time, or later in the set-up procedure -- shall be able to support the bearer set-up direction indicated by the Action indicator, support the received BNC characteristics, as included in the BICC_data indication primitive associated with the IAM, and support bearer control tunneling if required. Other information elements, if received, shall be taken into account. The Incoming bearer set-up procedure (see 7.5) is started when a BIWF has been selected.

If the call cannot be routed as a BICC call, interworking may take place or the call will fail.

7.2.6.1.2 Outgoing signaling procedure

7.2.6.1.2.1 Initial Address Message

A free CIC value is selected, and the Outgoing Bearer Set-up procedure (see 7.4) is invoked to send an IAM and perform bearer set-up to the next CSF.

When constructing the IAM, the CSF may modify signaling information received from the preceding CSF:

- a) The Satellite Indicator in the Nature of Connection Indicators parameter should be incremented if the characteristics of the selected outgoing network connection indicates satellite usage. Otherwise, the indicator is passed on unchanged.
- b) The Continuity Indicator in the Nature of Connection Indicators parameter shall be set to indicate *"COT to be expected."*
- c) [Not applicable to North American networks.]
- d) Signaling procedures in clause 8 may modify parameters.
- e) BAT ASE data is not necessarily passed on transparently.
- f) The most significant digits in the Called Party Number may be amended or omitted.
- g) *Information related to Number Portability:* The actions at the CSF at an incoming gateway SN acting as an initiating node are the same as at the CSF at an originating SN acting as an initiating node. Otherwise, no action is required at the CSF at an incoming gateway SN. In particular, the CSF at an incoming gateway SN that receives an IAM with the Forward Call Indicators parameter set to *"number translated"* shall not act as the initiating node.
- h) *Information related to the dialed number:* The CSF may include a GAP containing the number dialed by the calling party (that is, the Type of Address of the GAP is coded with *"dialed"*

number”) when the number dialed by the calling party is translated to a different called number.

If the IAM received for a call at the CSF contains a “dialed number” GAP, the CSF shall not modify the “dialed number” GAP but shall pass the parameter as received.

Other signaling information is passed on transparently, e.g., the Access Transport Parameter, etc⁴.

Signaling procedures in clause 8 may add parameters.

The IAM may be subject to Simple Segmentation (see 12.2).

7.2.6.1.2.2 Internal through connection of the bearer path

Subclause 7.2.2.1.2.2 applies.

7.2.6.1.2.3 Network protection timer

Subclause 7.2.1.2.3 applies.

7.2.6.2 Actions required at an incoming national gateway SN

Subclause 7.2.6.1 applies.

7.2.6.3 Actions required at an incoming international gateway SN

[Not applicable to this Standard.]

7.2.7 Actions required at an incoming gateway CMN

This subclause describes the CSF actions to be performed at an incoming gateway CMN. This may be an incoming gateway at a point of interconnection between two networks.

7.2.7.1 Common procedures

7.2.7.1.1 Incoming signaling procedure and outgoing selection

The CSF at an incoming gateway CMN, on receipt of an IAM will analyze the Called Party Number and the other routing information (see 7.2.1.1) to determine the routing of the call.

⁴ Certain signaling information may be passed on to other networks based on bilateral agreements.

If the call can be routed using the connection type specified in the User Service Information parameter, the Outgoing signaling procedure (see 7.2.7.1.2) is started.

7.2.7.1.2 Outgoing signaling procedure

7.2.7.1.2.1 Initial Address Message

A free CIC value is selected, and the IAM is sent to the next CSF.

When constructing the IAM, the CSF may modify signaling information received from the preceding CSF. Subclause 7.2.6.1.2.1 applies with the following exceptions:

- a) The Satellite Indicator in the Nature of Connection Indicators parameter should be passed on unchanged.
- b) The Continuity Indicator in the Nature of Connection indicators parameter shall be passed on unchanged.
- c) [Not applicable to North American networks.]

7.2.7.2 Actions required at an incoming national gateway CMN

Subclause 7.2.7.1 applies.

7.2.7.3 Actions required at an incoming international gateway CMN

[Not applicable to this standard.]

7.2.8 Actions required at the destination SN

Upon receipt of an IAM, the CSF at the destination SN will analyze the called party number to determine to which party the call should be connected. It will also, if possible, check the called party's line condition and perform various checks to verify whether or not the connection is allowed. These checks will include correspondence of compatibility checks (e.g., checks associated with supplementary services).

If the call cannot be connected due to, for instance, the called party being busy, a Release Message indicating the reason is sent to the preceding CSF (see clause 9).

In the case of congestion, the CSF may send a Release Message (including Automatic Congestion Level parameter) to the preceding CSF indicating congestion and initiating release of the call at that CSF. The Release Message shall include the cause indicators parameter with cause value 42 "*switching equipment congestion*." Refer to 12.8 for automatic congestion control procedures.

In the case where the connection is allowed, a BIWF is selected and the Incoming bearer set-up procedure (see 7.5) is started. The BIWF selected shall be able to support the bearer set-up direction indicated by the Action indicator, support the received BNC characteristics, as included in the BICC_data indication primitive associated with the IAM, and support bearer control tunneling if required. Other information elements, if received, shall be taken into account.

The connection to the called party will be set-up when:

- The incoming bearer set-up procedure is successfully completed; and
- If the incoming IAM indicated “*COT to be expected*,” a Continuity message, with the Continuity Indicators parameter set to “*continuity*” is received.

If the IAM had been segmented by the use of the Segmentation message, the remainder of the call set-up information is awaited (see 12.2).

See also the relevant interworking specification, e.g., Annexes G/T1.673.4 and H/T1.673.4.

Upon receipt of an IAM, the CSF shall also analyze the IAM for the presence of CCPN network capability specific information. When the “ported number” GAP is present and the Forward Call Indicators parameter is set to “*number translated*,” the ported number contained in the GAP shall be used to connect the call to the called party and be used for services that need the ported number. If no “ported number” GAP is present, the Called Party Number shall be used to connect the call to the called party and be used for services that need the ported number.

In the event that the CSF cannot determine an end user’s ported number based on the Called Party Number parameter and possibly a “ported number” GAP, it will do the following:

- If the IAM does not contain a “ported number” GAP, the CSF shall either release the call or provide a suitable tone or announcement using one of the existing Cause values for unidentified users.
- If the IAM contains a “ported number” GAP, the CSF shall release the call using ANSI Cause value 26, “*misrouted to a ported number*.”

Upon receipt of the IAM with a “dialed number” GAP, the CSF may use this information for supplementary services.

7.2.9 Called party number for operator calls

[Not applicable to this Standard.]

7.2.10 Called number for calls to testing and measuring devices

[Not applicable to this Standard.]

7.3 Forward address signaling - *overlap* operation

[Not applicable to North American networks.]

7.4 Outgoing bearer set-up procedure

Bearer set-up procedures are not applicable at a CMN.

When the relevant Outgoing signaling procedure (in 7.2 or 7.3) determines that the IAM can be sent, the procedure for bearer set-up in forward or backward direction is started.

Five variations of procedure are defined. The bearer control protocol used to set-up the bearer may be either tunneled in BICC messages (see 6.4), or sent between the BCFs via alternative signaling means. In the former case, there are three variations:

- *Fast set-up*: In which bearer control information is carried in the IAM and subsequent APM(s). This variation is supported for both the forward and backward bearer set-up cases.
- *Delayed Forward set-up*: In which bearer control information is carried in APM messages following the first backward APM.
- *Delayed Backward set-up*: In which bearer control information is carried in the first backward APM and a subsequent APM(s).

In the non-tunneled case, two possibilities are defined.

- *Per-call bearer set-up in forward direction*: In which bearer control is achieved using a separate bearer control protocol, initiated in the forward direction, (relative to the call set-up direction).
- *Per-call bearer set-up in backward direction*: In which bearer control is achieved using a separate bearer control protocol, initiated in the backward direction, (relative to the call set-up direction).

The choice of variation to use for a call is done as follows:

- *If a BIWF has been selected when outgoing set-up is initiated*:
 - The choice between forward and backward bearer set-up is provisioned at the CSF, as an originating BIWF or outgoing call route characteristic.
 - The choice of tunneled or non-tunneled operation is made by the originating BCF and is indicated in the initial response from the BCF. [The CSF may indicate in the initial request to the BCF what tunneling option(s) it may choose.]
 - The choice between Fast (Forward or Backward) and Delayed Forward/Backward set-up, respectively, is made by the originating BCF and is indicated in the initial response from this BCF. [The CSF may indicate in the initial request to the BCF what option(s) it may choose.]
- *If no BIWF has been selected when outgoing set-up is initiated*:
 - Forward set-up is used.
 - The first backward APM indicates whether non-tunneled or tunneled operation is to be used. [The choice of tunneled or non-tunneled operation is made by the destination BCF, considering the tunneling option(s) allowed by the destination CSF.]
 - For the tunneled case Delayed Forward set-up is used.

Additionally two variations of each of the above forward set-up procedures are defined. The variant to be followed depends on the through connection characteristic of the bearer, and is indicated in the first backward message (APM).

7.4.1 Per-call bearer set-up in forward direction

In this procedure the bearer is set-up from the SN that sends the IAM. Information to enable addressing and bearer identification is awaited from the succeeding SN before the bearer set-up can be initiated.

1. Initial actions depend on whether a BIWF has been selected at the initiation of outgoing bearer set-up.
 - 1.1. *If a BIWF has been selected:* In the response to the BNC Information request primitive, the BCF returns the BNC characteristics, and may include the BIWF Address. The response also indicates that bearer control tunneling is not being used.

NOTE - the BNC Characteristics value indicated by the BCF may be dictated by the CSF if a BNC Characteristics was provided in the BNC Information request primitive.
 - 1.2. *If no BIWF has been selected:* BNC Characteristics is set to a value determined by the CSF application logic.
 - 1.3. An IAM is sent including in the BICC_Data request primitive:
 - Action indicator set to *“Connect forward.”*
 - BNC characteristics.
 - BIWF Address, if received from the BCF.
 - Bearer Control Tunneling set to *“no indication,”* if the BIWF has not been selected.
2. Subsequently, a BICC_Data indication primitive (corresponding to an APM message) should be received:
 - 2.1. If the received Action indicator is *“Connect forward, plus notification,”* the Connect Type⁵ is set to *“notification required”*; else it is set to *“notification not required.”*
 - 2.2. If the BICC_Data indication primitive includes the Bearer Control Tunneling information element set to *“tunneling to be used”* the procedure continues at 7.4.4, item 2.2.
 - 2.3. A BIWF is selected, if one was not selected earlier.
 - 2.4. A Bearer Set-up request is sent to the selected BCF. This request includes:
 - BNC-ID (as received in the BICC_Data indication primitive);
 - BIWF Address (as received in the BICC_Data indication primitive); and
 - Bearer Characteristics, i.e., User Service Information (as received in the IAM).
3. When a Bearer Set-up Connect indication is received this indicates successful completion of the outgoing set-up procedure.
 - 3.1. If the Connect Type is *“notification required,”* a BICC_Data request primitive (corresponding to an APM message) is sent containing:
 - Action indicator set to *“Connected.”*
4. If ACM or ANM are received, and Bearer Set-up Connect indication has not yet been received the ACM or ANM shall be handled according to 7.7 or 7.8, respectively, and Bearer Set-up Connect or Bearer Set-up Failure indication is awaited.

⁵ An internal variable “Connect Type” is used in the Outgoing set-up procedure to record which variety of the set-up protocol is being performed to the succeeding SN.

7.4.2 Per-call bearer set-up in backward direction

In this procedure the bearer is set-up in the backward direction from the succeeding SN back to the SN that sends the IAM. The IAM sent includes information to enable the bearer to be addressed back to the SN that sent the IAM, and to allow the bearer set-up indication to be correlated with the call.

1. In the response to the BNC Information request primitive, the BCF returns the BNC characteristics, BNC-ID and BIWF Address. The response also indicates that bearer control tunneling is not being used.

NOTE - The BNC Characteristics value indicated by the BCF may be dictated by the CSF, if a BNC Characteristics value was provided in the BNC Information request primitive.

- 1.1. An IAM is sent together with a BICC_Data request primitive containing:

- Action indicator set to *"Connect backward"*;
- BNC-ID;
- BIWF Address; and
- BNC characteristics.

2. When the bearer connection arrives at the SN, a Bearer Set-up indication is received from the BCF:

2.1. The Bearer Set-up indication is correlated with the call instance.

2.2. A Bearer Set-up response is sent to the BCF.

The outgoing set-up procedure is now successfully completed.

7.4.3 Per-call bearer set-up using bearer control tunneling -- fast set-up

In this procedure the bearer is set-up from the SN that sends the IAM. Information concerning the bearer set-up is carried transparently between BCFs via bearer control tunneling (see 6.4). Initial bearer set-up information is available when the IAM is sent.

1. In the response to the BNC Information request primitive, the BCF returns the BNC characteristics and a bearer control PDU, and may include the BNC-ID and BIWF Address. The response also indicates that bearer control tunneling is being used.

NOTE - The BNC Characteristics value indicated by the BCF may be dictated by the CSF, if a BNC Characteristics was provided in the BNC Information request primitive.

- 1.1. An IAM is sent including in the BICC_Data request primitive:

- Action indicator set to *"Connect forward"* or *"Connect backward"* - depending on whether the CSF chose forward or backward bearer set-up;
- Bearer Control Tunneling set to *"tunneling to be used"*;
- BNC characteristics;
- Bearer Control Information, containing the bearer control PDU;
- BNC-ID, if received from the BCF; and
- BIWF Address, if received from the BCF.

2. Subsequently a BICC_Data indication primitive (corresponding to an APM message) should be received.

- 2.1. If the IAM indicated *“Connect forward”*: If an Action indicator is received set to *“Connect forward, plus notification,”* the Connect Type⁵ is set to *“notification required,”* else it is set to *“notification not required.”*
- 2.2. If the IAM indicated *“Connect backward”*: the Connect Type⁵ is set to *“notification required.”*
 This primitive should include the Bearer Control Information information element. This information element, and any subsequently received Bearer Control Information information element(s) are handled according to the bearer control tunneling procedure (see 6.4).
3. Receipt of a primitive from the BCF, indicating *“BNC set-up success,”* indicates successful completion of the outgoing set-up procedure.
 - 3.1. If the Connect Type is *“notification required,”* a BICC_Data request primitive (corresponding to an APM message) is sent containing:
 - Action indicator set to *“Connected.”*

7.4.4 Per-call bearer set-up using bearer control tunneling -- delayed forward

In this procedure the bearer is set-up from the SN that sends the IAM. Information concerning the bearer set-up is carried transparently between BCFs via bearer control tunneling (see 6.4). Initial bearer set-up information is unavailable when the IAM is sent -- if a BIWF has been selected at this point the unavailability is indicated by the BCF. Alternatively, bearer set-up information is unavailable if the BIWF has not yet been selected, but in this case, the fact that bearer control tunneling will be applicable for the call is not initially known and the set-up starts according to 7.4.1.

1. Initial actions depend on whether a BIWF has been selected at the initiation of outgoing bearer set-up.
 - 1.1. *If a BIWF has been selected:* In the response to the BNC Information request primitive, the BCF returns the BNC characteristics. The response primitive also may include the BIWF-Address. The response also indicates that bearer control tunneling is being used and that the delayed forward set-up procedure is to be used.
 NOTE - The BNC Characteristics value indicated by the BCF may be dictated by the CSF, if a BNC Characteristics was provided in the BNC Information request primitive.
 - 1.2. *If no BIWF has been selected:* see 7.4.1.
 - 1.3. An IAM is sent including in the BICC_Data request primitive:
 - Action indicator set to *“Connect forward”*;
 - Bearer Control Tunneling, set to *“tunneling to be used”*;
 - BNC characteristics; and
 - BIWF Address, if received from the BCF.
2. Subsequently, a BICC_Data indication primitive (corresponding to an APM message) should be received.
 - 2.1. If the received Action indicator is *“Connect forward, plus notification,”* the Connect Type⁵ is set to *“notification required,”* else it is set to *“notification not required.”*
 - 2.2. A BIWF is selected, if one was not selected earlier.
 - 2.3. An Bearer Set-up request primitive is then sent to the selected BCF containing:
 - BNC-ID (if received in the BICC_Data indication primitive);

- BIWF Address (if received in the BICC_Data indication primitive);
 - Bearer Characteristics, i.e., User Service Information (as received in the IAM); and
 - An indication that bearer control tunneling shall be used (if this request was received in the BICC_Data indication primitive).
3. Bearer control tunneling (see 6.4) is then used to exchange bearer set-up information between BCFs.
 4. Receipt of a primitive from the BCF, indicating “*BNC set-up success*,” indicates successful completion of the outgoing set-up procedure.
 - 4.1. If the Connect Type is “*notification required*,” a BICC_Data request primitive (corresponding to an APM message) is sent containing:
 - Action indicator set to “*Connected*.”

7.4.5 Per-call bearer set-up using bearer control tunneling -- delayed backward

In this procedure the bearer is set-up in the backward direction from the succeeding SN back to the SN that sends the IAM. Information concerning the bearer set-up is carried transparently between BCFs via bearer control tunneling (see 6.4).

1. In the response to the BNC Information request primitive, the BCF returns the BNC characteristics and may also return the BNC-ID and BIWF Address. The response also indicates that bearer control tunneling is being used.

NOTE - The BNC Characteristics value indicated by the BCF may be dictated by the CSF, if a BNC Characteristics value was provided in the BNC Information request primitive.

- 1.1. An IAM is sent together with a BICC_Data request primitive containing:

- Action indicator set to “*Connect backward*”;
- Bearer Control Tunneling, set to “*tunneling to be used*”;
- BNC characteristics;
- BNC-ID, if received from the BCF; and
- BIWF Address, if received from the BCF.

2. Bearer control tunneling (see 6.4) is then used to exchange bearer set-up information between BCFs.
3. Receipt of a primitive from the BCF, indicating “*BNC set-up success*,” indicates successful completion of the outgoing set-up procedure.

7.5 Incoming bearer set-up procedure

Bearer set-up procedures are not applicable at a CMN.

See 7.4 for an introduction to the bearer set-up procedures.

7.5.1 Per-call bearer set-up in forward direction

This procedure is invoked if the received Action indicator is set to “*Connect forward*,” and the Bearer Control Tunneling information element indicating “*tunneling to be used*” is not present.

In this procedure the bearer is set-up from the SN that sends the IAM. Addressing and bearer identification information is sent backward to enable the preceding SN initiate the bearer connection. Alternatively, if the Bearer Control Tunneling information element set to *"no indication"* is received in the IAM, the BCF may indicate that bearer control tunneling (see 6.4) is applicable and the procedures continue in 7.5.4.

1. If Codec negotiation (see 8.3) is applicable, the following steps are delayed until indicated by that procedure.
2. A BNC Information Request primitive is sent to the BCF. This request includes:
 - BNC Characteristics (as received via BICC_Data indication primitive associated with the IAM);
 - Bearer Characteristics, i.e., User Service Information (as received in the IAM);
 - BIWF-Address, if received in the BICC_Data indication primitive; and
 - An indication that bearer control tunneling can be used, if the Bearer Control Tunneling information element set to *"no indication"* was received in the BICC_Data indication primitive.

If the response indicates that bearer control tunneling is applicable, the procedure continues at 7.5.4, item 2.1. Alternatively the response primitive returns the BNC-ID and BIWF Address and the procedure continues as follows:

- 2.1. The Connect Type⁶ is set to *"Notification not required."*

NOTE - The Connect Type *"Notification required"* may be set in networks that use bearer protocols that do not provide backward through connection of the bearer path at bearer set-up request time, for telephony service.
- 2.2. A BICC_Data request primitive is issued, (corresponding to an APM message), containing:
 - Action indicator set to: *"Connect forward, plus notification"* if the Connect Type is *"Notification required,"* else it is set to *"Connect forward, no notification."*
 - BNC-ID; and
 - BIWF Address.
3. When the bearer connection arrives at the SN a Bearer Set-up indication is received from the BCF:
 - 3.1. The Bearer Set-up indication is correlated with the call instance.
 - 3.2. A Bearer Set-up response is sent to the BCF.
 - 3.3. If the Connect Type is *"notification not required,"* the incoming set-up procedure is now successfully completed.
 - 3.4. If the Connect Type is *"notification required,"* the incoming set-up procedure awaits a BICC_Data indication primitive (corresponding to an APM message) containing Action indicator set to *"Connected."* The incoming set-up procedure is now successfully completed.

⁶ An internal variable "Connect Type" is used in the Incoming set-up procedure to record which variety of the set-up protocol is being performed to the preceding SN.

7.5.2 Per-call bearer set-up in backward direction

This procedure is invoked if the received Action indicator is set to *“Connect backward,”* and the Bearer Control Tunneling information element indicating *“tunneling to be used”* is not present.

In this procedure the IAM contains address and bearer identification information. This information is provided to the BCF. The address information enables the bearer to be routed back to the preceding SN. The bearer identification information is sent backward to enable the preceding SN to identify that this bearer relates to this call.

1. If Codec negotiation (see 8.3) is applicable the following steps are delayed until indicated by that procedure.
2. A Bearer Set-up request is sent to a selected BCF. This request includes:
 - BNC-ID (as received via BICC_Data indication primitive associated with the IAM).
 - BIWF Address (as received via BICC_Data indication primitive associated with the IAM).
 - Bearer Characteristics, i.e., User Service Information (as received in the IAM).
3. When the Bearer Set-up Connect indication is received from the BCF, the incoming set-up procedure is now successfully completed.

7.5.3 Per-call bearer set-up using bearer control tunneling -- fast set-up

This procedure is invoked if the received Action indicator is set to *“Connect forward”* or *“Connect backward,”* the Bearer Control Tunneling information element indicating *“tunneling to be used”* is present, and the Bearer Control Information information element is received.

In this procedure, the bearer is set-up from the SN that sends the IAM. Information concerning the bearer set-up is carried transparently between BCFs via bearer control tunneling (see 6.4).

1. If Codec negotiation (8.3) is applicable, the following steps are delayed until indicated by that procedure.
2. A BNC Information request primitive is sent to the selected BCF. This request includes:
 - BNC Characteristics (as received via BICC_Data indication primitive associated with the IAM);
 - Bearer Characteristics, i.e., User Service Information (as received in the IAM);
 - Bearer control PDU, (as received in the Bearer Control Information information element in the BICC_Data indication primitive);
 - BIWF-Address, if received in the BICC_Data indication primitive; and
 - BNC-ID, if received in the BICC_Data indication primitive.

The response primitive returns a bearer control PDU.

- 2.1. If the Action indicator in the IAM was *“Connect forward,”* the Connect Type⁶ is set to *“Notification not required.”*

NOTE - The Connect Type *“Notification required”* may be set in networks that use bearer protocols that do not provide backward through connection of the bearer path at bearer set-up request time, for telephony service.

If the Action indicator in the IAM was *“Connect backward,”* the Connect Type⁶ is set to *“Notification required.”*

- 2.2. A BICC_Data request primitive is issued (corresponding to an APM message), containing:

- If the Action indicator in the IAM was *"Connect forward"*: Action indicator set to: *"Connect forward, plus notification"* if the Connect Type is *"Notification required,"* else it is set to *"Connect forward, no notification"*;
 - If the Action indicator in the IAM was *"Connect backward"*: no Action indicator is sent; and
 - Bearer Control Information, containing the bearer control PDU.
3. Bearer control tunneling (see 6.4) may then be used to exchange further bearer set-up information between BCFs.
 4. If the Connect Type is *"notification not required,"* receipt of a primitive from the BCF, indicating *"BNC set-up success"* indicates successful completion of the incoming set-up procedure.
 5. If the Connect Type is *"notification required"* the incoming set-up procedure awaits a BICC_Data indication primitive (corresponding to an APM message) containing Action indicator set to *"Connected."* The incoming set-up procedure is now successfully completed.

7.5.4 Per-call bearer set-up using bearer control tunneling -- delayed forward

This procedure is invoked if the received Action indicator is set to *"Connect forward,"* the Bearer Control Tunneling information element indicating *"tunneling to be used"* is present, and no Bearer Control Information information element is received in the IAM. Alternatively this procedure can be applicable in case the Bearer Control Tunneling information element indicating *"no indication"* is present in the IAM, but in that case the procedure starts at 7.5.1.

In this procedure, the bearer is set-up from the SN that sends the IAM. Information concerning the bearer set-up is carried transparently between BCFs via bearer control tunneling (see 6.4).

1. If Codec negotiation (see 8.3) is applicable, the following steps are delayed until indicated by that procedure.
2. A BNC Information request primitive is sent to the selected BCF. This request includes:
 - BNC Characteristics (as received via BICC_Data indication primitive associated with the IAM);
 - Bearer Characteristics, i.e., User Service Information (as received in the IAM);
 - BIWF-Address, if received in the BICC_Data indication primitive; and
 - An indication that bearer control tunneling shall be used if *"tunneling to be used"* was received in the Bearer Control Tunneling information element in the BICC_Data primitive.

Upon receipt of the response primitive:

- 2.1. The Connect Type⁶ is set to *"Notification not required."*

NOTE - The Connect Type *"Notification required"* may be set in networks that use bearer protocols that do not provide backward through connection of the bearer path at bearer set-up request time, for telephony service.

- 2.2. A BICC_Data request primitive is issued (corresponding to an APM message), containing:
 - Action indicator set to *"Connect forward, plus notification"* if the Connect Type is *"Notification required,"* else it is set to *"Connect forward, no notification"*;
 - If *"tunneling to be used"* indication was not present in the IAM, i.e., bearer control tunneling has been initiated by the BCF at this SN (see 7.5.1), the Bearer Control Tunneling information element is included indicating *"tunneling to be used."*

- BNC-ID, if received from the BCF; and
 - BIWF Address, if received from the BCF.
3. Bearer control tunneling (see 6.4) may then be used to exchange bearer set-up information between BCFs.
 4. If the Connect Type is *"notification not required,"* receipt of a primitive from the BCF, indicating *"BNC set-up success"* indicates successful completion of the incoming set-up procedure.
 5. If the Connect Type is *"notification required,"* the incoming set-up procedure awaits a BICC_Data indication primitive (corresponding to an APM message) containing Action indicator set to *"Connected."* The incoming set-up procedure is now successfully completed.

7.5.5 Per-call bearer set-up using bearer control tunneling -- delayed backward

This procedure is invoked if the received Action indicator is set to *"Connect backward"* and the Bearer Control Tunneling information element is present indicating *"tunneling to be used."*

In this procedure, the bearer is set-up in the backward direction from the succeeding SN back to the SN that sends the IAM. Information concerning the bearer set-up is carried transparently between BCFs via bearer control tunneling.

1. If Codec negotiation (see 8.3) is applicable, the following steps are delayed until indicated by that procedure.
2. A Bearer Set-up request primitive is sent to a selected BCF. This request includes:
 - BNC Characteristics (as received via BICC_Data indication primitive associated with the IAM);
 - BIWF-Address (if received in the BICC_Data indication primitive);
 - BNC-ID (if received in the BICC_Data indication primitive);
 - Bearer Characteristics, i.e., User service Information (as received in the IAM); and
 - An indication that bearer control tunneling shall be used.
3. Bearer control tunneling (see 6.4) may then be used to exchange bearer set-up information between BCFs.
4. Receipt of a primitive from the BCF, indicating *"BNC set-up success,"* indicates successful completion of the incoming set-up procedure.

7.6 Continuity message

7.6.1 Actions required at the originating SN

If the Continuity Indicator in the Nature of Connection Indicators parameter sent in the IAM (see 7.2 and 7.3) was set to *"COT to be expected,"* then the Continuity message -- with the Continuity Indicators parameter set to *"continuity"* -- is sent when the incoming bearer set-up procedures are successfully completed (see relevant interworking specification).

7.6.2 Actions required at an intermediate SN

7.6.2.1 Outgoing signaling procedure

The IAM is sent before completion of the bearer set-up, and the Continuity message is used to withhold call completion until establishment of the bearer is complete.

As described in the Outgoing signaling procedures in 7.2 and 7.3, when the IAM is sent the Continuity Indicator in the Nature of Connection Indicators parameter is set to indicate *“COT to be expected.”*

The Continuity message -- with the Continuity Indicators parameter set to *“continuity”* -- is sent when the two following conditions are satisfied:

1. If the incoming IAM indicated *“COT to be expected,”* a Continuity message -- with the Continuity Indicators parameter set to *“continuity”* -- shall be received.
2. One of the following events, which indicate successful completion of bearer set-up, shall also be received by the Incoming bearer set-up procedure, depending on the procedure being applied:
 - 2.1. *Bearer Set-up indication*: For the forward bearer set-up case where the incoming Connect Type is *“notification not required.”*
 - 2.2. *BICC_Data indication primitive with Action indicator set to “Connected”*: For the forward bearer set-up cases (with or without bearer control tunneling) where the incoming Connect Type is *“notification required,”* and for the fast set-up (backward) case.
 - 2.3. *Bearer Set-up Connect indication*: For the backward bearer set-up case.
 - 2.4. *BNC set-up success indication*: For cases using bearer control tunneling, except as identified in item 2.2 above.

7.6.2.2 Incoming signaling procedure

When an IAM is received with the Nature of Connection Indicators parameter set to indicate *“COT to be expected,”* timer T8 is started. On receipt of a Continuity message with the Continuity Indicators parameter set to *“continuity,”* timer T8 is stopped, and the message passed to the outgoing signaling procedures. However, if timer T8 expires, the call is released with cause #41, *“temporary failure.”*

7.6.3 Actions required at a CMN

A CMN shall pass the Continuity Indicator in the IAM and any subsequent COT message unchanged. A CMN does not run timer T8.

7.6.4 Actions required at the destination SN

7.6.4.1 Incoming signaling procedure

When an IAM is received with the Nature of Connection Indicators parameter set to indicate *“COT to be expected,”* timer T8 is started. On receipt of a Continuity message with the Continuity Indicators parameter set to *“continuity,”* timer T8 is stopped, and the call shall proceed according to 7.7.1. However, if timer T8 expires, the call is released with cause #41, *“temporary failure.”*

7.7 Address Complete Message⁷

The ACM carries a charge indicator in addition to other indicators. Additional information (e.g., related to supplementary services) can be included as well.

The ACM may be subject to Simple Segmentation (see 12.2).

7.7.1 Actions required at the destination SN

An ACM will be sent by the CSF at the destination SN as soon as it has been determined that the complete called party number has been received, or an indication received from the called party that an in-band tone is being connected (for this case, see 8.2 and 9.5). However, there is no direct mapping from alerting, received from the access signaling system, to address complete in the network. In the case that the Continuity message is awaited according to 7.6.4, the CSF shall withhold sending the ACM until a successful continuity indication has been received.

ACM is sent by the CSF at the destination SN according to the relevant interworking specification, e.g., Annexes G/T1.673.4 and H/T1.673.4.

The CSF will set the fields of the Backward Call Indicators parameter to indicate:

- i) *"No end-to-end method available";*
- ii) *"No interworking encountered";* and
- iii) *"ISDN-User Part/BICC used all the way."*

See 7.8.6 for generation of immediate ANM at the destination SN.

7.7.2 Actions required at an intermediate SN/CMN

This subclause describes the CSF actions to be performed at an intermediate SN or CMN.

7.7.2.1 Common procedures

Upon receipt of an ACM, the CSF will send the corresponding ACM to the preceding CSF with the parameters and parameter contents as received, unless indicated otherwise in this American National Standard. However, if the CSF has already sent an ACM to the preceding CSF, the procedure in 13A.4 applies.

For a speech, 3.1 kHz audio, or UDI-TA call, the intermediate SN shall through connect the internal bearer path in the backward direction, if not already connected. If the ACM indicates that interworking has occurred, the intermediate SN shall through connect the internal bearer path in both directions, if not already connected.

⁷ The Connect message as specified in ITU-T Recommendation Q.1902.4 is not specified for U.S. networks.

7.7.2.2 Actions required at an intermediate national SN/CMN

Subclause 7.7.2.1 applies.

7.7.2.3 Actions required at an intermediate international SN/CMN

[Not applicable to this Standard.]

7.7.3 Actions required at an outgoing gateway SN/CMN

This subclause describes the CSF actions to be performed at an outgoing gateway SN or CMN.

Upon receipt of an ACM or ANM, the awaiting address complete timer (T7) is stopped if it was running.

See also 7.7.2.

7.7.4 Actions required at an incoming gateway SN/CMN

This subclause describes the CSF actions to be performed at an incoming gateway SN or CMN.

Upon receipt of an ACM or ANM, the awaiting address complete timer (T7) is stopped if it was running.

See also 7.7.2.

7.7.5 Actions required at the originating SN

- a) On receipt of the ACM, the awaiting address complete timer (T7) is stopped⁸.
- b) If an ANM is received, then the awaiting address complete timer (T7) is stopped if it was running (see 7.8.6).

See also the relevant interworking specification, e.g., Annexes G/T1.673.4 and H/T1.673.4.

For a speech, 3.1 kHz audio, or UDI-TA call, the originating SN shall through connect the internal bearer path in the backward direction, if not already connected. If the ACM indicates that interworking has occurred, the originating SN shall through connect the internal bearer path in both directions, if not already connected.

⁸ The awaiting answer timer as specified in ITU-T Recommendation Q.1902.4 is not specified for U.S. networks.

7.7.6 Internal through-connection of the bearer path and awaiting answer indication at the destination SN

The sending of the awaiting answer indication (e.g., ring tone) at the destination SN depends on the type of call. On speech, 64 kbit/s UDI-TA, 3.1 kHz calls, and calls to an non-ISDN called party, the awaiting answer indication is applied to the bearer path to the calling party from the destination SN on receipt of an alerting indication from the called party or from information contained within the destination SN that the called party will not or is prohibited from providing in-band tone. It may optionally be provided based on timer expiry in networks supporting the call delay indication (see Annex G/T1.673.4 and T1.609-1999).

Regardless of whether tones are to be provided or not, the destination SN will through connect after the reception of the connection indication from the called party and before sending the ANM to the preceding CSF.

If the destination SN does not send the awaiting answer indication because the destination user provides for the sending of tones, then the destination SN will through connect the internal bearer path in the backward direction on receipt of the progress indication.

The complete through-connection of the internal bearer path at answer is covered in 7.8.

7.8 Answer message

The ANM may be subject to Simple Segmentation (see 12.2).

7.8.1 Actions required at the destination SN

When the called party answers, the destination SN connects through the internal bearer path and the ringing tone is removed if applicable. An ANM is sent to the preceding CSF.

When the called party is designated as a free call (Official Number), the CSF shall indicate "*no charge*" in the Backward Call Indicators parameter in the Answer Message. In all other cases, if the Backward Call Indicators parameter is included in the Answer Message, the charge indicator is set to "*no indication*."

See also the relevant interworking specification, e.g., Annexes G/T1.673.4 and H/T1.673.4.

7.8.2 Actions required at an intermediate SN/CMN

This subclause describes the CSF actions to be performed at an intermediate SN or CMN.

7.8.2.1 Common procedures

Upon receipt of an ANM, an intermediate SN through connects the internal bearer path in both directions if not already connected. The CSF sends the corresponding ANM to the preceding CSF with the same parameters and parameter contents as received unless indicated otherwise in this American National Standard.

7.8.2.2 Actions required at an intermediate national SN/CMN

Subclause 7.8.2.1 applies with the following exception:

- If this is the CSF controlling charging, charging may begin.

7.8.2.3 Actions required at an intermediate international SN/CMN

[Not applicable to this Standard.]

7.8.3 Actions required at an outgoing gateway SN/CMN

This subclause describes the CSF actions to be performed at an outgoing gateway SN or CMN.

Subclause 7.8.2 applies.

7.8.4 Actions required at an incoming gateway SN/CMN

This subclause describes the CSF actions to be performed at an incoming gateway SN or CMN.

Upon receipt of an ANM, the CSF sends the corresponding ANM to the preceding CSF with the same parameters and parameter contents as received unless indicated otherwise in this American National Standard.

7.8.5 Actions required at the originating SN

When the CSF at the originating SN receives an ANM indicating the required connection has been completed, the internal bearer path is connected through in both directions, if not already connected. If the CSF at the originating SN controls charging, charging may begin if applicable.

See also the relevant interworking specification, e.g., Annexes G/T1.673.4 and H/T1.673.4.

7.8.6 Return of answer from automatic terminals

When connections are set up to terminals having an automatic answer feature, the alerting indication may not be received from the called party. If the CSF at a destination SN receives a connect indication, an ANM is sent as soon as the internal bearer path is completed.

See also the relevant interworking specification, e.g., Annexes G/T1.673.4 and H/T1.673.4.

7.9 Access Transport Parameter

Whenever the CSF at an intermediate SN/CMN passes on a message containing the Access Transport parameter, the order of information elements carried in the parameter received from the preceding/succeeding CSF shall be retained.

7.10 Storage and release of Initial Address Message information

Each CSF in the call path shall store during the call set-up the IAM information sent (the originating SN) or received (intermediate SN or CMN, or destination SN). The information to be stored includes all parameters in the IAM and, if the IAM has been segmented, in the subsequent Segmentation message. The contents of the IAM information shall be updated, if the value of parameters change during the call set-up.

The IAM information can be released from memory:

- a) By the CSF in the originating SN when the ACM (or an ANM instead of an ACM) has been received and the calling party does not subscribe to a supplementary service that would cause a new call set-up. The release of the information when the calling party does subscribe to a supplementary service is covered in separate service-specific American National Standards;
- b) By the CSF in the intermediate SN or CMN when the ACM (or an ANM instead of an ACM) has been received;
- c) By the CSF in the destination SN when the ACM (or an ANM instead of an ACM) has been sent and the called party does not subscribe to a supplementary service which would cause a new call set-up. The release of the information when the called party does subscribe to a supplementary service is covered in separate service-specific American National Standards;

and when the call is released earlier and no automatic repeat attempt is to be attempted.

8 Additional set-up procedures

8.1 Introduction

This clause describes procedures that can be employed -- in addition to the procedures in clause 7 -- during the set-up of a call, to provide added functionality relating to that call.

8.2 Call Progress

The CPG is sent from a CSF in either direction, indicating that an event has occurred that should be relayed to the user.

For the basic call, a CPG can be sent only after the ACM in the backward direction. A CPG can be sent in either direction after receipt of an ANM, if required by a supplementary service.

If a backward CPG is received before an ACM, it should not cause change of call state. In this case, the CPG is used by a supplementary service to report occurrence of an event. It has no effect to the basic call flow, since the CPG is not considered as the first backward basic call message.

A CPG shall not be sent in the forward direction until an ACM has been received in the backward direction. On receipt of a CPG in the forward direction before an expected COT message has been received, the CSF receiving the CPG shall start the CIC reset sending sequence, which shall result in a Reset CIC message being sent in the backward direction. In addition, the CSF shall send a Release Message with Cause Value 41 signifying temporary failure to the succeeding CSF to release the call.

The CPG may be subject to Simple Segmentation (see 12.2).

8.2.1 Actions required at the destination SN

The CPG is sent from the CSF at a destination SN if the ACM has been sent and subsequently:

- An indication is received that the called party is being alerted; the CPG contains an Event Indicator that is set to *“alerting”*;
- A progress indication is received from the called party; the CPG contains an Event Indicator that is set to *“progress.”*

In both cases, the Event Presentation Restricted indicator shall be set to *“no indication.”*

See the relevant interworking specification, e.g., Annexes G/T1.673.4 and H/T1.673.4.

The destination SN may on receipt of the indication from the called party, that contains an appropriate progress indication, through connect the internal bearer path (see 7.7.6).

In the case of call failure and the connection of a tone or announcement being returned before the ACM has been returned (see 9.5).

8.2.2 Actions required at an intermediate SN/CMN

On receipt of a CPG, a CSF will send the corresponding CPG to the preceding CSF with the same parameters and parameter contents as received unless indicated otherwise in this American National Standard.

On receipt of a CPG in the backward direction before the COT message has been sent (if applicable), the CSF receiving the CPG shall start the CIC reset sending sequence that shall result in a Reset CIC message being sent. In addition, the CSF shall send a Release Message with Cause Value 41, signifying temporary failure to the preceding CSF to release the call.

8.2.3 Actions required at the originating SN

On receipt of a CPG, no state change occurs (in particular, the awaiting address complete timer is not stopped if it is running) and the appropriate indication is sent to the calling user. See the relevant interworking specification, e.g., Annexes G/T1.673.4 and H/T1.673.4.

On receipt of the CPG in the backward direction before the Continuity message is sent (if applicable), the CSF shall start the CIC reset sending sequence, which shall result in the Reset CIC message being sent.

8.3 Codec Negotiation

The support of the codec negotiation procedure is optional. Codec negotiation is not applicable in case of re-use of idle bearers, see Annex B/T1.673.4. Codec negotiation procedures are not applicable at a CMN -- a CMN shall pass all codec information unchanged.

When codec negotiation is not being performed the set-up of the bearers is performed, call segment by call segment, concurrent with the progressing of the IAM through the network. However, when codec negotiation is required the negotiation has to be performed edge-to-edge (across the BICC network(s) that support this procedure), and the result of this negotiation is needed before the bearers can be set-up. The following subclauses detail the procedures as a set of variations to the non-codec procedures, as defined in the preceding subclauses.

8.3.1 SN initiating codec negotiation

At an SN generating an IAM, the CSF procedures in 7.4 apply with the following additions:

1. The Supported Codec List is constructed and contains all the codecs, in priority order, that are offered for use in the call. The preferred codec is placed as the highest priority in the list.
2. The Supported Codec List for the call is sent forward in the BICC_Data request primitive associated with the IAM. It is coded as a Codec List information element and shall not include more than eight Single Codec information elements.
3. The preferred codec identity is indicated to the BCF, if a BIWF has currently been selected.

Subsequent procedures are according to the relevant outgoing bearer set-up procedure, as amended by the exceptions defined in 8.3.4.

8.3.2 SN transiting codec negotiation

For the TSN case within one network, or for a GSN connecting two networks that support codec negotiation, an IAM with a BICC_Data indication primitive that includes the Codec List information element, is processed according to procedures in 7.2 or 7.3, but the incoming bearer set-up procedure is suspended until backward codec information is received (see 7.5).

The BICC_Data request primitive associated with the IAM sent to the next CSF shall include the Supported Codec List. This Supported Codec List is derived from the received Supported Codec List by deleting the codecs from the received Supported Codec List that cannot be used for the call.

When the outgoing bearer set-up procedure (see 8.3.4) receives Selected Codec and Available Codecs List information, it is passed to the relevant incoming bearer set-up procedure in 8.3.5.

In the case of a GSN between a network supporting codec negotiation and a network not supporting such capability, then:

- If the incoming side of the call is the network that supports codec negotiation then the CSF shall perform the codec negotiation procedures described in 8.3.3 for SN terminating codec negotiation.
- If the incoming side of the call is the network that does not support codec negotiation, then the CSF shall perform the codec negotiation procedures described in 8.3.1 for an SN initiating codec negotiation.

8.3.3 SN terminating codec negotiation

When an SN terminating codec negotiation receives an IAM with a BICC_Data indication primitive that includes the Codec List information element, the CSF procedures in 7.5 apply with the following additions:

- The CSF performs the following procedure to select the appropriate codec to be used for the call (the “Selected Codec”), and to discover the list of codecs available for the call (the “Available Codec List”):
 - a) It selects the codec with highest priority in the received Supported Codec List that is appropriate for the call.
 - b) It constructs the Available Codec List for the call by deleting the entries that cannot be used for the call. (The selected codec is also included in the list of available codecs.)

Subsequent procedures are according to the relevant incoming bearer set-up procedure, as amended by the exceptions in 8.3.5.

8.3.4 Outgoing bearer set-up procedure

When the Outgoing signaling procedure determines that the IAM can be sent onwards from this CSF the forward or backward outgoing bearer set-up procedure is started.

Two variations of each procedure are defined. The variant to be followed depends on the through connection characteristic of the bearer.

8.3.4.1 Per-call bearer set-up in forward direction

The procedures in 7.4.1, 7.4.3 (forward set-up), or 7.4.4 apply with the following additions:

- The Selected Codec and Available Codecs List for the call shall be received in the BICC_Data indication primitive (corresponding to an APM) received at 7.4.1, 7.4.3 or 7.4.4 item 2:
 - Action indicator set to “*connect forward, no notification + selected codec*” or “*connect forward, plus notification + selected codec*.” (The handling of these Action indicators in the relevant subclause in 7.4 shall be as for values “*connect forward, no notification*” or “*connect forward, plus notification*,” respectively.)
 - The Selected Codec is coded as the Single Codec information element.
 - The Available Codecs List is coded as the Codec List information element.

The selected codec identity is indicated to the BCF, unless it is identical to the preferred codec indicated to the BCF in 8.3.1, and the Available Codec List is stored for future use.

8.3.4.2 Per-call bearer set-up in backward direction

The procedures in 7.4.2, 7.4.3 (backward set-up), or 7.4.5 apply with the following additions:

- The Selected Codec and Available Codecs List for the call shall be received in a BICC_Data indication primitive (corresponding to an APM message):
 - Action indicator set to “*selected codec*”;
 - The Selected Codec is coded as the Single Codec information element; and
 - The Available Codecs List is coded as the Codec List information element.

In the fast set-up (forward) case (see 7.4.3), this primitive will be received prior to 7.5.3, item 2.

The selected codec identity is indicated to the BCF, unless it is identical to the preferred codec indicated to the BCF in 8.3.1, and the Available Codec List is stored for future use.

8.3.5 Incoming bearer set-up procedure

8.3.5.1 Per-call bearer set-up in forward direction

The procedures in 7.5.1, 7.5.3 (forward set-up), or 7.5.4 apply with the following exceptions:

- The incoming bearer set-up procedure shall wait, at 7.5.1, 7.5.3, or 7.5.4, item 1, until the Selected Codec and the Available Codecs List for the call become available⁹ -- the procedure then continues. The Selected Codec and the Available Codecs List shall be included in the BICC_Data request primitive sent at 7.5.1, 7.5.3, or 7.5.4, item 2.2:
 - Action indicator set to “*connect forward, no notification + selected codec*” or “*connect forward, plus notification + selected codec.*” (Instead of values “*connect forward, no notification*” or “*connect forward, plus notification,*” respectively.)
 - The Selected Codec is coded as the Single Codec information element.
 - The Available Codecs List is coded as the Codec List information element.

The selected codec identity is indicated to the BCF and the Available Codec List is stored for future use (if not already stored).

8.3.5.2 Per-call bearer set-up in backward direction

The procedures in 7.5.2, 7.5.3 (backward set-up), or 7.5.5 apply with the following exceptions:

- The incoming bearer set-up procedure shall wait, at 7.5.2, 7.5.3, or 7.5.5, item 1, until the Selected Codec information and the Available Codecs List for the call become available⁹, the procedure shall continue as follows:
 1. A BICC_Data request primitive (corresponding to an APM message) shall be issued including:
 - Action indicator set to “*selected codec*”;

⁹ This information is either received from the terminating codec negotiation procedure, or from the Outgoing bearer set-up procedure, if at a SN transiting codec negotiation.

- Selected Codec, coded as the Single Codec information element; and
 - Available Codecs List, coded as the Codec List information element.
2. The selected codec identity is indicated to the BCF and the Available Codec List is stored for future use (if not already stored).
 3. The procedures to initiate bearer set-up continue at 7.5.2, 7.5.3, or 7.5.5, item 2.

8.3.6 Abnormal cases

8.3.6.1 Codec Unavailability

If there is no codec available in the SN that matches any of the codecs offered in the received Supported Codec List, then call release procedures with cause #47, “*resource unavailable, unspecified,*” shall be initiated.

8.3.6.2 SN initiating codec negotiation

Whenever a CSF that has initiated codec negotiation procedures for a call receives a BAT Compatibility Report information element in a BICC_Data indication primitive from the succeeding node indicating that the codec negotiation parameters have been discarded and the call is proceeding without such parameters, the CSF shall then terminate its internal codec negotiation procedures and the procedures shall continue from item 2 of the relevant Outgoing bearer set-up procedure in 7.4.

8.3.6.3 Codec negotiation in a SN transiting codec negotiation

Whenever a CSF transiting codec negotiation for a call, as described in 8.3.2, receives a BAT Compatibility Report information element in a BICC_Data indication primitive from the succeeding node indicating that the codec negotiation parameters have been discarded and the call is proceeding without such parameters, the procedures are for further study.

8.4 Echo Control

8.4.1 General

The echo control procedure is used on a per call basis to convey information between the CSFs at SNs about the demand and ability to insert echo control devices.

Echo control procedures are not applicable at a CMN -- a CMN shall pass the Echo Control Device Indicators in the Nature of Connection Indicators and Backward Call Indicators parameter unchanged.

The procedure is invoked when a call is to be routed on a connection for which echo control is necessary. It could be initiated by the CSF at an originating or intermediate SN.

Echo control devices shall not be used when codec negotiation is employed and the resultant codec is not G.711.

NOTE 1 - Due to the bearer technologies being employed, there may be cases when echo control will be performed by enabling an outgoing echo control device on the incoming side of an SN and an incoming echo

control device on the outgoing side of an SN. Such configurations are allowed by the echo logic in ITU-T Recommendation Q.115.

8.4.2 Procedures

The procedures described in this subclause indicate when echo control devices should be enabled/disabled. The action of enabling/disabling the device is achieved by the CSF issuing appropriate requests to the BCF.

8.4.2.1 Forward direction

NOTE - In all cases the sending of the IAM message does not need to wait for confirmation that a requested echo control device has been enabled. The action to be taken if a BCF subsequently identifies a failure to enable the requested echo control device is a network operator's option -- i.e., the call may be allowed to proceed or release procedures may be invoked using cause value #41 "*temporary failure*" (see ITU-T Recommendation Q.115).

8.4.2.1.1 Actions at the originating SN

If the CSF at an originating SN has sufficient information to determine that echo control is necessary for the outgoing bearer connection, then:

- Outgoing echo control device is enabled; and
- The Echo Control Device Indicator of the Nature of Connection Indicators parameter in the IAM is set to "*outgoing echo control device included.*"

8.4.2.1.2 Actions at an intermediate SN

If the CSF at an intermediate SN has sufficient information to determine that echo control is required for the outgoing bearer connection, then one of the following actions can occur:

- a) When the Nature of Connection Indicators parameter field in the IAM indicates that an echo control device is already included:
 - No change to the Nature of Connection Indicators parameter field in the IAM is made;
 - An incoming echo control device is reserved; and
 - Any outgoing echo control device is disabled.
- b) When the Nature of Connection Indicators parameter field in the IAM does not indicate that an echo control device is already included:
 - An outgoing echo control device is enabled; and
 - The Echo Control Device Indicator in the Nature of Connection Indicators parameter is set to "*outgoing echo control device included.*"

If the CSF at the intermediate SN has sufficient information to determine that echo control is not required for the outgoing bearer connection, then one of the following actions can occur:

- a) When the Nature of Connection Indicators parameter field in the IAM indicates that an echo control device is already included:
 - No change to the Nature of Connection Indicators parameter field in the IAM is made; and
 - No incoming echo control device is reserved.
- b) When the Nature of Connection Indicators parameter field in the IAM does not indicate that an echo control device is already included:
 - No additional action is required.

8.4.2.1.3 Actions at the destination SN

See 8.4.2.2.1 below.

8.4.2.2 Backward direction

8.4.2.2.1 Actions at the destination SN

Upon the receipt of an IAM with the indication “*outgoing echo control device included*” in the Nature of Connection Indicators parameter field, the following action is taken:

- An incoming echo control device is enabled; and
- The Echo Control Device Indicator of the Backward Call Indicators parameter in the first backward message (ACM, ANM, or CPG) is set to “*incoming echo control device included.*”

If the CSF at the destination SN is unable to include an incoming echo control device, the information is conveyed to the preceding CSF by the Echo Control Device Indicator in the Backward Call Indicators parameter in the first backward message (ACM, ANM, or CPG) set to “*incoming echo control device not included.*”

8.4.2.2.2 Actions at an intermediate SN

Upon receipt of the first backward message (ACM, ANM, or CPG) in response to an IAM with echo control indication, then one of the following actions can occur:

- a) When the Backward Call Indicators parameter field indicates that an incoming echo control device is not already included:
 - The reserved incoming echo control device is included; and
 - The Echo Control Device Indicator in the Backward Call Indicators parameter is set to “*incoming echo control device included.*”
- b) When the Backward Call Indicators parameter field indicates that an incoming echo control device is already included:
 - The reserved incoming echo control is released; and
 - No change to the Backward Call Indicators parameter field in the backward message is made.

8.4.2.2.3 Actions at the originating SN

No additional action is required.

8.5 Propagation delay procedure

[Not applicable to North American networks.]

8.6 Signaling procedures for connection type allowing fallback.

A connection type -- "connection type allowing fallback" -- is specified. With this connection type a call is setup using 64 kbit/s "unrestricted digital information with tones and announcements (UDI-TA)" as the preferred bearer capability and is allowed to fallback to either speech or 3.1 kHz audio if the calling user has indicated that fallback is allowed by including another bearer capability information element in the setup. This means that connection type allowing fallback shall be capable of invoking echo control, as it may be required for speech or 3.1 kHz audio.

When fallback has occurred, the call is routed on a fallback connection type, which is either speech or 3.1 kHz audio as indicated by the calling user.

In order to support the connection type allowing fallback, the following optional parameters are required:

- User Service Information Prime (USI'); and
- Transmission Medium Used (TMU).

The optional USI' parameter may be contained in an IAM. If a USI' parameter is not present, fallback is not allowed. The optional TMU parameter may be contained in an ACM, CPG, or ANM.

8.6.1 Actions in the forward direction

8.6.1.1 Actions at the originating SN

In order to set-up a connection type allowing fallback, the relevant access interworking specification -- e.g., Annexes G/T1.673.4 and H/T1.673.4 -- may require that:

1. Two bearer capability information elements are mapped into one corresponding USI parameter and one corresponding USI' parameter to be carried in the IAM. If the USI' parameter is not present, fallback is not allowed.

The USI' parameter carries the preferred bearer capability and the USI parameter carries the fallback bearer capability.

2. The USI' parameter is coded "*64 kbit/s UDI-TA*," and the call is routed according to this parameter.

This means that the connection must be capable of satisfying the connection type requirements of both 64 kbit/s unrestricted and 3.1 kHz audio or speech connection types (e.g., it must be possible to invoke echo control on the connection, if applicable, and the signaling procedures for fallback).

3. The USI parameter carries the fallback connection type and is coded either as "*3.1 kHz audio*" or "*speech*," depending on which connection type should be used in the case of fallback.

8.6.1.2 Actions at an intermediate SN/CMN

8.6.1.2.1 Succeeding network does have the capability of performing fallback

The CSF at an intermediate SN or CMN will set up the call on a route according to the USI' parameter "64 kbit/s UDI-TA" whenever available.

If congestion on the route is encountered, and if there is no alternative route available supporting the connection type allowing fallback or a signaling capability to fallback, fallback procedures will be initiated according to 8.6.1.2.2.

8.6.1.2.2 Succeeding network does not have the capability of performing fallback

In case there is no route available being capable of satisfying the connection type requirements of "64 kbit/s UDI-TA," the CSF will continue the call, discard the USI' parameter, maintain the USI parameter.

Appropriate actions to modify network resources (e.g., echo control) will be initiated.

8.6.1.3 Actions at the destination SN

The information carried in the USI parameter and the USI' parameter is handled according to the relevant interworking specification -- e.g., Annexes G/T1.673.4 and H/T1.673.4.

8.6.2 Actions in the backward direction – fallback indicated before answer

8.6.2.1 Actions at the destination SN

Fallback before answer may be indicated according to the relevant access interworking. This will be indicated in the backward direction by including a TMU parameter (which has been set according to the fallback connection type indicated by the USI parameter) in the ACM or CPG if an ACM had already been returned.

Appropriate actions to modify network resources (e.g., echo control) will be initiated.

8.6.2.2 Actions at an intermediate SN/CMN

8.6.2.2.1 Succeeding network does have the capability of performing fallback

The CSF will know that fallback has occurred by receiving the TMU parameter. This parameter indicates the fallback connection type.

At an SN, appropriate actions to modify network resources (e.g., echo control) will be initiated.

8.6.2.2.2 Succeeding network does not have the capability of performing fallback

The CSF will include a TMU parameter (which has been set according to the fallback connection type indicated in the USI parameter) in the ACM or CPG indicating that fallback has occurred for this call.

At an SN, appropriate actions to modify network resources (e.g., echo control) will be initiated.

8.6.2.3 Actions at the originating SN

The CSF will know that fallback has occurred by receiving the TMU parameter. The TMU parameter indicates the fallback connection type.

Appropriate actions to modify network resources (e.g., echo control) will be initiated.

8.6.3 Actions in the backward direction – fallback indicated at answer

8.6.3.1 Actions at the destination SN

Fallback at answer may be indicated according to the relevant access interworking. This will be indicated by including a TMU parameter (which has been set according to the fallback connection type indicated in the USI parameter) in the ANM.

Appropriate actions to modify network resources (e.g., echo control) will be initiated.

8.6.3.2 Actions at an intermediate SN/CMN

The CSF will know that fallback has occurred by receiving the TMU parameter. This parameter indicates the fallback connection type.

At an SN, appropriate actions to modify network resources (e.g., echo control) will be initiated.

8.6.3.3 Actions at the originating SN

The CSF will know that fallback has occurred by receiving the TMU parameter. The TMU parameter indicates the fallback connection type.

Appropriate actions to modify network resources (e.g., echo control) will be initiated.

8.6.4 Actions in the backward direction – fallback does not occur

The non-occurrence of fallback is indicated in the backward direction by the absence of the TMU parameter.

No further actions are required in any of the CSFs involved in the call.

8.6.5 Echo control for connection types allowing fallback

The placement of echo control devices on a connection type allowing fallback is performed by the echo control signaling procedures (see 8.4). The enabling of the echo control devices shall only be carried out if a TMU parameter is received in the backward direction indicating "*speech*" or "*3.1 kHz audio*."

8.6.6 Completion of the internal bearer path

For a call using the connection type allowing fallback, the through-connect procedure at an originating, intermediate, and destination SN shall be the same as for 3.1 kHz audio.

8.7 Transit network selection

If transit network selection information is included in the set-up information from the calling party or is provided on a subscription basis, this information is carried in the Transit Network Selection parameter, and is used for routing of the call (e.g., to a specific carrier). The Transit Network Selection parameter is removed before the call is passed to the indicated transit network.

8.8 Support for Temporary Alternative Routing (TAR)

As described in ITU-T Recommendation E.412 (clause 3.2.3), a CSF which has invoked the network management Temporary Alternative Routing (TAR) control shall include a "*TAR controlled call*" indication in an outgoing IAM.

A succeeding CSF which receives a TAR Indicator indicating "*TAR controlled call*" in the Network Management Controls parameter shall not apply network management TAR to the same call. The received TAR Indicator shall be passed on unchanged. This procedure relates to call routing only(i.e., not bearer routing).

8.9 Hop counter procedure

A CSF settable option to deactivate the hop counter capability applies per outgoing route. The default is active.

The hop counter procedure specifies common CSF actions and those that result when calls are routed with the capability active or deactivated.

8.9.1 Actions at the originating SN

The CSF at an originating SN shall not initiate the hop counter parameter.

The CSF at an originating SN receiving a REL with ANSI cause 25, "*SN/CMN routing error*," shall notify the management system of the SN/CMN routing error and provide the called party number, identity of the succeeding SN/CMN¹⁰, and if available, the calling party number.

8.9.2 Actions at an intermediate SN/CMN (includes forwarding SN/CMN)

CSF actions are dependent upon whether a hop counter parameter is received from the preceding CSF, and if received, the result of decrementing the hop counter value. The hop counter value is manipulated on a per call association basis. The actions are also dependent on the occurrence of call forwarding, and rely on the use of the redirection information parameter to release calls that involve call forwarding looping.

If the hop counter parameter is received, the CSF at an intermediate SN/CMN shall decrement the hop counter value by 1, after first checking its value being equal to zero as received. If its value is zero upon receipt, the CSF shall release the call as specified in a) below. Subsequent actions are based on the result as described below:

- a) If the result equals 0, the CSF shall release the call by returning a REL with ANSI cause 25, "*SN/CMN routing error*," to the preceding CSF. In addition, the management system shall be informed of the hop counter exhaust (value = 0), associated called party number, identity of the preceding SN/CMN, and if available, the calling party number.
- b) If result is greater than 0, the CSF shall include the hop counter parameter in the outgoing IAM with the counter value decremented as follows:
 - 1) If no call forwarding occurs and the hop counter capability is active, set:
 counter value = result = received hop counter - 1.
 If no call forwarding occurs and the hop counter capability is deactivated on the outgoing route:
 counter value = result + 1 = received hop counter.
 - 2) If call forwarding occurs, set:
 counter value = initial count,
 independent of whether the hop counter capability is active or deactivated.

If no hop counter parameter is received (e.g., if the incoming connection is not SS7 or BICC, or if it is a connection from an SN/CMN that has not yet implemented this capability), the CSF at the intermediate SN/CMN shall take the following action:

- a) If the hop counter capability is active, the CSF at a non-forwarding SN/CMN shall include the hop counter parameter in the outgoing IAM and set:
 counter value = initial count.
- b) If the hop counter capability is deactivated, the CSF at a non-forwarding SN/CMN shall not originate the hop counter parameter.
- c) the CSF at a forwarding SN/CMN shall not originate the hop counter parameter if none is received, independent of whether the hop counter capability is active or deactivated.

¹⁰ The method of identifying the succeeding/preceding SN/CMN is for further study.

The initial count value is sent by the CSF originating the hop counter parameter, and it shall be settable by the network operator on a per SN basis (provisional range 10 to 20).

A CSF at a forwarding SN/CMN receiving a REL with ANSI cause 25, "*SN/CMN routing error*," shall notify the management system of the SN/CMN routing error and provide the called party number, identity of the succeeding SN/CMN, and the forwarding number. Cause value 31, "*normal unspecified*," shall be returned to the preceding CSF.

A hop counter procedure logic diagram summarizing actions in a CSF at an intermediate SN/CMN upon receipt of an IAM can be found in Annex K/T1.673.4.

8.9.3 Actions at the destination SN

None; the CSF shall ignore the hop counter if received.

8.10 Charge information¹¹

When a CSF at an SN or CMN wishes to forward charge information to the next CSF in an IAM, it shall include the Originating Line Information parameter and possibly the Charge Number parameter.

The Charge Number parameter shall be included, unless the charge number digits agree with those in the calling party number and the calling party number is in the IAM. In the case in which the charge number digits agree with those in the Calling Party Number parameter in the same IAM, the Charge Number parameter may be omitted.

If the Charge Number parameter is included in the IAM and if the Nature of Address field in the Charge Number parameter is coded "*ANI of the called party: no number present*," the Numbering Plan octet and the Address Digits octets in the Charge Number parameter shall be omitted. This coding of the Charge Number parameter would be used only if the charge number digits are the same as those in the Called Party Number parameter in the IAM.

A CSF receiving an IAM with an Originating Line Information parameter and no Charge Number parameter will identify the calling party address digits as the charge number digits. A CSF receiving a Charge Number parameter with a Nature of Address coded "*ANI of the called party: no number present*" and no charge number digits will recognize the called party address digits as the charge number digits.

8.11 Access delivery indication

[Not applicable to North American networks.]

¹¹ Procedures are given only for the case when charge information is included in the IAM. Possible extension of the procedures to allow the charge information to be sent in an Information Message in response to a request is for further study.

8.12 Information messages

8.12.1 Requesting information

An Information Request message may be sent to any CSF in the forward (backward) call establishment direction after sending (receiving) an IAM during call set-up.

8.12.2 Sending solicited information

On sending an Information Request message a timer (T33) is started. Optionally, a service-specific timer may also be started. No second Information Request message may be sent in the same direction until a response Information message is received. If the timer (T33) expires before the response message is received (see 13.7.5). The value of this timer (T33) is 12-15 seconds to allow for a cascade of Information Request messages, as described in item ii). If the service-specific timer expires, timer T33 shall be stopped, and the appropriate service-specific actions shall be taken. The response Information message shall be sent as follows:

- i) If all the information requested is available locally, then an Information message containing all the required information is sent in response;
- ii) If all the information is not available locally, but may be available remotely, then an Information Request message may be sent to a subsequent CSF in the call in an attempt to extract the information not locally available. (This Information Request message may be delayed if one has already been sent and the response not yet received.) On receipt of a response, all the information necessary to respond to the original Information Request message is sent in an Information message;
- iii) If all the information is not available locally or remotely, then an Information message containing only the available information is sent and the requested but not delivered information is indicated as "*not available*," using either the indication in the information indicator or an appropriate coding in the requested parameter.

8.12.3 Receiving a solicited Information message

Upon receipt of an Information message timer T33 is stopped.

If this message neither contains the requested information nor an indication that the requested information is not available, the actions taken will depend on whether the call can be progressed.

8.13 Call collect request procedure

[Not applicable to North American networks.]

8.14 Calling party number

The calling party number can either be included in the IAM or requested by the CSF at the destination SN (see 8.12). If the calling party number is required at the destination but is not included in the IAM, the CSF may request the calling party number. It may be necessary to withhold the sending of the ACM until the calling party number has been successfully delivered.

8.15 Calling Geodetic location procedure

8.15.1 Introduction

The calling geodetic location procedure is used where the geodetic location information of the calling party is required to be transported from some point in the call path (typically the originating) to another point.

NOTE - The transportation of the geodetic information related to the location of any other party (e.g., redirection, redirecting, called party, etc.) is for further study.

How geodetic location information is transformed into other forms is outside the scope of this American National Standard.

Possible applications of the transport of calling geodetic location information include:

- Emergency services;
- Location dependent routing;
- Location number portability; and
- Location mobility services.

8.15.2 Transfer of Geodetic information

Where the CSF logic at a node determines that geodetic information is required to be transported in the forward direction, the Calling Geodetic Location parameter shall be sent in the IAM.

8.16 Inter-nodal traffic group identification

The Inter-nodal Traffic Group Identifier parameter may be included in the IAM in order to enable classification of calls between adjacent nodes. It identifies the logical traffic group to which the call belongs (i.e., this identifier is of significance only between two adjacent CSFs). These classifications could, for example, be used to make a distinction between different service sets. These classifications are not standardized.

8.16.1 Sending Inter-nodal traffic group identification

If needed for the chosen outgoing route, the CSF shall include the Inter-nodal Traffic Group Identifier parameter, populated according to the relevant classification. This classification may depend on a classification received on the incoming side.

NOTE - The Parameter Compatibility Instruction Indicators for this parameter should be set to ensure that the parameter is not passed on at a node that does not recognize the parameter.

8.16.2 Receiving Inter-nodal traffic group identification

The traffic group identification received in an Inter-nodal Traffic Group Identifier parameter is used according to the relevant classification. A received Traffic Group Identifier parameter may be used to influence the routing of the call.

8.17 Carrier selection information

[Not applicable to this Standard.]

8.18 Global Call Reference

The Global Call Reference parameter is generated by the CSF at the first SN/CMN in a call path that requires a globally unique call reference to be associated with a particular call.

The Global Call Reference is a combination of a Network ID field, a Node ID field, and a Call Reference ID field. The Network ID field will uniquely identify the network. The Node ID field will uniquely identify the node within this network that generates the Global Call Reference parameter. The Call Reference ID field will be a unique number generated on a per call instance within this node.

The Global Call Reference parameter is sent in the forward direction in the IAM.

The CSF at an intermediate SN/CMN shall pass this parameter unchanged.

The Global Call Reference parameter shall be stored in the nodes which require this reference according to the needs of the application that uses the information.

NOTE 1 - The Global Call Reference parameter may typically be used for off-line purposes (e.g., to be stored for billing applications).

NOTE 2 - A CSF may delete a received Global Call Reference parameter. (e.g., at an outgoing gateway SN).

NOTE 3 - A received Global Call Reference may be overridden, (e.g., at an incoming gateway SN).

8.19 Bearer Control Unit Identifier (BCU-ID)

8.19.1 General

The procedure for use of the BCU-ID is typically used to aid the BIWF selection by the destination CSF at each call leg. The BCU-ID is an optional parameter and consists of the Network ID field and the Local BCU-ID field.

8.19.2 Actions at a SN

The BCU-ID may be generated in the following cases:

- If the BIWF address is absent in the BICC signaling.
- If a topology is used with a physical separation between CSF and BIWF.
- If a topology is used with a BIWF being controlled by multiple CSFs.
- Limited interconnectivity between the BIWFs.
- Optimal placement of the BIWF used for the call.

When used inside a network domain, the Network ID may be omitted by setting the length indicator of the Network ID field to the value "0." When the call leg passes network domain boundaries, the Gateway SN shall include the Network ID if not received.

8.19.3 Actions at a CMN

If a CMN receives a BCU-ID and the call leg doesn't pass network domain boundaries, the BCU-ID shall be passed on unchanged. If a CMN receives a BCU-ID and the call leg passes network domain boundaries, the CMN shall include the Network ID if not received. If a CMN doesn't receive a BCU-ID, it may generate a BCU-ID based on information stored in that node.

When used inside a network domain, the Network ID may be omitted by setting the length indicator of the Network ID field to the value "0."

8.19.4 Selection of BCU-ID

When selecting a BCU (see below, NOTE 1) a number of criteria may be considered, for example:

- BIWF capabilities including types of accesses required for the call.
- Minimization preferences regarding equipment and transmission costs.
- Connectivity to peer BCUs.
- Point of interconnect restrictions.

Forward bearer establishment enables the selection of the BCU to be deferred (see below, NOTE 2) until more information is available about the destination of the connection. Once information is available about both the origin and the destination of the bearer connection, it is possible to select the most suitable BCU. The BCU-ID information element is used to provide information about the origin and destination of the connection.

In the case of backward bearer establishment or when deferred selection is not performed, the BCU must be selected before more information about the destination of the connection can be received. This means that the optimal selection of the BCU can only take into account information about the origin of the connection (BCU-ID of the preceding BCU) and destination information derived from the Called party number.

If no BCU-ID parameter is received from a preceding/succeeding CSF and this node selects no BCU, the BCU-ID information element is not included in the signaling (IAM or APM).

The BCU-ID (succeeding or preceding) also provides information to enable the sharing of a BCU.

NOTE 1 – In some cases more than one BCU has to be selected for the call, e.g., when only separate BCUs can be found supporting the BIWF capabilities required for incoming and outgoing access, respectively, etc.

NOTE 2 – In some situations it is not possible to defer this decision, e.g., when BICC is not using codec negotiation procedures; when the incoming access is a fixed subscriber access or an ISUP trunk, at point of interconnect restrictions. But this does not preclude an additional BCU being selected to minimize transmission costs once more information about the destination of the connection is available.

8.19.5 Forward/Backward Bearer Establishment

8.19.5.1 BCU-ID sending node

8.19.5.1.1 Forward direction

The CSF includes in the IAM the BCU-ID, which contains the identity of the selected BCU.

8.19.5.1.2 Backward direction

The CSF includes in a first APM sent backward the BCU-ID, which contains the identity of the selected BCU.

8.19.5.2 BCU-ID receiving node

When the CSF receives a BCU-ID (in forward or backward direction), it uses this as input to the selection of the most suitable BCU.

8.20 Out of band transport of DTMF and Tone information

8.20.1 Introduction

This subclause describes the procedures to be performed for the transport of DTMF and Tone information in the BICC protocol on call control level. The procedures are applicable during call set-up and during the active phase of the call.

DTMF and Tone information may be provided to the BICC call control in two different ways. Either the information is already presented to the BICC environment on call control level, which may be the case in certain interworking scenarios (e.g., to GSM or UMTS Radio Access Networks), or it is received from the BCF.

Transport of DTMF and tone information in the BICC call control signaling has to be provided across those sections of bearer networks where the bearer -- including possible framing protocols and applied codecs -- will not provide for a transport of the corresponding tones that guarantees a correct reproduction after decompression. As a general rule, the number of transitions between transport in the bearer and in call control signaling should be minimized. This does not preclude provisioning according to the needs of network operators.

NOTE - *DTMF and Tone information* in this context is understood as an encoded representation of DTMF tones and Tones. If no further differentiation is required DTMF and Tones will be commonly addressed as "signals."

8.20.2 Procedures

8.20.2.1 No Signal Insertion in Bearer

If information is received by the CSF either via incoming call control signaling or from the BCF indicating that a signal is switched on/off and no insertion of signals in the bearer has to be performed, a

BICC_Data request primitive (corresponding to an APM message) is issued with the Action indicator set to either *"START Signal (no) notify"* or *"STOP Signal (no) notify"* depending on the received information.

NOTE - Notification may be required, depending on interworking scenarios.

In case *"START Signal (no) notify"* is set, additionally the Signal parameter subfield Signal Type shall be set to the appropriate value. If a length of the signal is provided, this shall be encoded in the Duration subfield.

If notification is requested, timer T40, for *"START Signal notify,"* or T41, for *"STOP Signal notify,"* is started and the reception of a BICC_Data indication primitive (corresponding to an APM message) is awaited with Action Indicator set to *"START Signal ACKNOWLEDGE"* or *"START Signal REJECT"*, or *"STOP Signal ACKNOWLEDGE,"* respectively. On reception of this message, timer T40 or T41, respectively, is stopped and a corresponding notification is given to the requesting side. If timer T40 or T41 expires, the procedure is terminated without retransmissions. In case *"START Signal notify"* was requested, an appropriate notification shall be sent to the requesting side before termination.

After sending a *"START Signal notify"* message, another *"START Signal (no) notify"* message shall only be sent after reception of *"STOP Signal ACKNOWLEDGE," "START Signal REJECT,"* or expiry of either timer T40 or timer T41.

If *"START Signal notify"* was specified, a *"STOP Signal (no) notify"* message shall only be sent after reception of the *"START Signal ACKNOWLEDGE."*

NOTE - This description covers also the relay case where a BICC SN receives a BICC_Data indication primitive (corresponding to an APM message) containing a signal and no signal insertion in the bearer is required.

8.20.2.2 Signal Insertion in Bearer

If a BICC_Data indication primitive (corresponding to an APM message) indicating that a Signal is switched on/off is received by the CSF and insertion of signals in the bearer is required, the BCF is requested to insert or disconnect the signal.

In case of START Signal, a received Signal parameter subfield Signal Type is used to determine the tone indication to the BCF. The length of the signal is signaled to the BCF, if a Duration subfield value is provided.

For *"START Signal notify,"* and *"STOP Signal notify,"* an appropriate notification is requested from the BCF and monitored by a timer. On reception of the notification from the BCF this timer is stopped and a BICC_Data indication primitive (corresponding to an APM message) shall be issued to the requesting side. The Action Indicator shall be set to:

1. *"START Signal ACKNOWLEDGE"* for successful signal insertion;
2. *"START Signal REJECT"* if signal insertion was not possible; or
3. *"STOP Signal ACKNOWLEDGE"* for successful disconnection of the signal.

On timer expiry the procedure is terminated without retransmission. In case *"START Signal notify"* was requested, a notification with *"START Signal REJECT"* shall be sent to the requesting side before termination.

8.A Exit message

8.A.1 Actions at a sending gateway SN/CMN

The Exit Message may be generated by the CSF at an outgoing gateway SN or CMN in a network and sent backward to notify preceding CSFs that a call connection has been completed into a succeeding network. When an Initial Address Message is sent from the gateway SN or CMN for the outgoing connection, a timer ($T_{EXM,d}$) should be set. The timer value is network dependent. The Exit Message should be returned for the incoming connection at the expiration of this timer.

The message shall consist of the Message Type, and optionally, an Outgoing Trunk Group Number parameter. When included, the Outgoing Trunk Group Number parameter should carry a unique identifier to indicate the internodal traffic group used to complete the connection from the SN/CMN originating the Exit Message. This unique identifier has the same format as the outgoing trunk group number specified in T1.113-2000.

8.A.2 Actions at an intermediate SN/CMN

Upon receipt of the Exit Message, the CSF at an intermediate, non-gateway SN/CMN may send the corresponding Exit Message to the preceding CSF.

8.A.3 Actions at an originating SN or receiving gateway SN/CMN

Receipt of the Exit Message may be used to generate timing indications by the CSF at the originating SN. Upon receipt of the Exit Message by the CSF at an originating or gateway SN, no Exit Message is generated to preceding points, as the Exit Message is only used within a network.

8.B Carrier identification

A network completing a call to a transit network may optionally include a Carrier Identification parameter in the IAM. This parameter contains the carrier identification code that identifies the transit network, and is derived from the setup information provided by the calling party or is provided on a subscription basis. This information is not used for routing the call.

8.C Jurisdiction information

The CSF at an originating SN may optionally include the Jurisdiction Information parameter¹² in the IAM. If included, the Jurisdiction Information parameter shall contain six digits representing the geographic location (NPA-NXX) of the call origination.

The CSF at an intermediate or gateway SN/CMN shall pass a Jurisdiction Information parameter unchanged from an incoming IAM to an outgoing IAM. If the CSF at an intermediate or gateway SN/CMN receives an IAM without a Jurisdiction Information parameter, the SN/CMN can be provisioned such that,

¹² As the Jurisdiction Information parameter is an optional parameter in BICC, service standards will determine when the parameter is to be included in an IAM and how the contents of the parameter are to be used.

for calls received with a particular internodal traffic group, a Jurisdiction Information parameter may be optionally included in the outgoing IAM. In this case, the CSF shall populate a Jurisdiction Information parameter with the NPA-NXX associated with the internodal traffic group.

8.D Egress service

If the CSF, an SN, or CMN receives a call set-up from a preceding network and is routing the call to a succeeding network, the CSF may optionally include the Egress Service parameter in the IAM so that the succeeding network can accurately attribute and rate the call.

8.E Transfer of network signaling information

8.E.1 Actions by the CSF at an SN which initiates a message with a network transport parameter

When the CSF at an originating or destination SN initiates an ISDN User Part message, it may optionally include parameters which are only of relevance to the CSF at the destination or originating SN, respectively, in the Network Transport parameter. The intent of the Network Transport parameter is to provide a graceful evolution to new protocol elements. The messages that may carry the Network Transport parameter are IAM, ACM, CPG, ANM, Information Request Message, and Information Message. Other messages are for further study.

8.E.2 Actions at the intermediate and gateway SN/CMN

Upon receiving the ISDN User Part message containing the optional Network Transport parameter, the CSF should not make any changes to the content of the Network Transport parameter and include the same into the outgoing message to the succeeding (preceding) CSF. The CSF at a gateway SN/CMN may screen the contents and take the actions based on the bilateral agreement.

8.E.3 Actions at the SN which terminates a message with a network transport parameter

Upon receiving the ISDN User Part message containing the optional Network Transport parameter, the CSF which terminates the message shall process all the parameters enclosed by the Network Transport parameter and take the appropriate actions based on the content of the parameters. If the Network Transport parameter received within a message contains unreasonable signaling information or unrecognized signaling information, that unreasonable or unrecognized information should be discarded while the message should be processed as normal. The CSF at a gateway SN/CMN may screen the contents and take the actions based on the bilateral agreement.

9 Unsuccessful call set-up

9.1 Introduction

If at any time in the call set-up the connection cannot be completed, a Release Message is returned. This message contains the reason.

When an SN cannot handle the specified bearer capability (e.g., data call to an analog switch), Cause Value 65 shall be used to signify bearer capability not implemented.

If "ISUP/BICC is Required" for a call, but there are no ISUP circuits/BICC CICs provisioned, Cause Value 65 shall be used to signify bearer capability not implemented.

When a destination SN can handle the specified bearer capability but the end user is not an authorized subscriber, Cause Value 57 shall be used to signify bearer capability not authorized.

When a SN can handle the specified bearer capability but:

- End user's terminal cannot handle it; Cause Value 88 shall be used to signify incompatible destination; or
- Private network cannot handle it; Cause Value 65 shall be used to signify bearer capability not implemented.

When the CSF at a destination SN determines that the reason for call clearing is under normal circumstances but cannot decide which available cause value to use for the particular event, Cause Value 31, "*normal unspecified*," shall be used and the call can be cleared normally.

Cause value 41, "*temporary failure*" is sent in a REL message whenever a call attempt fails and other specific causes do not apply (95-12408, Northern).

If, at an SN, in response to a Bearer Set-up request, the BCF indicates failure to set-up the bearer connection, the set-up of the bearer may be re-attempted, or the call shall be failed. In the latter case the CSF shall determine the cause value, or other failure indication (e.g., tone or announcement) to be used, considering the cause provided by the BCF.

If a receiving SN cannot select a BIWF according to the criteria specified in 7.2, the call shall be failed using Cause value #63 "*service or option not available, unspecified*" or #79 "*service or option not implemented, unspecified*," as appropriate.

9.2 Actions at a CSF initiating a Release message

The initiating CSF requests the BCF to disconnect the internal through-connection of the bearer path (if applicable) and invokes the Release sending procedure (see 11.5).

9.3 Actions at an intermediate SN/CMN

On receipt of a REL, a CSF performs the procedures described in 11.2 or 11.3 as applicable, depending on the release direction.

9.4 Actions at the controlling SN/CMN (i.e., the SN/CMN controlling the call)

9.4.1 Actions at a controlling SN

On receipt of a REL from the preceding or succeeding CSF, the CSF at a controlling SN requests the BCF to disconnect the internal through-connection of the bearer path. In addition, the controlling CSF will (if applicable):

- a) Return an indication (in-band or out-band) to the calling party (see 9.5);
- b) Attempt to re-route the call set-up; or
- c) Initiate release procedures to the preceding or succeeding CSF (see 11.5).

In case a) above, an indication is carried in the CPG or ACM indicating in-band information is available along with the Cause parameter. The cause value should reflect the reason of call failure in the same way as the in-band tone or announcement to be applied by the controlling SN (see 9.5).

When the BCF acknowledges successful disconnection of the internal bearer path, the RLC is sent to the preceding or succeeding CSF (see 11.6).

9.4.2 Actions at a controlling CMN

On receipt of a REL from the preceding or succeeding CSF, the CSF at a controlling CMN will (if applicable):

- a) Attempt to re-route the call set-up; or
- b) Pass the REL to the preceding or succeeding CSF (see 11.6).

In case a), the CSF at the CMN shall send RLC to the preceding or succeeding CSF when the CIC value is released.

9.5 Tones and announcements

9.5.1 Tones and announcements at an SN

The applicability of tones and announcements is decided based on the User Service Information. Tones and announcements are applicable for the following USI values;

- Speech;
- 3.1 kHz audio; and
- 64 kbit/s UDI-TA.

If a call set-up fails and no in-band tone or announcement has to be returned to the calling party from an SN succeeding the controlling SN, the CSF sends a REL to the CSF at the controlling SN. The cause value should reflect the reason of the call failure in the same way as the in-band tone or announcement to be applied by the controlling SN.

If a call set-up fails and an in-band tone or announcement has to be returned to the calling party from an SN or called party, the in-band tone or announcement is connected to the bearer path either by a request from CSF to BCF, or by the user concerned. If a time-out occurs at the SN providing the in-band tone or announcement, the CSF sends a REL to the preceding CSF with cause value #31, "*normal unspecified.*"

Call failure cases are possible where the bearer establishment has not yet been initiated. If a tone or announcement should be required in such cases, the Incoming bearer set-up procedure shall be performed prior to connecting the tone or announcement.

Call failure cases are possible where the bearer is not fully established, due to failure during the Incoming bearer set-up procedure, and thus no tone or announcement can be played to the calling party from the SN detecting the failure (e.g., in the backward bearer set-up case if the set-up of the bearer fails). In these cases, the CSF shall release the call (without sending ACM), with the cause value most accurately describing the cause of failure.

If an ACM has been returned to the preceding CSF, a CPG indicating that in-band tone information is available along with the Cause parameter is returned to the preceding CSF (see 8.2). The cause value should reflect the reason of call failure in the same way as the in-band tone or announcement to be applied.

If an ACM has not been returned to the preceding CSF already, an ACM -- with the Cause parameter and the In-band Information Indicator set in the Optional Backward Call Indicators parameter -- will be returned to the CSF at the originating SN. The cause value should reflect the reason of call failure in the same way as the in-band tone or announcement to be applied.

In case a special tone or announcement has to be applied due to an event only known by a certain CSF and not covered by a cause value, no Cause parameter is included in either the ACM or CPG messages. The ANM must not be sent in this case.

For the preceding CSFs, the inclusion of the Cause parameter in the ACM or CPG implies an unsuccessful call set-up. The Cause parameter will not be included for unsuccessful call set-ups when interworking has occurred and the in-band tone or announcement is returned from beyond the interworking point.

9.5.2 Tones and announcements at a CMN

Tones or announcements cannot be applied by a CMN. If a call set-up fails, this CSF sends a REL to the preceding CSF. The cause value should reflect the reason of the call failure in the same way as the in-band tone or announcement to be applied by the controlling SN.

9.6 Address incomplete

[Not applicable to North American networks.]

9.A Number portability

When the CSF at an SN acting as an initiating node receives a Release message with an ANSI Cause value 26 in the backward direction, the procedure to be taken by the CSF is one of the following:

- The SN, as an option, plays tone or announcement, and the CSF sends an ACM or CPG message containing the ANSI Cause value 26 towards the originating User-Network Interface according to clause 9.5.1.
- The SN does not play tone or announcement, but the CSF sends a Release message with ANSI Cause value 26, "*misrouted call to a ported number*," toward the originating User-Network Interface.

In either case, the originating User-Network Interface will interpret the received ANSI Cause value 26 as a Cause value 31, "*normal unspecified*" and use existing procedures to provide interworking with DSS1.

10 Mid-call procedures

10.1 Introduction

This clause describes procedures that may be applied subsequent to the successful completion of the call set-up procedures.

10.2 Suspend and resume

10.2.1 Suspend

The SUS message indicates a temporary cessation of communication without releasing the call. It can only be accepted during the conversation/data phase.

A SUS (network) message can be generated by the network in response to a clearback indication from an interworking node or an on-hook condition from a non-ISDN called party.

- a) *Action at the destination SN or an interworking SN*: On receipt of an on-hook condition in the destination SN or a clearback signal at the interworking SN, the CSF may send a SUS (network) message to the preceding CSF.
- b) *Action at the intermediate SN/CMN*: On receipt of a SUS (network) message, the CSF will send a SUS (network) message to the preceding CSF.
- c) *Action at the controlling CSF (i.e., the CSF at the SN or CMN controlling the call)*: On receipt of the on-hook condition or clearback indication or SUS message, the CSF starts timer T6¹³ to ensure that an off-hook condition, a re-answer indication, a RES (network) message, or a REL is received. If timer T6 expires, the procedures in 10.2.3 apply.

10.2.2 Resume

A RES message indicates a request to recommence communication. A request to release the call received from the calling party will override the suspend/resume sequence, and the procedures given in 11.2 will be followed.

¹³ The value of this timer is taken from ITU-T Recommendation Q.118

A RES (network) message is initiated by the network, if a SUS (network) message had previously been sent, in response to a re-answer indication from an interworking node or an off-hook condition from a non-ISDN called party.

- a) *Action at the destination SN or interworking SN*: On receipt of a re-answer indication at the interworking SN or an off-hook condition in the destination SN, the CSF may send a RES (network) message to the preceding CSF if a SUS (network) message had previously been sent.
- b) *Actions at the intermediate SN/CMN*: On receipt of a RES (network) message the CSF will send a RES (network) message to the preceding CSF.
- c) *Action at the controlling CSF (i.e., the CSF at the SN or CMN controlling the call)*: On receipt of the off-hook condition, re-answer signal, or RES (network) message the CSF stops timer T6 [started in 10.2.1 c)]. On receipt of a REL, the CSF stops timer T6 and releases the call according to the procedure in 11.4.

10.2.3 Expiration of timer T6

If a request for reconnection or a RES (network) message is not received within timer T6, then the CSF where the timer has been started will initiate the release procedure on both sides.

10.3 Forward Transfer message

The FOT message may be sent in telephony semi-automatic operation in either of the following two cases:

- a) Following a call switched automatically to a subscriber, or following a call established via a special operator, the controlling operator wishes to call in an assistance operator. On receipt of the FOT message by the CSF at the incoming international gateway SN, an assistance operator is called in;
- b) Following a call via codes 11 and 12, the controlling operator wishes to recall the incoming international gateway SN. Receipt of the FOT message by the CSF at the incoming international gateway SN recalls the incoming operator on calls completed via the operator positions at the SN.

The support of the FOT message in the international interface does not impose that the related functions are implemented in each incoming or outgoing international gateway SN (e.g., language assistance).

Equivalent procedures, using standard digit operator codes, are available on national calls between operators.

10.4 Codec modification/mid-call codec negotiation procedures

Networks supporting the codec negotiation procedure (see 8.3) may also support the codec modification/mid-call codec negotiation procedures. Codec modification/mid-call codec negotiation procedures are not applicable at a CMN – a CMN shall pass all codec information unchanged.

When the codec modification/mid-call codec negotiation option is supported, the codec selected for a call can be modified in any direction and at any time during the active phase of the call. Codec modification can only occur once the bearer connection has been fully established, a codec has been selected for the

call, and an Available Codec List for the call has been stored in all the CSFs intervening in the codec negotiation procedures (see 8.3). Mid-call codec negotiation can only occur once the bearer connection has been fully established. The procedure to be followed for codec modification/mid-call codec negotiation depends on whether the SN is to act as a SN initiating, transiting, or terminating codec modification/mid-call codec negotiation.

An SN involved in a codec modification/mid-call codec negotiation procedure must not initiate a new codec modification/mid-call codec negotiation procedure for the same call until the existing codec modification/mid-call codec negotiation procedure has been completed.

NOTE 1 - The terms “preceding” and “succeeding” SN in the following subclauses refer to the direction of the modification/mid-call codec negotiation flow, not of the direction of the call set-up flow. To illustrate this, a successful codec modification and a successful mid-call codec negotiation procedure between two CSFs are as follows: -

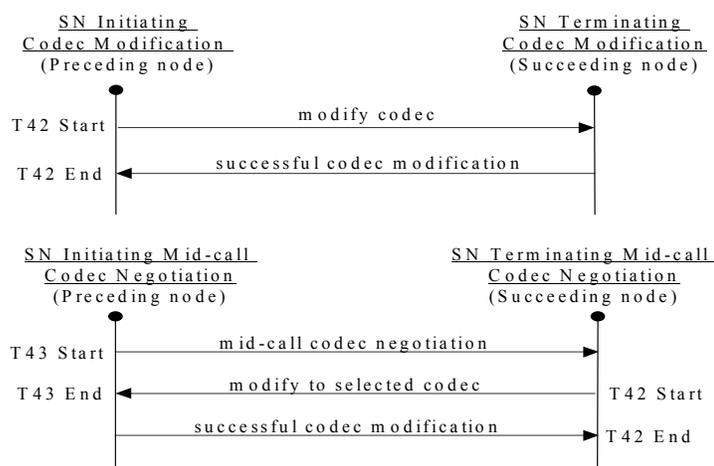


Figure 1/T1.673.4 - Overview of codec modification and mid-call negotiation

NOTE 2 - The role of the “nodal functions” in the codec modification/mid-call codec negotiation procedures is outside the scope of this North American Standard. A typical example of a “nodal function” is the interworking with an access network.

NOTE 3 - Example message flows of successful codec modification, successful mid-call codec negotiation and codec modification/mid-call codec negotiation collisions can be found in Annex I/T1.673.4.

10.4.1 SN initiating codec modification

In an SN, a codec modification procedure can be initiated in any direction and at any time during the active phase of a call, after the bearer connection has been fully established, a codec has been selected for the call, and an Available Codec List for the call has been stored in the CSF. This procedure is triggered by the nodal functions to request:

- The modification of the selected codec to a new one included in the Available Codec List; and/or

- The modification of the stored Available Codec List for the call. The modified Available Codec List for the call can only comprise a subset of the stored Available Codec List.

To initiate the modification of the selected codec and/or the Available Codec List for a call the following procedure shall be followed by the CSF in an SN:

1. If the selected codec is to be modified, the CSF shall request the BCF to allocate the new codec resources required for the connection towards the succeeding BIWF. Upon reception of the result of the allocation request, the following actions are taken by the CSF:
 - If the result of the allocation request is successful, the CSF proceeds according to step 2 below.
 - if the result of the allocation request is unsuccessful, the modification is considered to have been rejected, the nodal functions are notified and no further action is taken.
2. Issue a BICC_Data request primitive (corresponding to an APM message) containing:
 - An Action indicator set to *“modify codec.”*
 - A Single Codec information element indicating the newly selected codec for the call if the selected codec is to be modified. The newly selected codec must be among the ones in the currently stored Available Codec List.
 - A Codec List information element indicating the new Available Codec List for the call if the stored Available Codec List is to be modified.

When the BICC_Data request primitive is issued, codec modification timer (T42) is started.

3. A BICC_Data indication primitive will be received in response, including an Action indicator:
 - If the received Action indicator is set to *“successful codec modification,”* then the codec modification has been successful. Codec modification timer (T42) is stopped, the nodal functions are notified, and the new Available Codec List is stored for future use, if modification of the stored Available Codec List was requested.
 - If the received Action indicator is set to *“codec modification failure,”* then the codec modification has been rejected. Codec modification timer (T42) is stopped and the nodal functions are notified. If modification of the selected codec was originally requested, the CSF shall request the BCF to revert to the original codec resources required for the connection towards the succeeding BIWF.

10.4.2 SN terminating codec modification

In an SN terminating codec modification, a codec modification request can be received at any time during the active phase of a call, after the bearer connection has been fully established, a codec has been selected for this call, and an Available Codec List has been stored for the call. The following CSF procedure applies:

Codec modification is initiated when a BICC_Data indication primitive is received that contains:

- An Action indicator set to *“modify codec.”*
- A Single Codec information element, if the currently selected codec for the call is to be modified.
- A Codec List information element, if the stored Available codec List for the call is to be modified.

The following evaluation is performed by the CSF when codec modification is requested:

- If either the Single Codec or the Codec List are not valid, i.e., the Single Codec is not among the ones offered in the stored or received Available Codec List, or the Codec List is not a subset of the stored Available Codec List, then the modification is rejected.
- If the Codec Information is valid, and the selected codec is not required to be modified, then the modification is considered to have been accepted.
- If the codec information is valid, and the selected codec is to be modified, the CSF shall issue a request to the BCF containing the following information:
 - a. To allocate the selected codec resources required for the connection to the preceding BIWF;
 - b. To initiate bearer modification procedures towards the preceding BIWF to prepare the bearer connection to support the selected codec type and to secure additional bandwidth (if necessary);
 - c. To notify the CSF when the bearer connection to the preceding BIWF has been successfully modified to support the selected codec type. This notification contains an indication that the modification has been either rejected or accepted.

If the modification is rejected, then a BICC_Data request primitive with an Action indicator set to “*codec modification failure*” is issued towards the preceding CSF and no further action is taken.

If the modification is accepted, the nodal functions are informed of the successful modification, and a response is awaited. Upon reception of a response from the nodal functions, the following actions are taken by the CSF:

- If the nodal functions indicate that the modification cannot be accepted, then a BICC_Data request primitive with an Action indicator set to “*codec modification failure*” is issued towards the preceding CSF. If modification of the selected codec was originally requested, the CSF requests the BCF to initiate bearer modification procedures to revert to the original codec resources and to free any unused bandwidth for the connection towards the preceding BIWF. Additionally, the CSF requests the BCF to notify the CSF when the bearer connection to the preceding BIWF has been successfully modified to support the original codec type.
- If the nodal functions indicate that the modification can be accepted, then a BICC_Data request primitive with an Action indicator set to “*successful codec modification*” is sent to the preceding CSF. If modification of the selected codec was originally requested, the CSF indicates to the BCF to confirm that the modification has been successful and to initiate bearer modification procedures towards the preceding BIWF to free any unused bandwidth when it is no longer required for the connection. If the stored Available Codec List is modified, then the new Available Codec List is stored for future use.

10.4.3 SN transiting codec modification

The following CSF procedures apply at a SN transiting codec modification:

Upon reception from the preceding CSF of a BICC_Data indication primitive that includes:

- An Action indicator set to “*modify codec*”;
- A Single Codec information element, if the currently selected codec for the call is to be modified;
- A Codec List information element, if the stored Available Codec List is to be modified.

The CSF checks the received codec information and the following procedures are undertaken:

1. If either the Single Codec or the Codec List is not valid (i.e., the Single Codec is not among the ones offered in the stored or received Available Codec List for the call, or the Codec List is not a subset of the stored Available Codec List), then the codec modification is rejected. The CSF issues a BICC_Data request primitive towards the preceding CSF containing an Action indicator set to *“codec modification failure”* and no further action is taken.
2. If the codec information is valid, and the selected codec is not required to be modified, the CSF proceeds according to step 4 below. If the codec information is valid and the selected codec is to be modified, the CSF shall issue a request to the BCF containing the following information:
 - To allocate the selected codec resources required for the connection to the preceding BIWF;
 - To initiate bearer modification procedures towards the preceding BIWF to prepare the bearer connection to support the selected codec type and to secure additional bandwidth (if necessary);
 - To notify the CSF when the bearer connection to the preceding BIWF has been successfully modified to support the selected codec type.

If the above notification indicates an unsuccessful modification, the modification is considered to have been rejected, the CSF issues a BICC_Data request primitive towards the preceding CSF containing an Action indicator set to *“codec modification failure”* and no further action is taken.

3. If the above notification indicates a successful modification, the CSF shall request the BCF to allocate the new codec resources required for the connection towards the succeeding BIWF. Upon reception of the result of the allocation request, the following actions are taken by the CSF:
 - If the result of the allocation request is successful, the CSF proceeds according to step 4 below;
 - If the result of the allocation request is unsuccessful, the modification is considered to have been rejected, the CSF issues a BICC_Data request primitive towards the preceding CSF containing an Action indicator set to *“codec modification failure.”* The CSF requests the BCF to initiate bearer modification procedures to revert to the original codec resources, and free any unused bandwidth, for the connection towards the preceding BIWF. The CSF also requests the BCF to notify the CSF when the bearer connection to the preceding BIWF has been successfully modified to support the original codec type, and no further action is taken.
4. The received codec information is forwarded by the CSF in a BICC_Data request primitive towards the succeeding CSF.
5. Upon reception of a BICC_Data indication primitive from the succeeding CSF that contains an Action indicator set to *“successful codec modification”* or *“codec modification failure”* it shall forward the received information in a BICC_Data request primitive towards the preceding SN. The following additional actions are taken by the CSF according to the Action indicator:
 - If the received Action indicator was set to *“successful codec modification”* and if modification of the selected codec was originally requested, the CSF indicates to the BCF to confirm that the modification has been successful and to initiate bearer modification procedures towards the preceding BIWF to free any unused bandwidth when it is no longer required for the connection. If the stored Available Codec List has been modified, then the new Available Codec List is stored for future use.
 - If the received Action indicator was set to *“codec modification failure”* and if modification of the selected codec was originally requested, the CSF takes the following further actions:
 - a. The CSF shall request the BCF to revert to the original codec resources required for the connection towards the succeeding BIWF.
 - b. The CSF requests the BCF to initiate bearer modification procedures to revert to the original codec resources and to free any unused bandwidth for the connection towards the preceding BIWF. The CSF also requests the BCF to notify the CSF when the bearer

connection to the preceding BIWF has been successfully modified to support the original codec type.

10.4.4 SN initiating mid-call codec negotiation

In an SN, a mid-call codec negotiation procedure can be initiated in any direction and at any time during the active phase of a call, once the bearer connection has been fully established. Initiation of mid-call codec negotiation procedures is independent on whether codec negotiation procedures were initiated during the call set-up phase. The mid-call codec negotiation procedure is triggered by the nodal functions to request:

- The negotiation of the stored Available Codec List for the call. The new Available Codec List for the call may contain different codecs to those in the stored Available Codec List (if one exists); and/or
- The selection of a codec amongst the codecs present in the Supported Codec List.

To initiate the mid-call codec negotiation, the following procedure shall be followed by the CSF in an SN:

1. Construct a Supported Codec List including all the codecs, in priority order, that are offered for the call.
2. Issue a BICC_Data request primitive (corresponding to an APM message) to the succeeding CSF, containing:
 - An Action indicator set to *“mid-call codec negotiation”*,
 - A Supported Codec List coded as a Codec List information element.

When the BICC_Data request primitive is issued, mid-call codec negotiation timer (T43) is started.

3. A BICC_Data indication primitive will be received from the succeeding CSF in response. Mid-call codec negotiation timer (T43) is stopped, and the Action indicator examined:
 - If the received Action indicator is set to *“mid-call codec negotiation failure,”* then the mid-call codec negotiation has been rejected, the nodal functions are notified, and no further action is taken.
 - If the received Action indicator is set to *“modify to selected codec information,”* and the selected codec is not required to be modified, the nodal functions are informed of the request to modify to the codec information and a response is awaited. The CSF proceeds according to step 4 below.
 - If the received Action indicator is set to *“modify to selected codec information,”* and the selected codec is required to be modified, the CSF shall issue a request to the BCF containing the following information:
 - a. To allocate the selected codec resources required for the connection to the succeeding BIWF;
 - b. To initiate bearer modification procedures towards the succeeding BIWF to prepare the bearer connection to support the selected codec type and to secure additional bandwidth (if necessary);
 - c. To notify the CSF when the bearer connection to the succeeding BIWF has been successfully modified to support the selected codec type. This notification contains an indication that the modification has been either accepted or rejected.

- If the modification is accepted, the nodal functions are informed of request to modify to the selected codec information and a response is awaited. The CSF proceeds according to step 4 below.
 - If the modification is rejected, then a BICC_Data request primitive with an Action indicator set to “*codec modification failure*” is issued towards the succeeding CSF. The nodal functions are notified of the unsuccessful mid-call codec negotiation, and no further action is taken.
4. Upon reception of a response from the nodal functions, the following actions are taken by the CSF:
- If the nodal functions indicate that the mid-call codec negotiation cannot be accepted, then a BICC_Data request primitive with an Action indicator set to “*codec modification failure*” is issued towards the succeeding CSF. If modification of the selected codec was originally requested, the CSF requests the BCF to initiate bearer modification procedures to revert to the original codec resources and to free any unused bandwidth for the connection towards the succeeding BIWF. Additionally, the CSF requests the BCF to notify the CSF when the bearer connection to the succeeding BIWF has been successfully modified to support the original codec type.
 - If the nodal functions indicate that the mid-call codec negotiation can be accepted, then a BICC_Data request primitive with an Action indicator set to “*successful codec modification*” is sent to the succeeding CSF. If modification of the selected codec was originally requested, the CSF indicates to the BCF to confirm that the modification has been successful and to initiate bearer modification procedures towards the succeeding BIWF to free any unused bandwidth when it is no longer required for the connection. If the stored Available Codec List has been modified, then the new Available Codec List is stored for future use.

10.4.5 SN terminating mid-call codec negotiation

In an SN terminating mid-call codec negotiation, a mid-call codec negotiation request can be received at any time during the active phase of a call, once the bearer connection has been fully established.

Mid-call codec negotiation is initiated when a BICC_Data indication primitive is received from the preceding CSF that contains:

- An Action indicator set to “*mid-call codec negotiation*”,
- A Supported Codec List coded as a Codec List information element.

The following procedure shall be followed by the CSF:

1. The CSF performs the following procedure to select the appropriate codec to be used for the call (the “Selected Codec”), and to discover the list of codecs available for the call (the “Available Codec List”):
 - It constructs the Available Codec List for the call by deleting the entries that cannot be used for the call.
 - It selects the codec with the highest priority in the received Supported Codec List that may be used for the call.

If it is determined that there are no available codecs in the received Supported Codec List, the CSF issues a BICC_Data request primitive with an Action indicator set to “*mid-call codec negotiation failure*” towards the preceding CSF and no further action is taken.

2. The CSF shall inform the nodal functions of the mid-call codec negotiation request and a response is awaited. Upon reception of a response from the nodal functions, the following actions are taken by the CSF:
 - If the nodal functions indicate that the mid-call codec negotiation request cannot be accepted, a BICC_Data request primitive with an Action indicator set to *“mid-call codec negotiation failure”* is issued towards the preceding CSF and no further action is taken.
 - If the nodal functions indicate that the mid-call codec negotiation request can be accepted, and the selected codec is not required to be modified, the CSF proceeds according to step 3 below.
 - If the nodal functions indicate that the mid-call codec negotiation request can be accepted, and the selected codec is required to be modified, the CSF shall request the BCF to allocate the new codec resources required for the connection towards the preceding BIWF. Upon reception of the result of the allocation request, the following actions are taken by the CSF:
 - a. If the result of the allocation request is successful, the CSF proceeds according to step 3 below.
 - b. If the result of the allocation request is unsuccessful, the mid-call codec negotiation is considered to have been rejected. A BICC_Data request primitive with an Action indicator set to *“mid-call codec negotiation failure”* is issued towards the preceding CSF, the nodal functions are notified and no further action is taken.
3. Issue a BICC_Data request primitive (corresponding to an APM message) towards the preceding CSF, containing:
 - An Action indicator set to *“modify to selected codec information.”*
 - A Single Codec information element indicating the newly selected codec for the call.
 - A Codec List information element indicating the new Available Codec List for the call.

When the BICC_Data request primitive is issued, codec modification timer (T42) is started.

4. A BICC_Data indication primitive will be received from the preceding CSF in response, codec modification timer (T42) is stopped and the Action indicator examined:
 - If the received Action indicator is set to *“successful codec modification,”* then the mid-call codec negotiation has been successful. The nodal functions are notified and if the stored Available Codec List has been modified, then the new Available Codec List is stored for future use.
 - If the received Action indicator is set to *“codec modification failure,”* then the mid-call codec negotiation has been rejected and the nodal functions are notified. If modification of the selected codec was originally requested, the CSF shall request the BCF to revert to the original codec resources required for the connection towards the preceding BIWF.

10.4.6 SN transiting mid-call codec negotiation

The following CSF procedures apply at a SN transiting mid-call codec modification:

1. Upon reception from the preceding CSF of a BICC_Data indication primitive that includes:
 - An Action indicator set to *“mid-call codec negotiation”*;
 - A Supported Codec List coded as a Codec List information element.

The CSF derives the Supported Codec List by deleting the codecs inside the received Supported Codec List that cannot be used for the call. If it is determined that there are no available codecs in the received Supported Codec List, the CSF issues a BICC_Data request primitive with an Action

- indicator set to *“mid-call codec negotiation failure”* towards the preceding CSF and no further action is taken.
2. The CSF then sends a BICC_Data request primitive towards the succeeding CSF that includes:
 - An Action indicator set to *“mid-call codec negotiation”*; and
 - The Supported Codec List coded as a Codec List information element.
 3. A BICC_Data indication primitive will be received from the succeeding CSF in response, including an Action indicator:
 - If the received Action indicator is set to *“mid-call codec negotiation failure,”* then the mid-call codec negotiation has been rejected. A BICC_Data request primitive with an Action indicator set to *“mid-call codec negotiation failure”* is issued towards the preceding CSF and no further action is taken.
 - If the received Action indicator is set to *“modify to selected codec information,”* and the selected codec is not required to be modified, the CSF proceeds according to step 5 below.
 - If the received Action indicator is set to *“modify to selected codec information,”* and the selected codec is required to be modified, the CSF shall issue a request to the BCF containing the following information:
 - a. To allocate the selected codec resources required for the connection to the succeeding BIWF;
 - b. To initiate bearer modification procedures towards the succeeding BIWF to prepare the bearer connection to support the selected codec type and to secure additional bandwidth (if necessary);
 - c. To notify the CSF when the bearer connection to the succeeding BIWF has been successfully modified to support the selected codec type. This notification contains an indication that the modification has been either accepted or rejected:
 - If the modification is accepted, the CSF proceeds according to step 4 below.
 - If the modification is rejected, then a BICC_Data request primitive with an Action indicator set to *“mid-call codec negotiation failure”* is issued towards the preceding CSF, and a BICC_Data request primitive with an Action indicator set to *“codec modification failure”* is issued towards the succeeding CSF. No further action is taken.
 4. The CSF shall request the BCF to allocate the new codec resources required for the connection towards the preceding BIWF. Upon reception of the result of the allocation request, the following actions are taken by the CSF:
 - If the result of the allocation request is successful, the CSF proceeds according to step 5 below.
 - If the result of the allocation request is unsuccessful, the mid-call codec negotiation is considered to have been rejected. The CSF shall take the following actions:
 - a. A BICC_Data request primitive with an Action indicator set to *“mid-call codec negotiation failure”* is issued towards the preceding CSF.
 - b. A BICC_Data request primitive with an Action indicator set to *“codec modification failure”* is issued towards the succeeding CSF. The CSF requests the BCF to initiate bearer modification procedures to revert to the original codec resources and to free any unused bandwidth for the connection towards the succeeding BIWF. Additionally, the CSF requests the BCF to notify the CSF when the bearer connection to the succeeding BIWF has been successfully modified to support the original codec type. No further actions are taken.

5. Issue a BICC_Data request primitive (corresponding to an APM message) towards the preceding CSF, containing:
 - An Action indicator set to *“modify to selected codec information.”*
 - A Single Codec information element indicating the newly selected codec for the call.
 - A Codec List information element indicating the new Available Codec List for the call.
6. A BICC_Data indication primitive will be received from the preceding CSF in response, including an Action indicator:
 - If the received Action indicator is set to *“successful codec modification,”* then the mid-call codec negotiation has been successful. The CSF shall issue a BICC_Data request primitive with an Action indicator set to *“successful codec modification”* towards the succeeding CSF. If modification of the selected codec was originally requested, the CSF indicates to the BCF confirming that the modification has been successful and to initiate bearer modification procedures towards the succeeding BIWF to free any unused bandwidth when it is no longer required for the connection. If the stored Available Codec List has been modified, then the new Available Codec List is stored for future use.
 - If the received Action indicator is set to *“codec modification failure,”* then the mid-call codec negotiation has been rejected. The CSF shall issue a BICC_Data request primitive with an Action indicator set to *“codec modification failure”* towards the succeeding CSF. If modification of the selected codec was originally requested, the CSF takes the following further actions:
 - a. The CSF shall request the BCF to revert to the original codec resources required for the connection towards the preceding BIWF.
 - b. The CSF shall request the BCF to initiate bearer modification procedures to revert to the original codec resources, and to free any unused bandwidth, for the connection towards the succeeding BIWF. The CSF also requests the BCF to notify the CSF when the bearer connection to the succeeding BIWF has been successfully modified to support the original codec type.

10.4.7 Abnormal codec modification/mid-call codec negotiation cases

10.4.7.1 Failed modification/mid-call codec negotiation

In any situation where, due to a rejected codec modification/mid-call codec negotiation, the CSF has requested the BCF to revert to the original codec resources and the BIWF is unable to carry out the request, then call release procedures shall be initiated with cause #47 *“resource unavailable, unspecified.”*

10.4.7.2 Expiry of codec modification timer (T42)

If the codec modification timer (T42) expires, then -- because the CSF cannot be sure of the state of the end-to-end bearer connection -- call release procedures shall be initiated with cause #47 *“resource unavailable, unspecified.”*

10.4.7.3 Expiry of mid-call codec negotiation timer (T43)

If the mid-call codec negotiation timer (T43) expires, then the CSF notifies the nodal functions of the failed mid-call codec negotiation and no further actions are taken.

10.4.7.4 Procedure incompatibility

If a CSF initiating or transiting codec modification/mid-call codec negotiation procedures receives a BAT Compatibility Report information element in a BICC_Data indication primitive from the succeeding node, indicating that the codec modification/mid-call codec negotiation parameters have been discarded, the initiating/transiting CSF shall treat this indication as if a BICC_Data indication primitive with an action indicator with a rejection condition of the procedure has been received.

10.4.7.5 Collision of codec modification/mid-call codec negotiation procedures

In the event of a collision of codec modification/mid-call codec negotiation procedures, the CSF shall act as follows:

1. Mid-call codec negotiation procedures take precedence over codec modification procedures:
 - a. If a CSF receives a request for codec modification when it has already sent a request for mid-call codec negotiation, it shall discard the codec modification request and continue processing the mid-call codec negotiation.
 - b. If a CSF receives a request for mid-call codec negotiation when it has already sent a request for a codec modification, it shall cease processing the codec modification and process the mid-call codec negotiation.
2. Codec modification/mid-call codec negotiation requests initiated in the direction towards the called party shall take precedence over codec modification/mid-call codec negotiation requests initiated in the direction towards the calling party. The codec modification/mid-call codec negotiation request which takes precedence continues according to normal procedures while the other codec modification/mid-call codec negotiation request is discarded.
3. If a codec modification/mid-call codec negotiation collision has been detected by the CSF and resolved according to the above rules, and subsequently either an error in the received codec information or a resource unavailability is detected, then both of the codec modification/mid-call codec negotiation requests involved in the collision shall be rejected according to the relevant procedures in 10.4.1 to 10.4.6.

11 Normal call release

11.1 Introduction

The release procedures are based on a two-message (REL, RLC) approach, whereby the REL initiates release of the call.

NOTE - At an SN an indication of call release is issued to the BCF, but the subsequent decision to initiate bearer release protocol is the responsibility of BCF logic, and is not specified in this American National Standard. See Annexes I/T1.673.4 and J/T1.673.4.

11.2 Release initiated by a calling party

- a) *Actions at the originating SN:* On receipt of a request to release the call from the calling party, the CSF requests the BCF to disconnect the internal through-connection of the bearer path, and invokes the Release sending procedure (see 11.5).

- b) *Actions at an intermediate SN:* On receipt of a REL from the preceding CSF, the CSF invokes the Release reception procedure (see 11.6), and initiates call release on the outgoing side by invoking the Release sending procedure (see 11.5) towards the succeeding CSF.
- c) *Actions at a CMN:* On receipt of a REL from the preceding CSF, the CSF invokes the Release reception procedure (see 11.6) to pass the message on, or respond, as appropriate.
- d) *Actions at the destination SN:* On receipt of a REL from the preceding CSF, the CSF invokes the Release reception procedure (see 11.6).

11.3 Release initiated by a called party

- a) *Actions at the destination SN:* On receipt of a request to release the call from the called party, the CSF requests the BCF to disconnect the internal through-connection of the bearer path, and invokes the Release sending procedure (see 11.5).
- b) *Actions at an intermediate SN:* On receipt of a REL from the succeeding CSF, the CSF invokes the Release reception procedure (see 11.6), and initiates call release on the incoming side by invoking the Release sending procedure (see 11.5) towards the preceding CSF.
- c) *Actions at a CMN:* On receipt of a REL from the succeeding CSF, the CSF invokes the Release reception procedure (see 11.6) to pass the message on, or respond, as appropriate.
- d) *Actions at the originating SN:* On receipt of a REL from the succeeding CSF, the CSF invokes the Release reception procedure (see 11.6).

11.4 Release initiated by the network

Release can be initiated at any CSF. The network release can be initiated as a result of failure to set-up the call (see 9.2), as a result of receiving a Bearer Release indication from the BCF, or as a result of a failure in the bearer network during the active phase of a call.

- a) *Actions at an SN:* If the CSF needs to initiate call release, it requests the BCF to disconnect the internal through-connection of the bearer path, and invokes the Release sending procedure (see 11.5) towards the adjacent CSF(s).
- b) *Actions at a CMN:* If the CSF needs to initiate call release, it invokes the Release sending procedure (see 11.5) towards the adjacent CSF(s).

Subsequently at other CSFs, releases in the forward direction are treated as in 11.2, and releases in the backward direction are treated as in 11.3.

11.5 Release sending procedure

To initiate the signaling of call release to an adjacent CSF:

- a) The CSF shall send REL to the preceding/succeeding CSF (as applicable). Timers T1 and T5 are started to ensure that a RLC is received in response. (Expiration of timers T1 and T5 is covered in 13.7).

- b) When the RLC is received, timers T1 and T5 are stopped. At an SN, call release at the incoming/outgoing (as applicable) side is indicated to the BCF, and the Cause parameter in the original REL is passed to the BCF.

11.6 Release reception procedure

- a) *Actions at an SN:* On receipt of a REL the CSF requests the BCF to disconnect the internal through-connection of the bearer path. The received Cause parameter is passed to the BCF and call release at the incoming/outgoing (as applicable) side is indicated. When the BCF acknowledges successful disconnection of the internal bearer path a RLC is returned to the preceding/succeeding CSF (as applicable).
- b) *Actions at a CMN:* On receipt of a REL when there is a BICC signaling association set-up through the CMN, the REL message and the subsequent RLC message shall be passed through unchanged¹⁴. The CMN shall not start timers T1 and T5. If a REL is received when there is no BICC signaling association set-up through the CMN an RLC shall be sent. CIC values shall be released at the CMN, when the RLC is sent/received.

11.7 Collision of Release messages

- a) *Actions at an SN:* In the case when two points both initiate the release of a call, a REL may be received at a CSF from a succeeding or preceding CSF after the disconnection of the internal bearer path is initiated and after sending a REL to the adjacent CSF. In this case, the CSF will return a RLC to the CSF from which the concerned REL was received. The RLC will be sent only after the BCF acknowledges successful disconnection of the internal bearer path. The CSF will make the CIC value available for new calls when both a RLC is received (corresponding to the sent REL) and a RLC is sent (corresponding to the received REL).
- b) *Actions at a CMN:* If a REL is received from an adjacent CSF after REL has been sent to that adjacent CSF the actions depend on whether this CSF initiated the call release, or whether the CSF is passing through a REL received from a subsequent CSF:
 - If this CSF has passed through a REL received from another CSF (see 11.6), but it has not yet received the corresponding RLC when it receives a REL, then this REL shall also be passed through to the subsequent CSF. RLC messages will subsequently be passed through in both directions (i.e., the procedure in 11.6 is applied to both RELs). The CIC value shall be made available for new calls when RLC has been both sent and received.
 - If this CSF initiated call release (see 11.5) but it has not yet received the corresponding RLC when it receives a REL, the CSF will return a RLC to the CSF from which the REL was received. The CIC value shall be made available for new calls when RLC has been both sent and received.

11.8 Charging

Charging is stopped upon receipt of the REL at the charging CSF, or on the receipt of a request to release the call from the calling party when the charging CSF is at the originating SN.

¹⁴ The CSF at the sending SN awaits the RLC before initiating bearer release. This RLC means that the REL has been received by the peer CSF, as this ensures that the bearer release indication cannot arrive at the peer CSF before the REL message. The CMN should thus not generate the RLC itself.

12 Network features

12.1 Introduction

This clause includes a group of procedures that exist to support functionality required either due to limitations/problems with the signaling network, or to provide operational support to network operators.

12.2 Simple segmentation

The Simple Segmentation procedure uses the Segmentation message to convey an additional segment of an overlength message. Any message containing either the Optional Forward or Backward Call Indicators parameter can be segmented using this method. This procedure provides a mechanism for the transfer of certain messages whose contents are longer than 272 octets but not longer than 544 octets, for the case when the transport mechanism is limited to 272 octets (i.e., MTP).

If the START-INFO.indication primitive received from the STC (see T1.674-2002) indicates that the underlying message transport mechanism can transport greater than 272 octets, the CSF shall not invoke Simple Segmentation. However, a CSF may receive a segmented message, even if the transport mechanism supports messages greater than 272 octets (due to ISUP being used on a preceding/succeeding call segment); in this case, the following procedures for reception of the Segmentation message apply.

The procedure is as follows:

- a) The sending CSF, on detecting that the message to be sent exceeds the 272 octet limit, can reduce the message length by sending some parameters in a Segmentation message sent immediately following the message containing the first segment.

NOTE - The threshold for the initiation of the simple segmentation procedure may alternatively depend on network characteristics. The value of this threshold may vary per traffic relation depending on the typical network configuration and interconnection arrangements.
- b) The parameters that may be sent in the second segment using the Segmentation message are: the User-to-User Information and Access Transport parameters. If the User-to-User Information and Access Transport parameters cannot be carried in the original message, and the two together do not fit in the Segmentation message, the User-to-User Information parameter is discarded.
- c) The sending CSF sets the Simple Segmentation Indicator in the Optional Forward or Backward Call Indicators parameter to indicate that additional information is available.
- d) When a message is received by a CSF at an originating or destination SN, with the Simple Segmentation Indicator set to indicate additional information is available, the CSF starts timer T36 to await the Segmentation message. This action may also take place at other CSFs (in particular, incoming or outgoing gateway CSFs) if reassembly and subsequent policing of information is required.
- e) When the Segmentation message is received, timer T36 is stopped and the call continues. In the case of a segmented IAM, the ACM is not returned until the Segmentation Message has been received. Should parameters other than User-to-User Information or Access Transport be received, the CSF may discard the information and continue the call.
- f) In case any other message except the ones listed below is received before the Segmentation message containing the second segment, the CSF should react as if the second segment is lost (i.e., the timer T36 is stopped and the call continues).

The messages are:

- Continuity.
 - CIC Group Blocking.
 - CIC Group Blocking Acknowledgment.
 - CIC Group Unblocking.
 - CIC Group Unblocking Acknowledgment.
 - CIC Query.
 - CIC Query Response.
- g) After expiry of timer T36, the call shall proceed if possible, and a subsequently received Segmentation message containing the second segment of a segmented message is discarded. If it is not possible to continue the call, the call shall be released.
- h) When following the simple segmentation procedure, it is possible that a CSF has to reassemble an incoming message and subsequently re-segment it for onward transmission. In this case it has to be ensured that any unrecognized parameters received in the first or second segment are transmitted in the first or second segment, respectively, when the passing of the parameter is required by the compatibility procedure.
- i) In case a Segmentation message is received when not expected (see 13.4).

NOTE - Based on the set of services supported (e.g., Call Diversion, User-to-user, etc.) and the set of APM applications (e.g., BICC), the CSF performing the segmentation is able to calculate the maximum length of the first segment, to leave enough space in a message for use by any subsequent. This maximum length may vary per traffic relation depending on the typical network configuration and interconnection arrangements.

12.3 Pre-release information transport

Since additional parameters cannot be carried in the REL message due to the possibility of their loss at an intermediate CSF, a CSF wishing to send such parameters at release time shall include them instead within a Pre-release Information (PRI) message which shall be sent immediately prior to the REL. In the case that segmentation of the pre-release information is necessary, the subsequent segments will be sent between the PRI and REL messages.

A CSF receiving a PRI message shall determine whether to store the received information and process it upon release of the call or pass-on the PRI without awaiting REL, depending on the parameters received and the application present for the call at that CSF.

12.4 Automatic repeat attempt

Automatic repeat attempt is defined in ITU-T Recommendation Q.12. An automatic repeat attempt will be made (up to the point when the IAM information is released, see 7.10):

- i) On detection of dual seizure (at the non-control CSF) (see 13.2);
- ii) On receipt of the CIC Group Blocking message, including the relevant status bit for this CIC set to "1," after sending an IAM, and before any ACM/ANM has been received (see 12.5);
- iii) On receipt of a Reset CIC message after sending an IAM and before an ACM/ANM has been received [see 13.3.1 e)];
- iv) On receipt of an unreasonable message during call set-up (see 13.4);

- v) On receipt of an Unequipped CIC message on the first attempt.

12.5 Blocking and unblocking of CIC values

12.5.1 Introduction

The CIC Group Blocking (Unblocking) messages are provided to permit the switching equipment or maintenance system to remove from (and return to) traffic CIC values, thus providing a means to temporarily block use of CICs for maintenance purposes.

The CIC Group Blocking message can be originated by either CSF. The CICs shall be removed from service (blocked) on transmission of the CIC Group Blocking message at one CSF and on receipt of the CIC Group Blocking Message at the other CSF. The receipt of a CIC Group Blocking message will have the effect of prohibiting non-test calls using the relevant CIC value(s) outgoing from the CSF until an appropriate CIC Group Unblocking message is received, but will not prohibit test calls incoming to that CSF. The CIC value(s) is (are) marked as "remotely blocked." Test calls generated in the outgoing direction from the CSF that sent the CIC Group Blocking message will also be processed. Non-test IAMs will result in an abnormal case [see 12.5.4 x)].

12.5.2 CIC group blocking procedures

CIC values are removed from (returned to) service using the CIC Group Blocking (Unblocking) messages. The range of CIC values to be blocked (unblocked) is indicated in the Range field. Those CIC values within the range that have to be blocked (unblocked) are indicated in the Status field. The same rule applies to the acknowledgments. If the Range field is coded all zero, all CICs of a predetermined group of CICs have to be blocked (unblocked).

The number of CIC values to be blocked (unblocked) with one CIC Group Blocking (Unblocking) message is in the range 1 to 256.

An acknowledgment sequence is always required for the CIC Group Blocking message and CIC Group Unblocking message using the appropriate CIC Group Blocking Acknowledgment message and the appropriate CIC Group Unblocking Acknowledgment message, respectively. The acknowledgment is not sent until the appropriate action – either blocking or unblocking – has been taken. Reception of the CIC Group Blocking Acknowledgment message is guarded by timers T18 and T19, and reception of the CIC Group Unblocking Acknowledgment message is guarded by timers T20 and T21. Expiry of these timers is covered in 13.7.3.

The fact that a CIC value is in use for a call will not delay the transmission of the corresponding CIC Group Blocking (Unblocking) Acknowledgment message.

A received CIC Group Blocking (Unblocking) Acknowledgment message has to match in the parameter value of the CIC, the CIC Group Supervision Message Type, and the Range field (see chapter T1.673.3), with the previously sent Group Blocking (Unblocking) message in order to be considered a valid acknowledgment.

Some of the CIC values covered by the Range field of a CIC Group Blocking/Unblocking (Acknowledgment) message may not be provisioned. Then the corresponding Status bits in the Status field shall be set to 0.

The REL message should not override a blocked condition and return CIC value(s) to service. The blocked CIC value(s) will be returned to service (unblocked) on transmission of the appropriate CIC

Group Unblocking Acknowledgment message at one CSF, and on receipt of the appropriate CIC Group Unblocking Acknowledgment message at the other CSF.

For all instances of CIC Group Blocking (Unblocking) the maintenance personnel should be notified at both ends of the signaling association. The procedures for such notification are implementation-specific.

12.5.3 Interactions between CIC blocking and call set-up procedures

In the event of a CIC Group Blocking message -- including the relevant status bit set to "1" -- being received after an IAM has been sent in the opposite direction and before an ACM/ANM relating to that call has been received, an automatic repeat attempt will be made using another CIC value. The CSF receiving the CIC Group Blocking message releases the original call attempt in the normal manner after sending the CIC Group Blocking Acknowledgment message, and will not use that CIC value for subsequent calls.

If the CIC Group Blocking message is received:

- After an IAM has been sent for the indicated CIC value, in the opposite direction, and after an ACM/ANM relating to that call has been received; or
- After an IAM has been received for that CIC value beforehand;

the CSF will not seize that CIC value for subsequent calls, and the current call proceeds.

If a CIC Group Blocking message is sent, and subsequently an IAM is received in the opposite direction using a CIC value for which the relevant Status bit was set to "1," the following action is taken:

- For test calls, the call should be accepted, if possible. In the case where the test call cannot be accepted, the CIC Group Blocking message -- including the relevant status bit for this CIC set to "1" -- shall be returned;
- For calls other than test calls, the CIC Group Blocking message -- including the relevant status bit for this CIC set to "1" -- shall be returned, and the IAM discarded.

12.5.4 Abnormal CIC group blocking procedures

The following procedures are designed to cover abnormal cases which may occur in the CIC Group Blocking/Unblocking procedures:

- i) If a CIC Group Blocking message is received relating to remotely blocked CIC values, then blocking acknowledgment indications for those CIC values are given in the Status field of the corresponding CIC Group Blocking Acknowledgment message which will be sent in response.
- ii) If a CIC Group Unblocking message is received relating to CIC values which are not in the state remotely blocked, then unblocking acknowledgment indications for those CIC values are given in the Status field of the corresponding CIC Group Unblocking Acknowledgment message which will be sent in response.
- iii) When a CSF upon receipt of a CIC Group Blocking message is not able to give an appropriate blocking acknowledgment indication for each CIC value -- e.g., because that (those) CIC value(s) is (are) not provisioned at the receiving CSF -- for which also a blocking indication is given in the Status field of the received CIC Group Blocking message, then no blocking acknowledgment indication relating to that/those CIC value(s) shall be given in the Status field of the corresponding CIC Group Blocking Acknowledgment message which shall be sent in response. In addition, an Unequipped CIC message may be sent for such CIC values as specified in 13.5.

- iii a) When a CSF upon receipt of a CIC Group Unblocking message is not able to give an appropriate unblocking acknowledgment indication for each CIC value -- e.g., because that (those) CIC value(s) is (are) not provisioned at the receiving CSF -- for which also a unblocking indication is given in the Status field of the received CIC Group Unblocking message, then no unblocking acknowledgment indication relating to that/those CIC value(s) shall be given in the Status field of the corresponding CIC Group Unblocking Acknowledgment message which shall be sent in response. In addition, an Unequipped CIC message may be sent for such CIC values as specified in 13.5.
- iv) If a CIC Blocking Acknowledgment message in response to a CIC Group Blocking message is received containing in the Status field the indications no blocking acknowledgment for some or all of the CICs that are to be blocked due to the previously sent CIC Group Blocking message, then the maintenance personnel should be notified for the CICs concerned.
- iv a) If a CIC Unblocking Acknowledgment message in response to a CIC Group Unblocking message is received containing in the Status field the indications no unblocking acknowledgment for some or all of the CICs that are to be unblocked due to the previously sent CIC Group Unblocking message, then the maintenance personnel should be notified for the CICs concerned.
- v) If a CIC Group Blocking Acknowledgment message in response to a CIC Group Blocking message is received containing in the Status field blocking acknowledgment indications for the CIC values that are not to be blocked due to the previously sent CIC Group Blocking message and are not marked locally blocked, then the maintenance personnel should be notified for the CIC values concerned.
- vi) If a CIC Group Unblocking Acknowledgment message in response to a CIC Group Unblocking message is received containing in the Status field unblocking acknowledgment indications for CIC values that are not to be unblocked due to the previously sent CIC Group Unblocking message and have to remain marked locally blocked, then the maintenance personnel should be notified for the CIC values concerned.
- vii) If a CIC Group Blocking Acknowledgment message which is not expected as an acknowledgment for any CIC Group Blocking message is received:
 - Relating to CIC values which all are in the status "locally blocked," the received CIC Group Blocking Acknowledgment will be discarded.
 - Relating to CIC values part or all of which are not in the status "locally blocked," then a CIC Group Unblocking message shall be sent for the relevant CICs.
- viii) If a CIC Group Unblocking Acknowledgment message which is not expected as an acknowledgment for any CIC Group Unblocking message is received:
 - Relating to CIC values none of which is in the status "locally blocked," then the CIC Group Unblocking Acknowledgment message will be discarded.
 - Relating to CIC values part or all of which are "locally blocked," then a CIC Group Blocking message shall be sent for the relevant CICs.
- ix) If a CIC Group Blocking (Unblocking) message or a CIC Group Blocking (Unblocking) Acknowledgment message refers to status changes for more than 256 CIC values, the receiving CSF shall discard that message.
- x) If a non-test IAM is received with a remotely blocked CIC value, the remotely blocked state of the CIC value is removed, and the IAM is processed normally unless the CIC value is also locally blocked in which case a CIC Group Blocking message including the relevant Status bit for this CIC set to "1" is returned and the IAM is discarded. This should not be the preferred method of unblocking a CIC value.

12.6 CIC query

12.6.1 General

The CIC query test allows a CSF to audit the state of a CIC on a demand or routine basis.

This test is necessary in order:

- To ensure that the CICs are not incorrectly put in maintenance states, thereby denying them from service; and
- To coordinate a CIC turn-up procedure.

The value N of the Range field of the CIC Query message, including N = 0 for a single CIC, indicates the range to be tested. The maximum value of N is 23. If that value is exceeded the CIC Query message is discarded.

12.6.2 Interpretation of CIC states

For the purposes of the CIC query procedure, there are fourteen non-overlapping CIC states, which are classified into six major categories, as follows:

- Unequipped;
- Transient;
- Active;
- Remotely blocked;
- Locally blocked; and
- Locally blocked and remotely blocked.

Each of the last four of the above categories can be subdivided into three call-processing categories:

- Idle;
- Incoming CIC busy; and
- Outgoing CIC busy;

thus creating a total of fourteen states.

A CIC value is "unequipped" if the CIC value is not provisioned. This is a unique state and will not overlap with any of the other states.

The "transient" state refers to any transient call processing or maintenance states.

Call processing is in a transient state:

- After having sent an IAM and waiting for an ACM/ANM (Whether a suspended call is in a transient state in the context of CIC query is for further study); or
- After having sent a REL and waiting for the RLC.

Transient maintenance states are those where the CSF after having sent a CIC Group (Un)Blocking message is awaiting the proper CIC Group (Un)Blocking Acknowledgment message from the remote CSF.

The CIC state is also considered transient as long as a CIC (Group) Reset message has not been acknowledged.

The "active" state refers to an operationally available state, that is, equipped and a non-maintenance state. A CIC in an active state may be further qualified as being "idle," "incoming CIC busy," or "outgoing CIC busy."

The "remotely blocked" state refers to the state marked by the CSF when the far-end CSF initiated blocking. This state can co-exist with "idle," "incoming CIC busy," or "outgoing CIC busy."

The "locally blocked" state refers to the state marked by the CSF when it initiated blocking to the far-end CSF. This state can co-exist with "idle," "incoming CIC busy," or "outgoing CIC busy."

The "idle" state is a call-processing state of an equipped, non-busy CIC. The "incoming CIC busy" or "outgoing CIC busy" refers to a stable call-processing state.

To initiate the CIC query procedure, the sending CSF sends a CIC Query message indicating in the range of those CICs to be audited. If no response to the CIC Query message is received before timer T28 expires, maintenance systems should be informed.

The receiving CSF shall process the CIC Query message and return a CIC Query Response message setting the CIC state indicators to the state of the CICs being audited.

12.6.3 Auditing procedure

The CIC query test is designed for each end to audit CIC states using the data maintained by the near-end as well as the far-end CSF. The CIC query shall not be allowed to a CSF that does not support the CIC query process. The routine of CIC query shall be set up in each CSF in a manner to minimize glare if possible.

The basic CIC state discrepancies and the required corrective actions are listed below.

12.6.3.1 Error in call-processing states

- 1) If the near-end shows the CIC is outgoing CIC busy or incoming CIC busy and the far-end shows the CIC is unequipped, idle CIC and release any interconnected CIC.
- 2) If the near-end shows the CIC is unequipped and the far-end shows the CIC is outgoing CIC busy or incoming CIC busy, send a REL to idle the CIC at the far-end (the cause indicator should be coded "*protocol error, unspecified*").
- 3) If the near-end shows the CIC is idle and the far-end shows the CIC is incoming CIC busy or outgoing CIC busy, send a REL to idle the CIC at the far-end (the cause indicator should be coded "*protocol error, unspecified*").
- 4) The near-end shows the CIC is outgoing CIC busy or incoming CIC busy and the far-end shows the CIC is idle, idle CIC and release any interconnected CIC.
- 5) If both ends are incoming CIC busy or outgoing CIC busy:

- a) Send a REL to idle CIC at the far-end (the cause indicator should be coded "*protocol error, unspecified*").
- b) Idle CIC after REL is received.

12.6.3.2 Error in maintenance states

- 1) If the near-end shows the CIC is unequipped and the far-end shows the CIC is active, initiate a CIC Group Blocking message (if the CIC exists) including the relevant Status bit for the CIC set to "1" to establish remote blocking, thereby preventing the CIC from being seized for call processing or maintenance testing.
- 2) If the near-end shows the CIC is not locally blocked and the far-end shows the CIC is unequipped:
 - a) Mark the CIC as locally blocked and withhold sending any CIC Group Blocking message to the far-end¹⁵.
 - b) Print a message to maintenance.
- 3) If the near-end shows the CIC is remotely blocked and the far-end shows the CIC is not locally blocked:
 - a) Remove the remote blocking state.
 - b) Print a message to maintenance.
- 4) If the near-end shows the CIC is locally blocked and the far-end shows the CIC is not remotely blocked, send a CIC Group Blocking message including the relevant Status bit for the CIC set to "1" to establish the far-end remote blocking.
- 5) If the near-end shows the CIC is not locally blocked and the far-end shows the CIC is remotely blocked, send a CIC Group Unblocking message including the relevant Status bit for the CIC set to "1."
- 6) If the near-end shows the CIC is not remotely blocked and the far-end shows the CIC is locally blocked:
 - a) Mark the CIC as remotely blocked.
 - b) Print a message to maintenance.

All of the actions involved are given in Table 2/T1.673.4.

¹⁵ As an option, the CIC may instead be marked as remotely blocked.

Table 2/T1.673.4 - CIC Query State Actions (sheet 1 of 5)

NEAR-END STATE	FAR-END STATE	
	UNEQUIPPED	TRANSIENT
UNEQUIPPED	OK	OK
TRANSIENT	OK	OK
ACTIVE - IDLE	set Locally Blocked, print	OK
ACTIVE - Incoming CIC BUSY	IDLE, set Locally Blocked, print	OK
ACTIVE - Outgoing CIC BUSY	IDLE, set Locally Blocked, print	OK
LOCALLY BLOCKED - IDLE	OK	OK
LOCALLY BLOCKED -Incoming CIC BUSY	IDLE	OK
LOCALLY BLOCKED - Outgoing CIC BUSY	IDLE	OK
REMOTELY BLOCKED - IDLE	clear Remotely Blocked, set Locally Blocked, print	OK
REMOTELY BLOCKED -Incoming CIC BUSY	IDLE, clear Remotely Blocked, set Locally Blocked, print	OK
REMOTELY BLOCKED - Outgoing CIC BUSY	IDLE, clear Remotely Blocked, set Locally Blocked, print	OK
LOCALLY BLOCKED AND REMOTELY BLOCKED - IDLE	clear Remotely Blocked, print	OK
LOCALLY BLOCKED AND REMOTELY BLOCKED -Incoming CIC BUSY	IDLE, clear Remotely Blocked, print	OK
LOCALLY BLOCKED AND REMOTELY BLOCKED - Outgoing CIC BUSY	IDLE, clear Remotely Blocked, print	OK

Table 2/T1.673.4 - CIC Query State Actions (sheet 2 of 5)

NEAR-END STATE	FAR-END STATE		
	ACTIVE		
	IDLE	Incoming CIC BUSY	Outgoing CIC BUSY
UNEQUIPPED	send CGB(1)	send CGB(1) send REL	send CGB(1) send REL
TRANSIENT	OK	OK	OK
ACTIVE - IDLE	OK	send REL	send REL
ACTIVE - Incoming CIC BUSY	IDLE	send REL, IDLE	OK
ACTIVE - Outgoing CIC BUSY	IDLE	OK	send REL, IDLE
LOCALLY BLOCKED - IDLE	send CGB(1)	send CGB(1), send REL	send CGB(1), send REL
LOCALLY BLOCKED -Incoming CIC BUSY	IDLE, send CGB(1)	send CGB(1), send REL, IDLE	send CGB(1)
LOCALLY BLOCKED - Outgoing CIC BUSY	IDLE, send CGB(1)	send CGB(1)	send CGB(1), send REL, IDLE
REMOTELY BLOCKED - IDLE	Clear Remotely Blocked, print	send REL clear Remotely Blocked, print	send REL clear Remotely Blocked, print
REMOTELY BLOCKED -Incoming CIC BUSY	IDLE, clear Remotely Blocked, print	send REL, IDLE, clear Remotely Blocked, print	clear Remotely Blocked, print
REMOTELY BLOCKED - Outgoing CIC BUSY	IDLE, clear Remotely Blocked, print	clear Remotely Blocked, print	send REL, IDLE, clear Remotely Blocked, print
LOCALLY BLOCKED AND REMOTELY BLOCKED - IDLE	send CGB(1), clear Remotely Blocked, print	send CGB(1), send REL, clear Remotely Blocked, print	send CGB(1), send REL, clear Remotely Blocked, print
LOCALLY BLOCKED AND REMOTELY BLOCKED -Incoming CIC BUSY	IDLE, send CGB(1), clear Remotely Blocked, print	send CGB(1), send REL, IDLE, clear Remotely Blocked, print	send CGB(1), clear Remotely Blocked, print
LOCALLY BLOCKED AND REMOTELY BLOCKED - Outgoing CIC BUSY	IDLE, send CGB(1), clear Remotely Blocked, print	send CGB(1), clear Remotely Blocked, print	send CGB(1), send REL, IDLE, clear Remotely Blocked, print

CGB(1) - CIC Group Blocking message for CIC involved.

CGU(1) - CIC Group Unblocking message for CIC involved.

REL - Release message for CIC involved.

Table 2/T1.673.4 - CIC Query State Actions (sheet 3 of 5)

NEAR-END STATE	FAR-END STATE		
	LOCALLY BLOCKED		
	IDLE	Incoming CIC BUSY	Outgoing CIC BUSY
UNEQUIPPED	OK	send REL	send REL
TRANSIENT	OK	OK	OK
ACTIVE - IDLE	set Remotely Blocked, print	send REL, set Remotely Blocked, print	send REL, set Remotely Blocked, print
ACTIVE - Incoming CIC BUSY	IDLE, set Remotely Blocked, print	send REL, IDLE, set Remotely Blocked, print	set Remotely Blocked, print
ACTIVE - Outgoing CIC BUSY	IDLE, set Remotely Blocked, print	set Remotely Blocked, print	send REL, IDLE, set Remotely Blocked, print
LOCALLY BLOCKED - IDLE	send CGB(1), set Remotely Blocked, print	send CGB(1), send REL, set Remotely Blocked, print	send CGB(1), send REL, set Remotely Blocked, print
LOCALLY BLOCKED -Incoming CIC BUSY	IDLE, send CGB(1), set Remotely Blocked, print	send REL, IDLE, send CGB(1), set Remotely Blocked, print	send CGB(1), set Remotely Blocked, print
LOCALLY BLOCKED - Outgoing CIC BUSY	IDLE, send CGB(1), set Remotely Blocked, print	send CGB(1), set Remotely Blocked, print	send REL, IDLE, send CGB(1), set Remotely Blocked, print
REMOTELY BLOCKED - IDLE	OK	send REL	send REL
REMOTELY BLOCKED -Incoming CIC BUSY	IDLE	send REL, IDLE	OK
REMOTELY BLOCKED - Outgoing CIC BUSY	IDLE	OK	send REL, IDLE
LOCALLY BLOCKED AND REMOTELY BLOCKED - IDLE	send CGB(1)	send CGB(1), send REL	send CGB(1), send REL
LOCALLY BLOCKED AND REMOTELY BLOCKED -Incoming CIC BUSY	IDLE, send CGB(1)	send CGB(1), send REL, IDLE	send CGB(1)
LOCALLY BLOCKED AND REMOTELY BLOCKED - Outgoing CIC BUSY	IDLE, send CGB(1)	send CGB(1)	send CGB(1), send REL, IDLE

CGB(1) - CIC Group Blocking message for CIC involved.

CGU(1) - CIC Group Unblocking message for CIC involved.

REL - Release message for CIC involved.

Table 2/T1.673.4 - CIC Query State Actions (sheet 4 of 5)

NEAR-END STATE	FAR-END STATE		
	REMOTELY BLOCKED		
	IDLE	Incoming CIC BUSY	Outgoing CIC BUSY
UNEQUIPPED	OK	send REL	send REL
TRANSIENT	OK	OK	OK
ACTIVE - IDLE	send CGU(1)	send REL, send CGU(1)	send REL, send CGU(1)
ACTIVE - Incoming CIC BUSY	IDLE, send CGU(1)	send REL, IDLE, send CGU(1)	send CGU(1)
ACTIVE - Outgoing CIC BUSY	IDLE, send CGU(1)	send CGU(1)	send REL, IDLE, send CGU(1)
LOCALLY BLOCKED - IDLE	OK	send REL	send REL
LOCALLY BLOCKED -Incoming CIC BUSY	IDLE	send REL, IDLE	OK
LOCALLY BLOCKED - Outgoing CIC BUSY	IDLE	OK	send REL, IDLE
REMOTELY BLOCKED - IDLE	send CGU(1), clear Remotely Blocked, print	send REL, send CGU(1) clear Remotely Blocked, print	send REL, send CGU(1) clear Remotely Blocked, print
REMOTELY BLOCKED -Incoming CIC BUSY	IDLE, send CGU(1) clear Remotely Blocked, print	send REL, IDLE, send CGU(1) clear Remotely Blocked, print	send CGU(1), clear Remotely Blocked, print
REMOTELY BLOCKED - Outgoing CIC BUSY	IDLE, send CGU(1) clear Remotely Blocked, print	send CGU(1), clear Remotely Blocked, print	send REL, IDLE, send CGU(1), clear Remotely Blocked, print
LOCALLY BLOCKED AND REMOTELY BLOCKED - IDLE	clear Remotely Blocked, print	send REL, clear Remotely Blocked, print	send REL, clear Remotely Blocked, print
LOCALLY BLOCKED AND REMOTELY BLOCKED -Incoming CIC BUSY	IDLE, clear Remotely Blocked, print	send REL, IDLE, clear Remotely Blocked, print	clear Remotely Blocked, print
LOCALLY BLOCKED AND REMOTELY BLOCKED - Outgoing CIC BUSY	IDLE, clear Remotely Blocked, print	clear Remotely Blocked, print	send REL, IDLE, clear Remotely Blocked, print

CGB(1) - CIC Group Blocking message for CIC involved.

CGU(1) - CIC Group Unblocking message for CIC involved.

REL - Release message for CIC involved.

Table 2/T1.673.4 - CIC Query State Actions (sheet 5 of 5)

NEAR-END STATE	FAR-END STATE		
	LOCALLY BLOCKED AND REMOTELY BLOCKED		
	IDLE	Incoming CIC BUSY	Outgoing CIC BUSY
UNEQUIPPED	OK	send REL	send REL
TRANSIENT	OK	OK	OK
ACTIVE - IDLE	send CGU(1), set Remotely Blocked, print	send REL, send CGU(1), set Remotely Blocked, print	send REL, send CGU(1), set Remotely Blocked, print
ACTIVE - Incoming CIC BUSY	IDLE, send CGU(1), set Remotely Blocked, print	send REL, IDLE, send CGU(1), set Remotely Blocked, print	send CGU(1), set Remotely Blocked, print
ACTIVE - Outgoing CIC BUSY	IDLE, send CGU(1), set Remotely Blocked, print	send CGU(1), set Remotely Blocked, print	send REL, IDLE, send CGU(1), set Remotely Blocked, print
LOCALLY BLOCKED - IDLE	set Remotely Blocked, print	send REL, set Remotely Blocked, print	send REL, set Remotely Blocked, print
LOCALLY BLOCKED - Incoming CIC BUSY	IDLE, set Remotely Blocked, print	send REL, IDLE, set Remotely Blocked, print	set Remotely Blocked, print
LOCALLY BLOCKED - Outgoing CIC BUSY	IDLE, set Remotely Blocked, print	set Remotely Blocked, print	send REL, IDLE, set Remotely Blocked, print
REMOTELY BLOCKED - IDLE	send CGU(1)	send REL, send CGU(1)	send REL, send CGU(1)
REMOTELY BLOCKED - Incoming CIC BUSY	IDLE, send CGU(1)	send REL, IDLE, send CGU(1)	send CGU(1)
REMOTELY BLOCKED - Outgoing CIC BUSY	IDLE, send CGU(1)	send CGU(1)	send REL, IDLE, send CGU(1)
LOCALLY BLOCKED AND REMOTELY BLOCKED - IDLE	OK	send REL	send REL
LOCALLY BLOCKED AND REMOTELY BLOCKED - Incoming CIC BUSY	IDLE	send REL, IDLE	Ok
LOCALLY BLOCKED AND REMOTELY BLOCKED - Outgoing CIC BUSY	IDLE	OK	send REL, IDLE

CGB(1) - CIC Group Blocking message for CIC involved.

CGU(1) - CIC Group Unblocking message for CIC involved.

REL - Release message for CIC involved.

12.7 Support for Hard To Reach Network Management functions

[Not applicable to this Standard.]

12.8 Automatic congestion control

Automatic Congestion Control (ACC) is used when a CSF is in an overload condition. Three levels of congestion are distinguished; a less severe congestion threshold (congestion level 1), a more severe congestion threshold (congestion level 2) and, optionally, a most severe congestion threshold (congestion level 3). This option is applied to the entire SN.

If any of the three congestion thresholds are reached, an Automatic Congestion Level parameter is added to all REL messages generated by the CSF. This parameter indicates the level of congestion (congestion level 1, 2, or 3) to the adjacent CSFs. A CSF which supports three levels of congestion needs to have the ability to distinguish between far CSFs which support two levels of congestion and far CSFs that support three levels of congestion. The CSF shall not send an indication of congestion level 3 to an adjacent CSF which does not support three levels of congestion. A congestion level 2 would be sent in this case. A CSF which recognizes a single level of congestion should only send indication of congestion level 2 (CL2), and treat receipt of indication of congestion level 1 (CL1) or congestion level 2 (CL2) identically. The adjacent CSFs, when receiving a REL containing an Automatic Congestion Level parameter, should reduce their traffic to the overload affected CSF. If the overloaded CSF returns to a normal traffic load it will cease including Automatic Congestion Level parameters in RELs.

The adjacent CSFs then, after a predetermined time, automatically return to their normal status.

12.8.1 Receipt of a Release message containing an automatic congestion level parameter

When a CSF receives a REL containing an Automatic Congestion Level parameter, the appropriate information should be passed to the signaling system-independent network management/overload control function within the CSF. This information consists of the received congestion level information and the route identification to which the REL applies. The CSF should reduce its traffic to the overload affected CSF.

Automatic congestion level actions are applicable only at CSFs adjacent to the congested CSF. Therefore, a CSF that receives a REL containing an Automatic Congestion Level parameter should discard that parameter after notifying the network management/overload control function. If this is the CSF at an intermediate or gateway SN/CMN, the cause value in the received REL shall be passed unchanged. The CSF at an intermediate or gateway SN may decide that a tone/announcement must be provided instead (see 9.5).

12.8.2 Actions taken during overload

Whenever a CSF is in an overload state (congestion level 1, 2, or 3), the signaling system independent-network management/overload control function shall indicate that the CSF should include an Automatic Congestion Level parameter in every REL transmitted.

The network management/overload control function shall indicate which congestion level (1, 2, or 3) to code in the Automatic Congestion Level parameter.

If the CSF at the destination SN is in an overload state and the Release Message is generated due to the overload state, cause value 42, "*switching equipment congestion*," shall be used. Otherwise, other applicable cause value shall be used. If the CSF at an intermediate or gateway SN is in an overload state and the Release Message is generated due to the overload state, cause value 42, "*switching equipment congestion*," shall be used. Otherwise, the cause value in the received Release Message shall be passed on unchanged unless the CSF decides that a tone/announcement must be provided (see 9.5). If the CSF at an originating SN is in an overload state, a Release Message for the outgoing connection shall include an appropriate cause value other than 42, "*switching equipment congestion*."

When the overload condition has ended, the network management/overload control function shall indicate that the CSF should cease including Automatic Congestion Level parameters in the transmitted RELs. Applicable cause value other than 42, "*switching equipment congestion*" shall be used.

12.9 Signaling transport out-of-service and in-service indications

The OUT-OF-SERVICE.indication and IN-SERVICE.indication primitives may be received from the STC, see T1.674-2002.

- a) On receipt of the OUT-OF-SERVICE.indication primitive, no new calls shall be routed towards the associated signaling relation. Calls in progress need not be released, even though signaling messages cannot be sent to the affected CSF. (While it may not be technically necessary to release calls in progress, network providers may choose to release such calls, perhaps after some time interval, if there is a concern about overcharging due to the CSF's inability to completely clear the call when either the calling or called party disconnects.)
- b) On receipt of the IN-SERVICE.indication primitive, traffic is restarted. The traffic load offered to the associated signaling relation should be according to the value of the Level parameter received in the primitive.

12.10 Signaling transport congestion indications

The CONGESTION.indication primitive may be received from the STC (see T1.674-2002). The traffic load for the associated signaling relation should be adjusted according to the value of the Level parameter received in the primitive.

13 Abnormal conditions

13.1 Introduction

This clause includes procedures for the handling of events not expected during normal operation.

13.2 Dual seizure

CIC values for use across a signaling association may be allocated in two different ways:

1. The provisioned set of CIC values may be divided into two parts: one set selectable by one CSF, and the remainder selectable by the other CSF. This scheme avoids the possibility of dual seizure of a CIC value; or

2. A common set of CIC values may be provisioned (i.e., either CSF can select any provisioned value). In this case, it is possible that the two CSFs will attempt to seize the same CIC value at approximately the same time.

Subclauses 13.2.1 to 13.2.4 apply only when the second method of CIC provisioning is used.

13.2.1 Unguarded interval

The CSF must detect dual seizure and take action as defined in 13.2.4.

13.2.2 Detection of dual seizure

A dual seizure is detected by a CSF from the fact that it receives an IAM for a CIC value for which it has sent an IAM, but before it receives an ACM or ANM.

13.2.3 Preventive action

Different methods for CIC selection can be envisaged to minimize/remove the occurrence of dual seizure. The following method is defined:

- An opposite order of CIC value selection is used at each CSF.

(Other methods for CIC value selection may also be used, provided that they give the same degree of protection against dual seizure also when the method specified above is used at the other end.)

13.2.4 Action to be taken on detection of dual seizures

In the event of dual seizure, one CSF will be the control CSF and the other the non-control CSF. On detection of a dual seizure, the call being processed by the control CSF will be completed and the received IAM will be disregarded. If the IAM has been segmented using a Segmentation message, then this second segment will also be disregarded.

Under these conditions, the call being processed by the control CSF will be allowed to mature. The call being processed by the non-control CSF will be backed off and the internal bearer path disconnected (if applicable). A REL will not be sent. The non-control CSF will make an automatic repeat attempt on the same or on an alternative route.

The control CSF will be determined as follows:

- Each CSF will control one half of the CIC values. One CSF will control all even-numbered CICs and the other CSF the odd-numbered CICs. Each CSF will examine the CIC_control parameter in the START-INFO.indication primitive from the STC, T1.674-2002 to determine whether it controls odd or even CIC values per signaling association.

13.3 Reset of CICs

In systems which maintain call status in memory there may be occasions when the memory becomes mutilated. In such a case, the CIC values and associated resources must be reset to the idle condition at both CSFs to make them available for new traffic. Since the CSF with the mutilated memory does not know whether the CIC values are idle, busy outgoing, busy incoming, blocked, etc., Reset CIC messages or a CIC Group Reset message should be sent as appropriate for the affected CIC values.

13.3.1 Reset CIC procedure

If only a few CIC values are concerned, a Reset CIC message should be sent for each affected CIC value. On sending of a Reset CIC message, timers T16 and T17 are started awaiting a Release Complete message. Expiry of these timers is covered in 13.7.1.

On receipt of a Reset CIC message the receiving (unaffected) CSF will:

- a) If it is the incoming or outgoing CSF on a call in any state of call set-up, or during a call, accept the message as a REL message and respond by sending a RLC message, after the CIC value has been made idle;
- b) If the CIC value is in the idle condition, accept the message as a REL message and respond by sending a RLC message;
- c) If it has previously sent a CIC Group Blocking message with the Status bit for this CIC value set to "1," or if it is unable to release the CIC value as described above, respond by the CIC Group Blocking message. If an incoming or outgoing call is in progress, this call should be released and the CIC value returned to the "idle, blocked" state. A RLC message is sent following the CIC Group Blocking message. The CIC Group Blocking message should be acknowledged by the affected CSF. If the acknowledgment is not received, the repetition procedure specified in 13.7 should be followed. (The CSF should not wait for the CIC Group Blocking Acknowledgment before sending the Release Complete Message, however);
- d) If it has previously received a CIC Group Blocking message with the Status bit for this CIC value set to "1," respond by releasing a possible outgoing call or call attempt using the CIC value, remove the remotely blocked condition, restore the CIC value to the idle state, and respond with a RLC message;
- e) If the message is received after the sending of an IAM but before receipt of an ACM/ANM relating to that call, make an automatic repeat attempt using another CIC value if appropriate;
- f) If the message is received after having sent a Reset CIC message, respond by a RLC message. After receipt of the appropriate acknowledgment message, the CIC value should be made available for service;
- g) Except in the case of an automatic repeat attempt [see 13.3.1 e)], clear any interconnected call segments by the appropriate method:
 - At an SN: any interconnected call segments shall be released (see 11.4). The cause value in the REL should be coded for "*temporary failure*."
 - At a CMN: a Reset CIC shall be sent for any interconnected call segments¹⁶.

¹⁶ The reset request needs to be relayed through a CMN to ensure that bearer resources are released at the peer SN. The CSF sending reset may not be able to release the bearer resources, depending on the error causing the reset, and the sending of REL would not ensure that a receiving SN will release the bearer.

- h) At an SN: issue a request to the BCF to reset any allocated bearer resources, associated with this CIC value.

The affected CSF will then reconstruct its memory according to the received response(s) to the Reset CIC and respond to the message(s) in the normal way (i.e., CIC Group Blocking Acknowledgment message in response to a CIC Group Blocking message).

13.3.2 Group reset procedure

If a considerable number of CIC values or all CIC values are affected by a memory mutilation, (a) CIC Group Reset message(s) should be used to make them available for new traffic.

Upon sending a CIC Group Reset message, the affected CSF shall clear all blocking and call processing conditions, start timers T22 and T23, and mark each CIC state as "transient" until a CIC Group Reset Acknowledgment message is received. Expiry of the timers is covered in 13.7.2.

The maximum number of CIC values to be reset with a CIC Group Reset message is limited to 256.

On receipt of a CIC Group Reset message the receiving (unaffected) CSF will:

- a) Restore the CIC values to the idle state;
- b) If :
 - i) *The Range field is not coded all zero*, respond by a CIC Group Reset Acknowledgment message in which the Status indicator bits of the CIC values available for service are coded "0" and the status indicator bits of all locally blocked CIC values are set to "1."
 - ii) *The Range field is coded all zero*:
 - Send the appropriate CIC Group Blocking message if it had previously sent a CIC Group Blocking for any of the CIC in the predetermined range.
 - Respond by a CIC Group Reset Acknowledgment message in which the range field is coded all zero indicating that the restoration of the predetermined CIC has been completed.
- c) If it had previously received (a) CIC Group Blocking message(s) for one or more of the CIC value(s) involved, remove the blocked condition and make the CIC values available for service;
- d) If a CIC Group Reset message is received concerning CIC values for which a CIC Group Reset message or Reset CIC message(s) have been sent, make the CIC values concerned available for service after receipt of the appropriate acknowledgment message;
- e) If an IAM has been sent for any of the affected CICs and no ACM/ANM has yet been received, make an automatic repeat attempt on another CIC if appropriate. Otherwise, clear any interconnected call segments by the appropriate method:
 - *At an SN*: Any interconnected call segments shall be released (see 11.4). The Cause Indicator in the REL should be coded as "*temporary failure*";
 - *At a CMN*: A Reset CIC, or CIC Group Reset shall be sent for any interconnected call segments¹⁶;
- f) *At an SN*: Issue (a) request(s) to the BCF to reset any allocated bearer resources, associated with the reset CIC values.

The affected CSF will then reconstruct its memory according to the possibly received CIC Group Blocking messages and the received CIC Group Reset Acknowledgment message and from local status information. It will respond to the possibly received CIC Group Blocking messages in the normal way.

A correct acknowledgment should match the original CIC Group Reset message in Range and CIC value. The CIC value of both CIC Group Reset messages and CIC Group Reset Acknowledgment messages should be provisioned for BICC.

All CIC values in the range of a CIC Group Reset and CIC Group Reset Acknowledgment message must be provisioned for BICC.

13.3.3 Abnormal group reset procedures

- i) If a CIC Group Reset message is received indicating reset of more CIC values than allowed by the receiving CSF, it is discarded.
- ii) If a CIC Group Reset Acknowledgment message is received which is not a correct response to a sent CIC Group Reset message, it is discarded.
- iii) If a CIC Group Reset message is received requesting reset of CIC values that are not provisioned, or a CIC Group Reset Acknowledgment message that contains CIC values that are not provisioned, the message is discarded.

13.4 Receipt of unreasonable signaling information

The message transport service provided by the STC and its lower layers avoids mis-sequencing, or double delivery, of messages with a high reliability (e.g., see chapter T1.111.6 of T1.111-2001). However undetected errors at the lower message transport layers and CSF malfunctions may produce signaling information messages that are either ambiguous or inappropriate.

Unreasonable or unexpected signaling information may also be received at a CSF due to differing levels of signaling protocol enhancements at different CSFs within a network: a CSF using a more enhanced version of the protocol may send information to a less enhanced CSF which is outside the protocol definition supported at that CSF.

The procedures listed below do not include the procedures for group blocking and group reset, these are covered in 12.5 and 13.3 respectively.

13.4.1 Handling of message format errors

The following are considered message format errors:

- a) The message length is less than the number of octets required for the fixed mandatory part, the mandatory variable pointers, and the start of optional parameters pointer.
- b) A mandatory variable or start of optional parameter's pointer points beyond the message length.
- c) A mandatory variable or optional parameter's length indicator causes the overall message length to be exceeded.

When a message format error is detected the message shall be discarded.

NOTE – A format error can only be detected when the message is recognized.

For the purposes of format error detection, the message length may be interpreted as either:

- i) Received message length; or
- ii) Maximum message length as indicated by the STC in the START-INFO.indication primitive (e.g., 272 octets); see also T1.674-2002.

Interpretation i) is preferred, as it will detect errors which may not be found by interpretation ii). However the STC TRANSFER.indication does not contain the received message length.

13.4.2 Handling of unexpected messages

An unexpected message is one that contains a message type code that is within the set supported at this CSF, but is not expected to be received in the current state of the call.

In order to resolve possible ambiguities in the state of a CIC when unexpected messages are received the following will apply:

- a) If a REL is received relating to an idle CIC value it will be acknowledged with a RLC;
- b) If a RLC is received relating to an idle CIC value it will be discarded;
- c) If a RLC is received relating to a CIC value that is in use for a call, and a REL has not been sent, the call will be released and a REL will be sent;
- d) If a Segmentation message is received with a CIC value that is in use for a call; in case the segmentation has not been announced in the Simple Segmentation Indicator, the Segmentation message shall be discarded;
- e) If other unexpected signaling messages are received, the following actions will be undertaken:
 - If the CIC value is idle, the Reset CIC message is sent;
 - If the CIC value is in use for a call, after receipt of an ACM/ANM required for the call set-up, the unexpected signaling message is discarded, except in certain cases -- see item c);
 - If the CIC value is in use for a call, before receipt of an ACM/ANM required for the call set-up, the Reset CIC message is sent. If the CIC is in use for an incoming call, any interconnected call segment will be released. If the CIC is in use for an outgoing call, an automatic repeat attempt is provided using another CIC value.
- f) If a message is received with a CIC value that is not provisioned within the CSF, the procedure for sending the Unequipped CIC message will be applied (see 13.5).
- g) If an ACM (or an ANM in lieu of ACM) is received for the same incoming CIC for which an ACM (or ANM) has been sent, the Reset CIC message should be sent, the received ACM (or ANM) should be discarded, and the maintenance personnel should be notified for the CIC concerned.
- h) Except in certain cases (see 13.2, dual seizure) any other unexpected message information received shall be discarded. If the discarding of the signaling information prevents a call from being completed, that call shall eventually be released by the expiry of a time out.

13.4.3 General requirements on receipt of unrecognized messages and parameters

Normally a CSF knows the signaling system or version of a signaling system to be used to its adjacent CSFs. However, in certain circumstances (e.g., upgrading of a signaling system in the network), it may happen that a CSF receives unrecognized information (i.e., messages or parameters or parameter values). No distinction is being made between unrecognized and unimplemented functions.

It may happen that a CSF receives unrecognized messages, parameter types or parameter values. This can typically be caused by the upgrading of the signaling system used by other CSFs in the network. In these cases, the following compatibility procedures are invoked to ensure the predictable network behavior.

The procedures to be used on receipt of unrecognized information make use of:

- a) Compatibility information received in the same message as the unrecognized information;
- b) The Confusion message;
- c) The Release message;
- d) The Release Complete message;
- e) The Facility Reject message; or
- f) The Cause Indicators parameter; the following cause values are used:
 - #97 *“message type non-existent or not implemented, discarded”*;
 - #99 *“parameter non-existent or not implemented, discarded”*;
 - #103 *“parameter non-existent or not implemented, passed on”*;
 - #110 *“message with unrecognized parameter, discarded.”*

For all the above cause values a Diagnostic field is included containing, dependent on the Cause value either, the unrecognized parameter name(s), the message type code, or the message type code and the unrecognized parameter name(s).

It should be noted that the use of the Confusion message is mainly to facilitate interworking with different implementations of the BICC and/or the ISDN User Part protocol. In these cases, use of the Confusion message is a switch settable option.

The procedures are based on the following assumptions:

- i) The forward compatibility information contains different instructions for different CSFs. There are two types of CSFs, type A and type B. The classification of type A and B CSFs to the functional type a CSF may perform is listed below. It is determined on a per call basis. The classification of a CSF to the functional type can change during a call due to, for example, supplementary services.

Type A

- The CSF at an originating SN (i.e., the CSF in which the call is generated from a national public network point of view).
- The CSF at a destination SN (i.e., the CSF to which the call is destined from a national public network point of view).
- The CSF at an interworking SN (i.e., the CSF in which interworking is performed between BICC and other signaling systems -- see Note 1).

NOTE 1 – An ISN where BICC interworks to ISUP is not considered an interworking SN in this context.

- The CSF at an incoming or outgoing gateway SN or CMN (see Note 2).

NOTE 2 – In an incoming or outgoing gateway SN/CMN, the instruction to pass on a message or a parameter does not preclude the normal policing functions of these SNs.

- The CSF at a gateway ISN where ISUP interworks with BICC.

Type B

- The CSF at an intermediate SN or CMN (i.e., an SN/CMN that acts just as a transit node).
 - The CSF at an intermediate ISN where ISUP interworks with BICC.
- ii) [Not applicable to this Standard.]
 - iii) If a CSF receives a Confusion, a REL, a RLC, or Facility Reject message indicating an unrecognized message or parameter received, it assumes interaction with a CSF at a different functional level. See 13.4.5 for more details on this.
 - iv) All unrecognized messages that can be received only contain parameters coded as optional parameters; no “new” messages will contain mandatory fixed or mandatory variable parameters.
 - v) As a minimum, all implementations must recognize all messages and all parameters specified in this version of T1.673.

If messages are received without compatibility information and are not recognized, they are discarded and the Confusion message is sent.

When an unrecognized parameter or message is received, the CSF should find some corresponding instructions contained in the Parameter Compatibility Information or Message Compatibility Information parameters respectively. The Parameter Compatibility Information parameter may contain compatibility instructions for more than one parameter. The Message Compatibility Information parameter contains the instructions specific for the handling of the complete message.

If the CSF does not find instructions in an appropriate compatibility parameter, or if the compatibility parameter is not found in the message, the actions default to a basic action. Details of this are found in 13.4.4.

The instruction indicators are a set of Boolean indicators. The following general rules apply to the examination of these instruction indicators:

- i) Depending on the role of the CSF in the call (i.e., type A or type B), and the settings of the indicators, only a subset of the indicators are examined, some being ignored.

Only type B CSFs examine the Transit at Intermediate Exchange Indicator. If it is set to “*Transit Interpretation*,” the other indicators are ignored. If it is set to “*End Node Interpretation*,” the actions in accordance with the setting of the remaining indicators are performed.

Type A CSFs always interpret the remaining indicators (i.e., all indicators except the Transit at Intermediate Exchange indicator_).

Consequently, “*End Node Interpretation*” means that all kinds of CSFs (i.e., type A and type B) have to interpret the instruction indicators.

- ii) Instruction indicators marked as “*spare*” are not examined. They may be used by future versions of BICC; in this case the future version of BICC will set the currently defined instruction indicators to a reasonable value for the current version. This rule ensures that more types of instructions can be defined in the future without creating a backward compatibility problem.
- iii) A CSF must decide what CSF type it is for the call before performing compatibility actions.

- iv) At a type B CSF the unrecognized information should be passed on unchanged, if the Transit at Intermediate Exchange Indicator is set to *"Transit Interpretation."*
- v) At a type B CSF that has not been instructed to pass on the unrecognized information; if the Release Call Indicator is set to *"Release Call,"* the call is released.
At a type A CSF, the call is released if the Release Call Indicator is set to *"Release Call."*
- vi) At a type B CSF that has not been instructed to pass on the unrecognized information or at a type A CSF, in any case the following is applicable if the Release Call Indicator is set to *"Do Not Release Call"*:
 - If the Discard Message Indicator or the Discard Parameter Indicator is set to *"Discard Message/Discard Parameter,"* the message or parameter is discarded, as instructed; and
 - Then, if the Send Notification Indicator is set to *"Send Notification,"* a Confusion message is sent towards the CSF that sent the unrecognized information.
- vii) For the case of an unrecognized parameter, it is possible for the instruction to require that either the unrecognized parameter or the whole message is discarded. This provides for the case where the sending CSF determines that it is not acceptable for the message to continue being processed without this parameter.
- viii) In case a parameter is included more than once in the same message, the instruction indicator of the Parameter Compatibility Information parameter is set according to the most stringent combination of the possible codings (i.e., the coding "1" of a bit in the instruction indicator is dominant).
- ix) In case a message is used for more than one procedure related to the same call and the codings of the instruction indicator of the Message Compatibility Information parameter described in the corresponding texts are different, the instruction indicator is set according to the most stringent combination of the possible codings (i.e., the coding "1" of a bit in the instruction indicator is dominant).
- x) At a type A CSF where "pass on" has been specified for a message or parameter and "pass on" is not possible, then the Pass On Not Possible Indicator and Send Notification Indicator are checked.
- xi) In case of a repeat attempt if a Confusion message is sent or passed on with the indication that a parameter of an IAM is discarded, this parameter shall not be sent in a new IAM.
- xii) If a CSF applies the instruction "discard message" according to the Parameter Compatibility Information parameter, it should discard the first segment and its possible associated Segmentation message whenever timer T36 has been started.
- xiii) If unrecognized information is received when interworking with B-ISUP, the Broadband/narrow-band Interworking Indicator is checked.
- xiv) Tables 3/T1.673.4 and 4/T1.673.4 clarify the handling of the received compatibility information:

Table 3/T1.673.4 – On receipt of Message Compatibility Information parameter

Instruction indicator			Required action
B	C	D	
0	X	0	Pass on message (Notes 1, 2 and 3)
0	0	1	Discard message
0	1	1	Discard message and send notification
1	X	X	Release call

NOTE 1 – “x” = don't care.
 NOTE 2 – Applicable to type B CSFs. Other CSFs (e.g., originating, terminating, interworking) check bit E to determine the required action.
 NOTE 3 – In case of passing on a message, no notification is sent, bit C is ignored. If pass on is set (bit D=0) but not possible, then bits C and E are checked.

Table 4/T1.673.4 – On receipt of parameter compatibility information parameter

Instruction indicator				Required action
B	C	D	E	
0	X	0	0	Pass on parameter (Notes 1, 2 and 3)
0	0	0	1	Discard parameter
0	0	1	0	Discard message
0	0	1	1	Discard message
0	1	0	1	Discard parameter and send notification
0	1	1	0	Discard message and send notification
0	1	1	1	Discard message and send notification
1	X	X	X	Release call (Note 1)

Note 1 – “x” = don't care.
 Note 2 – Applicable to type B CSFs. Other CSFs (i.e., originating, terminating, interworking) shall check Bits G and F to determine the required action.
 Note 3 – In case of passing a message, no notification is sent, bit C is ignored. If pass on is set (bit D=0 and bit E=0) but not possible, then bits C, F, and G are checked.

If within chapters T1.673.3 or T1.673.4, specific actions or interpretations are described that are to be taken for receipt of unrecognized signaling information within the offending message or parameter, then those actions or interpretations shall be applied. Otherwise,

- 1) If the message is a REL, then the message shall be treated as if the unrecognized information was not present. If release of the CIC is possible, the REL shall be forwarded for any associated call segments. When there is no signaling system interworking, the message can be transferred transparently. In other cases, the unrecognized information shall be deleted.
- 2) If the message is a CIC supervision message (Release Complete, Reset CIC, Suspend, Resume, or Unequipped CIC) or CIC group supervision message (CIC Group Blocking, CIC Group Unblocking, CIC Group Blocking Acknowledgment, CIC Group Unblocking Acknowledgment, CIC Group Reset, CIC Group Reset Acknowledgment, CIC Query, or CIC Query Response), then the message shall be discarded, and no other action shall be taken.
- 3) If an IAM is received with invalid information needed to route the call, the message shall be discarded and the CIC shall be released along with any associated call segments.

- 4) For all other cases, the procedures specified in 13.4.4 apply.

13.4.4 Procedures for the handling of the unrecognized messages or parameters

Messages and parameters that are indicated as not used for BICC in chapter T1.673.3 shall be treated as unrecognized.

A Confusion message must not be sent in response to a received Confusion, Facility Reject, REL, or RLC message. Any unrecognized parameters received in a Confusion, Facility Reject, or RLC message are discarded. Any unrecognized mandatory parameter value received in a Confusion or Facility Reject message will result in the message being discarded.

13.4.4.1 Unrecognized messages

1) *Actions at type A CSFs:*

- a. *Compatibility parameter received:* Depending on the instructions received in the Message Compatibility Information parameter, a type A CSF receiving an unrecognized message will either:
- Transfer the message transparently (see Note 1);
 - Discard the message;
 - Discard the message and send Confusion; or
 - Release the call.

NOTE 1 – The transparent passing of a message is only applicable when the ISUP signaling is according to American National Standard T1.113-2000 or a later version, or BICC.

A REL and a Confusion message shall include the cause value #97 “*message type non-existent or not implemented-discarded*,” followed by a Diagnostic field containing the message type code. For multiple occurrences of unrecognized messages, a Confusion message should be sent for each occurrence.

- b. *Compatibility parameter not received:* If an unrecognized message is received without Message Compatibility Information parameter at a CSF, the message is discarded and a Confusion message is returned. A Confusion message shall include the cause value #97 “*message type non-existent or not implemented – discarded*,” followed by a Diagnostic field containing the message type code. For multiple occurrences of unrecognized messages, a Confusion message should be sent for each occurrence.

NOTE 2 – As a minimum all implementations must recognize all messages specified in this version of T1.673.

2) *Actions at type B CSFs:*

- a. *Compatibility parameter received:* Depending on the instructions received in the Message Compatibility Information parameter, a type B CSF receiving an unrecognized message will either:
- Transfer the message transparently;
 - Discard the message;
 - Discard the message and send Confusion; or
 - Release the call.

A Confusion message shall include the cause value #97 “*message type non-existent or not implemented-discarded*,” followed by a Diagnostic field containing the message type code.

A REL message shall include the cause value #97 "*message type non-existent or not implemented – discarded*," followed by a Diagnostic field containing the message type code.

- b. *Compatibility parameter not received*: If an unrecognized message is received without Message Compatibility Information parameter at a CSF, the message is discarded and a Confusion message is returned. A Confusion message shall include the cause value #97 "*message type non-existent or not implemented-discarded*," followed by a Diagnostic field containing the message type code.

NOTE 3 – As a minimum, all implementations must recognize all messages specified in this version of T1.673.

13.4.4.2 Unrecognized parameters

Receipt of unrecognized parameters can only refer to optional parameters, since mandatory parameters will always be recognized by their location in a message.

An unrecognized parameter is either one that is not defined for BICC (see chapter T1.673.3) or is marked as "no procedure specified for U.S. networks." In addition, a parameter will be considered unrecognized if it is received in the "wrong" message. New parameters that are added to a later version cannot be recognized at a CSF which has not upgraded to that later version; They are therefore detected as unrecognized.

i) *Actions at type A CSF*:

- a. *Compatibility parameter received*: Depending on the instructions received in the Parameter Compatibility Information parameter, a type A CSF receiving an unrecognized parameter will either:
- Transfer the parameter transparently (see Note);
 - Discard the parameter;
 - Discard the message;
 - Discard the parameter and send Confusion;
 - Discard the message and send Confusion; or
 - Release the call.

NOTE – The transparent passing of a parameter is only applicable when the ISUP signaling is according to T1.113-2000 (or a later version) or BICC.

A Confusion message shall include the cause value #99 "*parameter non-existent or not implemented-discarded*" followed by a Diagnostic field containing the parameter name, or #110 "*message with unrecognized parameter-discarded*," followed by a Diagnostic field containing the message name and the name of the first detected unrecognized parameter which caused the message to be discarded. A Confusion message may refer to multiple unrecognized parameters.

A REL shall include the cause value #99 "*parameter non-existent or not implemented-discarded*" followed by a Diagnostic field containing the parameter name.

If an unrecognized parameter is received in a Facility Request message, the parameter is handled like unrecognized parameters in other messages.

If a REL message is received containing an unrecognized parameter, depending on the instructions received in the compatibility information parameter, a type A CSF will either:

- Discard the parameter; or

- Discard the parameter and send a cause #99, “*parameter non-existent or not implemented-discarded,*” in the RLC message.
- b. *Compatibility parameter not received:* If a CSF receives and detects an unrecognized parameter without a Parameter Compatibility Information parameter, the actions taken will be dependent on whether the unrecognized parameter is passed on or discarded. If the unrecognized parameter is discarded, a Confusion message is sent to the CSF from which the unrecognized parameter was received. The Confusion message contains the cause value #99 “*parameter non-existent or not implemented-discarded,*” followed by a Diagnostic field containing the parameter name. A Confusion message may refer to multiple unrecognized parameters. If the unrecognized parameter is passed on unmodified, no subsequent actions are necessary.

If a Facility Request message is received with unrecognized parameters, the message is discarded and a Facility Reject message is returned including the cause value #99 “*parameter non-existent or not implemented-discarded,*” followed by the parameter name code in the Diagnostic field.

If a REL message containing an unrecognized parameter is received at a type A CSF, a RLC message is returned including the cause value #99 “*parameter non-existent or not implemented-discarded.*”

ii) *Actions at type B CSF:*

- a. *Compatibility parameter received:* Depending on the instructions received in the Parameter Compatibility Information parameter, a type B CSF receiving an unrecognized parameter will either:
 - Transfer the parameter transparently;
 - Discard the parameter;
 - Discard the message;
 - Discard the parameter and send Confusion;
 - Discard the message and send Confusion; or
 - Release the call.

A Confusion message shall include the cause value #99 “*parameter non-existent or not implemented-discarded,*” followed by a Diagnostic field containing the parameter name, or #110 “*message with unrecognized parameter-discarded,*” followed by a Diagnostic field containing the message name and the name of the first detected unrecognized parameter which caused the message to be discarded. A Confusion message may refer to multiple unrecognized parameters. If the unrecognized parameter is passed on unmodified, no subsequent actions are necessary.

A REL shall include the cause value #99 “*parameter non-existent or not implemented-discarded,*” followed by a Diagnostic field containing the parameter name.

If an unrecognized parameter is received in a Facility Request message, the parameter is handled like unrecognized parameters in other messages.

Depending on the instructions received in the Parameter Compatibility Information parameter, a CSF receiving an unrecognized parameter in a REL message will either:

- Transfer the parameter transparently;
- Discard the parameter; or
- Discard the parameter and send a cause #99, “*parameter non-existent or not implemented – discarded,*” in the RLC message.

- b. *Compatibility parameter not received*: If a CSF receives and detects an unrecognized parameter without a Parameter Compatibility Information parameter, the actions taken will be dependent on whether the unrecognized parameter is passed on or discarded. If the unrecognized parameter is discarded, a Confusion message is sent to the CSF from which the unrecognized parameter was received. The Confusion message contains the cause value #99 "*parameter non-existent or not implemented-discarded*," followed by a Diagnostic field containing the parameter name. A Confusion message may refer to multiple unrecognized parameters. If the unrecognized parameter is passed on unmodified, no subsequent actions are necessary.

If a Facility Request message is received with unrecognized parameters, the message is discarded and a Facility Reject message is returned including the cause value #99 "*parameter non-existent or not implemented-discarded*," followed by the parameter name code in the Diagnostic field.

If a REL message containing an unrecognized parameter that cannot be passed on is received at a type B CSF, a RLC message is returned including the cause value #99 "*parameter non-existent or not implemented-discarded*."

13.4.4.3 Unrecognized parameter values

Any parameter values marked as "spare," "reserved," or "no procedures specified for U.S. networks" in chapter T1.673.3 shall be regarded as unrecognized.

All parameter fields referred to in chapter T1.673.3 which are considered essential for basic call processing are marked as either having a default value or as uninterpretable if received with an unrecognized value.

If a CSF receives a recognized parameter which contains any value considered unrecognized, the CSF proceeds as follows:

- a) If there exists a default value for the parameter field, then this default value shall be used for any processing of that parameter field. The unrecognized parameter value, however, shall be passed on if the parameter is to be passed on, except if the value is in a network-specific range, in which case the value may be optionally replaced by the default value.
- b) If the parameter field is uninterpretable, the call shall be released with an appropriate cause value. In case no specific cause value can be identified, a Cause Indicators parameter coded as follows should be used:
 - Coding standard: "*ITU-T standard*";
 - Location: "*local interface controlled by this signaling link*";
 - Cause value: "*protocol error, unspecified*."
- c) If there is no default value and the parameter field is not marked as interpretable, the unrecognized parameter value shall be passed on or shall be processed in accordance with supplementary service procedures, if applicable.

13.4.5 Procedures for the handling of responses indicating unrecognized information has been sent

13.4.5.1 Type A CSFs

CSF action taken on receipt of these messages at an originating or terminating SN will depend on the call state and the affected service.

The definition of any procedure that is outside the basic call set-up protocol, as defined in this American National Standard, should include procedures for handling responses that indicate that another CSF has received, but not recognized, information belonging to that procedure. The procedure receiving this response should take the appropriate actions.

The default action taken on receipt of a Confusion message is to discard the message without disrupting normal call processing.

13.4.5.2 Type B CSFs

- i) *Confusion with Cause "message type non-existent or not implemented-discarded"*: A CSF receiving Confusion (message type non-existent or not implemented-discarded) has to determine the appropriate subsequent actions as described for type A CSFs in the above subclause.
- ii) *Confusion with Cause "parameter non-existent or not implemented-discarded, or passed on"*: The actions taken at a type B CSF, on receipt of a Confusion message will depend on whether the CSF has the functionality to generate the parameter identified in the diagnostic field:
 - a) If the CSF does not have the functionality to generate the parameter, the decision on what action should be taken is deferred to a CSF that does contain this functionality. This is achieved by passing the Confusion message transparently through the type B CSF.
 - b) If this CSF does have the functionality to generate the parameter, the procedural element that created or modified the information should determine any subsequent actions, as described for type A CSFs above.
- iii) *Facility Reject*: If a type B CSF does not have the capability to take action on receipt of Facility Reject, it should pass the message transparently to the preceding or succeeding CSF.
- iv) *Release and Release Complete*: Action taken on receipt of a REL or a RLC message with cause indicating unrecognized information is as for the normal procedures for these messages.

The above actions are summarized in Tables 5a/T1.673.4 and 5b/T1.673.4.

Table 5a/T1.673.4 – Handling of responses indicating unrecognized information has been sent

	CSF has the functionality to generate the information			
	Cause			
Message	Parameter discarded	Parameter passed on	Message discarded	Message passed on
Confusion	(Procedure dependent action)			
Facility reject	Normal procedures	Procedure depend. Action	Not applicable	Not applicable
Release	Normal procedures	Not applicable	Not applicable	Not applicable
Release complete	Normal procedures	Normal procedures	Not applicable	Not applicable

Table 5b/T1.673.4 – Handling of responses indicating unrecognized information has been sent

	CSF does not have the functionality to generate the information			
	Cause			
Message	Parameter discarded	Parameter passed on	Message discarded	Message passed on
Confusion	Defer action (transit Confusion)			
Facility reject	Defer action (transit the message)			
Release	Normal procedures	Not applicable	Not applicable	Not applicable
Release complete	Normal procedures	Normal procedures	Not applicable	Not applicable

13.4.6 Procedures for handling unreasonable parameters

If a message is received that:

- a) Is of valid type (i.e., it is not unexpected or unrecognized as described in 13.4.2 and 13.4.4.1); and
- b) It contains parameters of recognized type and value (i.e., the procedures in 13.4.4.2 do not apply);

it is still possible that the contents of the message are unreasonable. This can be as a result of conflicting information within the message. This situation should be handled by assuming the lower network capability for the affected parameter.

13.4.7 Handling of the BICC_Error indication primitive

On reception of a BICC_Error indication primitive containing an error notification indicating "*unidentified context / addressing error*," the call shall be released with cause value #79 "*service or option not implemented, unspecified*" and the maintenance system shall be notified.

On reception of a BICC_Error indication primitive containing an error notification indicating "*reassembly error*," the call shall be released with cause value #111 "*protocol error, unspecified*" and the maintenance system shall be notified.

On reception of a BICC_Error indication primitive containing an error notification indicating "*unrecognized information*," the Compatibility procedure in 13.4.8 applies.

13.4.8 Compatibility for the BICC APM user application

13.4.8.1 General requirements on receipt of unrecognized information elements

It may happen that a node receives unrecognized information element types or subfield values. This can typically be caused by the upgrading of the signaling system used by other nodes in the network. In these cases, the following compatibility procedures are invoked to ensure predictable network behavior.

All BAT information elements include a compatibility field as specified in chapter T1.673.6.

The procedures to be used on receipt of unrecognized information make use of:

- Compatibility field received within the information elements; and
- The BAT Compatibility Report information element, including a Report Reason and Diagnostics

The following Report Reasons are used:

- *“Information element non existent or not implemented”*
- *“BICC data with unrecognized information element, discarded”*

For the above Report Reasons, a Diagnostic field is included identifying the unrecognized information elements.

The procedures are based on the following assumptions:

- 1) [Not applicable to this Standard.]
- 2) If a node receives a BAT Compatibility Report information element indicating an unrecognized information element received, it assumes interaction with a node supporting a different functional level.

When an unrecognized information element is received, the node will find some corresponding instructions contained in the information element compatibility information field.

The instruction indicators consist of two subfields: one to indicate how to handle unrecognized information elements and the other to indicate what to do when an unrecognized information element cannot be passed on. The following general rules apply to the interpretation of these instruction indicators:

- a) “Reserved” subfields of the compatibility field are not examined. They may be used by future capability sets of this American National Standard; in this case, the future capability sets will set the currently defined instruction indicators to a reasonable value for nodes implementing the current capability set. This rule ensures that more types of instructions can be defined in the future without creating a backward compatibility problem.
- b) The call is released, using Cause value #31 *“normal, unspecified,”* if the instruction indicator is set to *“Release Call.”*
- c) If the instruction indicator is set to *“Discard information element,”* the information element is discarded, as instructed. If the Send Notification indicator is set to *“Send Notification,”* the BAT Compatibility Report information element with the appropriate Report Reason and Diagnosis fields is issued towards the node that sent the unrecognized information.
- d) If the instruction indicator is set to *“pass-on,”* the unrecognized information element is passed to the signaling association on the other side of the CSF for this call. If the ability to *“pass-on”* is not possible at a CSF, then the instruction indicators *“pass-on not possible”* are examined.

NOTE - Examples of where “pass-on” might not be possible are: At ISNs, or in GSN between different operators, where “pass-on” might depend on bilateral agreements.

- e) For the case of an unrecognized information element, it is possible for the instruction to require that either the unrecognized information element or all the information elements relating to received APP parameter containing the information element are discarded. This provides for the case where the sending node determines that it is not acceptable for the APP parameter to continue being processed without this information element.

13.4.8.2 Procedures for the handling of unrecognized information elements

13.4.8.2.1 Unrecognized information elements

Unrecognized information elements are received via the BICC_Error indication primitive, indicating *"unrecognized information."*

Unexpected information element(s), received via the BICC_Data indication primitive are handled like unrecognized information elements.

Depending on the instructions received in the Information Element Compatibility Information field, a node receiving an unrecognized information element will perform one of the following actions:

- a) Release the call;
- b) Discard all the associated information elements and send notification;
- c) Discard all the associated information elements;
- d) Discard the information element and send notification;
- e) Discard the information element; or
- f) Transfer the information element transparently.

In case d), the BAT Compatibility Report information element shall include the Report Reason *"information element non-existent or not implemented,"* followed by a Diagnostic field containing the pairs of Information Element Identifier and Index subfields for each unrecognized information element being referred to.

In case b), the BAT Compatibility Report information element shall include the Report Reason *"BICC data with unrecognized information element, discarded,"* followed by a Diagnostic field containing the Information Element Identifier (of the first detected unrecognized information element which caused the primitive to be discarded) and the Index subfield.

The Index subfield shall be coded as follows:

The Index subfield contains a pointer to the unrecognized Information Element Identifier octet. Thus:

1. For a "Simple" information element, see chapter T1.673.6, the Index is always coded as '0'.
2. For a "Constructor" information element the Index is coded as '0' if the Constructor information element itself is not recognized, but is coded with an octet offset value (see chapter T1.673.6), if the unrecognized information element is a sub-element within the Constructor information element.

This applies to Constructor information elements at the top level of the structure within an APP parameter. It shall not apply recursively within a Constructor information element.

On receiving a BICC_Error indication primitive including multiple unrecognized information elements, the different instruction indicators associated with those information elements, shall be processed in priority order, according to the list (a-f), above.

When the call is released due to compatibility procedures, the BAT Compatibility Report information element shall be sent in a BICC_Data request primitive (corresponding to a PRI message) towards the

node that sent the unrecognized information element, including the Report Reason *“information element non-existent or not implemented”* followed by a Diagnostic field containing the Information Element Identifier (of the first detected unrecognized information element which caused the call to be released) and the Index subfield.

If a BICC_Error indication primitive indicating *“unrecognized information”* is received relating to a PRI message, depending on the instructions received in the Information Element Compatibility field the node will either:

- a) Discard all the associated information elements;
- b) Discard the information element; or
- c) Transfer the information element transparently.

On receiving a BICC_Error indication primitive including multiple unrecognized information elements relating to a PRI message, the different instruction indicators associated with those information elements, shall be processed in priority order, according to the list (a-c), above.

No BAT Compatibility Report information element is sent for unrecognized information inside a PRI message, or for unrecognized information inside a BAT Compatibility Report information element inside a BICC_Data indication primitive.

13.4.8.2.2 Unrecognized fields

There exists no specific compatibility information for each field. For all fields contained in a information element, the compatibility information of the information element applies.

13.4.8.3 Procedures for the handling of a response indicating unrecognized information has been sent

Action taken on receipt of a BAT Compatibility Report information element will depend on whether the CSF has the functionality to generate the information element identified in the diagnostic field:

- a) If the CSF does not have the functionality to generate the information element, the decision on what action should be taken is deferred to a CSF that does contain this functionality. This is achieved by passing the BAT Compatibility Report information element transparently through the CSF.
- b) If this CSF does have the functionality to generate the information element, the procedural element that created or modified the information should determine any subsequent actions.

The default action taken on receipt of a BAT Compatibility Report information element is to discard the primitive containing the BAT Compatibility Report without disrupting normal call processing.

13.4.8.4 Handling of unexpected values

If a BICC_Data indication primitive is received with an Action indicator value that is not expected the following actions shall be taken:

- If the set-up procedure (incoming or outgoing, as appropriate) has not been completed, the Reset procedure (see 13.3) shall be invoked. Any associated call segment shall be released with Cause #111 “*Protocol error, unspecified.*”
- If the set-up procedure (incoming or outgoing, as appropriate), has been completed, the Action indicator is treated as unrecognized (see 13.4.8.2).

13.5 Unequipped CIC message

An Unequipped CIC message is sent by a CSF in response to the reception of an Initial Address, Release, Reset CIC, CIC Group Blocking, CIC Group Unblocking, or CIC Group Reset message, and optionally any other message except a CIC Query or CIC Query Response message, on which it is unable to act as a consequence of its inability to perform a CIC translation.

If an Unequipped CIC message is received for a CIC value in the context of BICC signaling, the receiving CSF shall:

1. Remove the indicated CIC value from service and report the CIC value to the maintenance system for maintenance action;
2. If the CIC has been selected and an IAM transmitted, but the set-up sequence has not as yet resulted in the receipt of an ACM/ANM, reattempt the call on another CIC providing the rejected attempt was a first attempt. If the rejected attempt was a second attempt, either a REL should be returned (if the incoming connection uses ISUP or BICC) or a recorded announcement should be connected (if the incoming connection uses in-band signaling); and
3. Except in the case of a reattempt indicated in (2), send appropriate signals on any interconnected call segments to release them. As an option, stable calls may not be released.

A CSF receiving a CIC Group Blocking, CIC Group Unblocking, or CIC Group Reset Message where the CIC is provisioned, but one or more of the CICs indicated by the Range (and Status) field is not provisioned, may optionally send an Unequipped CIC message for each of these non-provisioned CICs. Otherwise, the non-provisioned state of the CIC(s) will be recovered when an IAM or a CIC Query message is received for the affected CIC(s).

A CSF receiving an Unequipped CIC message after having transmitted a CIC Group Blocking, CIC Group Unblocking, or CIC Group Reset message, assumes that the regular acknowledgment message shall not be received and treats the other CICs as though the responding CSF had not taken the action on the affected CICs indicated in the initial message.

13.6 Overlength messages

If a sending CSF detects that a message to be sent exceeds the octet limit of the underlying message transport mechanism as indicated by the START-INFO.indication primitive received from the STC (see T1.674-2002), and the message is not able to be segmented or segmentation has already been applied, then the User-to-User Information parameter (if present) should first be discarded followed by all unrecognized optional parameters to bring the message to within the indicated octet limit.

13.7 Timer expiries

13.7.1 Failure in the Reset CIC procedure

If no RLC message is received in acknowledgment to the Reset CIC message before 4-15 seconds (T16), the Reset CIC message should be repeated. If an acknowledgment for the message is not received within one minute (T17) after the initial Reset CIC message, the maintenance personnel should be notified. However, the sending of the Reset CIC message should continue at one minute (T17) intervals until maintenance intervention occurs or an expected response is received.

13.7.2 Failure in the Group Reset procedure

If no acknowledgment to a CIC Group Reset message is received before 4-15 seconds (T22), the CIC Group Reset message should be repeated. If an acknowledgment for the CIC Group Reset message is not received within one minute (T23) after sending the initial CIC Group Reset message, the maintenance personnel should be notified to permit manual restoration procedures. However, the sending of the CIC Group Reset message should continue at one minute (T23) intervals until maintenance intervention occurs.

13.7.3 Failure in the blocking/unblocking sequence

A CSF will repeat the CIC Group Blocking (Unblocking) message on failure to receive the appropriate acknowledgment in response to one of these messages before 4-15 seconds (T18, T20 appropriately; see 12.5).

If the appropriate acknowledgment is not received within a period of one minute (T19, T21 appropriately) after sending the initial CIC Group Blocking (Unblocking) message, the maintenance personnel should be alerted, the repetition of the CIC Group Blocking (Unblocking) message should be continued at the intervals specified by T19 and T21, respectively, until maintenance intervention occurs and the CIC value(s) taken out of (returned to) service as appropriate.

13.7.4 Failure to receive a Release Complete message – Timer T1 and T5

If a RLC is not received in response to a REL before 4-15 seconds (T1), the CSF will retransmit the REL message, and indicate call release to the BCF [see 11.5 b)].

On transmitting the initial REL message, a one minute timer (T5) is started. If after repeating the REL message for this period of one minute, a RLC is not received, the CSF shall:

- i) Send a Reset CIC message;
- ii) Alert the maintenance system;
- iii) Cease sending REL messages; and
- iv) Continue the sending of the Reset CIC message at one minute intervals until maintenance action occurs or an expected response is received.

13.7.5 Failure to receive a response to an Information Request message

If a response is not received in response to an Information Request message before timer T33 expires, the CSF will release the call and the maintenance system may be informed.

13A Generic signaling procedures and support of ISDN supplementary services

13A.1 Soliciting information

See 8.12.

13A.2 Special processing request

13A.2.1 Actions required at the initiating CSF

If a CSF recognizes, based on available information, that a call requires some special processing not resident at its SN or CMN, the CSF -- referred to as the initiating CSF -- determines which SN or CMN has the needed processing capability. Associated with CSF in the selected SN/CMN -- referred to as the special processing CSF -- is a routing number that is unique to the SN/CMN in which the CSF resides. The initiating CSF forms an IAM in order to route the call to the SN of the special processing CSF. In addition to basic call set-up information (see 7.2.1.2.1), the IAM shall include:

- The routing number in the Called Party Number parameter;
- The dialed number in the Generic Address parameter;
- An indication of the type of processing required in the Special Processing Request parameter; and
- The ISDN User Part/BICC Preference Indicator set to "*required*."

13A.2.2 Actions required at an intermediate CSF

The CSF at an intermediate, non-gateway SN (referred to as the intermediate CSF), on receipt of an IAM, shall analyze the called party number (routing number) and the other routing information (see 7.2.1.1) to determine the routing of the call. The special processing request indication and the dialed number are passed on transparently to the next CSF.

13A.2.3 Actions required at the special processing CSF

The special processing CSF, on receipt of an IAM, shall analyze the called party number to determine if it is a special routing number reserved at the CSF in order to trigger special processing. If the called party number is such a routing number, the special processing CSF analyzes the contents of the Special Processing Request parameter and other information contained in the IAM (e.g., dialed number) and invokes the required processing.

13A.2.4 Abnormal conditions

If the special processing CSF receives an IAM containing a called party number that is a special routing number but does not contain a Special Processing Request parameter, or if the special routing number and the Special Processing Request parameter are received but the dialed number is not received or is not readable, then the CSF should decide that reorder tone is to be provided to the calling party.

If the special processing CSF receives an IAM containing a special processing request indication that the CSF does not understand, then the CSF should forward the call to another special processing CSF or decide that reorder tone is to be provided to the calling party.

13A.3 Transfer of supplementary services notification information**13A.3.1 Actions at the CSF which initiates messages with notification information**

When a CSF sends an BICC message, it may include the Notification Indicator parameter to transport notification information for supplementary services. If the Notification Indicator parameter is generated by the CSF invoking the service, it shall be coded according to the service invoked. If notification information is received from the access protocol, the information shall be mapped to the appropriate values in the Notification Indicator parameter.

The Notification Indicator parameter shall be carried in a call control message, if a suitable one is available (IAM, ACM, ANM, or CPG). If a suitable call control message is not available, the Notification Indicator parameter shall be carried in the CPG.

13A.3.2 Actions at an intermediate or gateway CSF

Upon receiving a BICC message containing the Notification Indicator parameter, the CSF at an intermediate or gateway CS (referred to as the intermediate or gateway CSF) shall include the parameter without modification in the outgoing message to the succeeding/preceding CSF.

13A.3.3 Actions at the CSF which terminates messages with notification information

Upon receiving a BICC message containing the Notification Indicator parameter, the CSF that terminates the message shall map the contents to the appropriate access protocol.

13A.4 ACM to CPG mapping

The receipt of an ACM at the CSF at an intermediate or gateway SN which has previously sent an ACM shall cause the CSF to:

- 1) Cancel the awaiting address complete timer (T7);
- 2) Send a CPG to the preceding CSF containing all of the parameters in the ACM received, with the possible exception of parameters and contents that need to be changed for the same reasons that would apply if the ACM were relayed (see 7.7.2.1). The mandatory Event Information parameter in the CPG -- indicating the reason for sending the CPG -- is set based on the Called Party Status field in the Backward Call Indicators parameter received in the ACM as follows:

1. If the Called Party Status field is set to "*subscriber free*," the Event Information parameter shall indicate "*ALERTing*";
2. If the Called Party Status field is set to "*no indication*," the Backward Call Indicators parameter indicates "*no interworking encountered*," and the ACM contains the Optional Backward Call Indicators with the indication "*inband information available*," the Event Information parameter shall indicate "*inband information now available*";
3. For all other cases, the Event Information parameter shall indicate "*PROGress*."

13A.5 Generic digit transfer

This capability enables supplementary services to transfer digit information, which cannot suitably be sent within any numbering address parameter, in a Generic Digit parameter. A Generic Digit parameter is transported in an IAM. Use of the Generic Digit parameter in other call control messages shall not be precluded.

The Generic Digit parameter is generated by the CSF invoking a service. This parameter is passed unchanged to the relevant CSF.

Examples of digit information in the Generic Digit parameter are account code, authorization code, etc.

13A.6 User network interaction

This procedure allows a network node to temporarily halt call set-up and play tones or announcements (or both), and collect additional in-band information from the calling user before routing the call further.

This procedure makes use of the User-Network Interaction Indicator (Bit H of Optional Backward Call Indicators parameter).

13A.6.1 Actions at a controlling SN

When a CSF has received an IAM from a preceding CSF and has determined that additional information is necessary from the calling user before the call can be routed further, the CSF (namely, the controlling CSF) shall send an ACM containing the Optional Backward Call Indicator to the preceding CSF with the User-Network Interaction Indicator indicating "*user-network interaction occurs, cut through in both directions*" and the Inband Information Indicator indicating "*inband information or an appropriate pattern is now available*."

The Backward Call Indicator parameter shall be coded as follows:

Charge indicator	<i>no indication</i>
Called party's status indicator	<i>no indication</i>
Called party's category indicator	<i>no indication</i>
End-to-end method indicator	<i>no end-to-end method available</i>
Interworking indicator	<i>no interworking encountered</i>
IAM Segmentation indicator	<i>no indication</i>
ISDN-UP/BICC indicator	<i>ISDN-UP/BICC used all the way</i>
ISDN access indicator	<i>non-ISDN</i>
Echo control device indicator	coded the same as in the received Nature of Connection Indicators

In the case that the Continuity message is awaited, the sending of the ACM shall be withheld until a successful continuity indication has been received (see 7.7.1).

After sending the ACM, the internal bearer path in the backward direction at the controlling SN is connected to the appropriate tones or announcements (or both). The forward path is cut through to the preceding SN so that information can be received from the calling user.

Subsequently, the call is routed further. Receipt of an ACM from a succeeding CSF will cause the mapping of ACM to a CPG as specified in 13A.4. The CPG will transport all parameters of the received ACM.

If a REL is received for outgoing CIC before an ACM is received for the outgoing CIC, and the REL contains a Cause code which can be mapped into the playing of a tone/announcement, the REL should not be returned to the preceding CSF (unless prior arrangement has assured that the appropriate announcement can be played). The appropriate tone or announcement should be played from the serving (controlling) SN.

13A.6.2 Action at an intermediate or gateway SN/CMN

Clauses 7.7.2, 7.7.3, or 7.7.4 shall apply as appropriate. When the User-Network Interaction Indicator indicates "*user-network interaction occurs, cut through in both directions*," an SN shall through connect the internal bearer path in both directions, if not already through connected. The Echo control device indicator in the Backward Call Indicator parameter shall be ignored by the CSF.

13A.6.3 Action at the originating SN

On the receipt of an ACM, the CSF shall cancel the awaiting address complete timer (T7; also known as Network Protection Timer). When the User-Network Interaction Indicator indicates "*user-network interaction occurs, cut through in both directions*," the SN shall through connect the internal bearer path in both directions. Appropriate progress indication shall be sent to the calling user, if possible. The Echo control device indicator in the Backward Call Indicator parameter shall be ignored.

13A.7 Network excessive delay

This procedure is used by a supplementary service at an SN (namely, the controlling SN) when excessive processing delay is anticipated during call set-up.

This procedure makes use of the Call Completion Delay indicator in the Notification Indicator parameter (see 13A.3).

13A.7.1 Actions at a controlling SN

When the CSF has received an IAM and has determined that call set-up will be delayed due to anticipation of excessive processing, the CSF shall send an ACM to the preceding CSF to enable stopping of the awaiting address complete timer (T7).

The ACM sent from the CSF shall contain a Notification Indicator indicating call completion delay. The Backward Call Indicator parameter shall be coded as follows:

Charge indicator	<i>no indication</i>
Called party's status indicator	<i>no indication</i>
Called party's category indicator	<i>no indication</i>
End-to-end method indicator	<i>no end-to-end method available</i>
Interworking indicator	<i>no interworking encountered</i>
IAM Segmentation indicator	<i>no indication</i>
ISDN-UP/BICC indicator	<i>ISDN-UP/BICC used all the way</i>
ISDN access indicator	<i>non-ISDN</i>
Echo control device indicator	coded the same as in the received Nature of Connection Indicators

In the case that the Continuity message is awaited, the sending of the ACM shall be withheld until a successful continuity indication has been received (see 7.7.1).

Subsequently, the call set-up proceeds normally. However, receipt of the ACM from a succeeding CSF shall cause the mapping of ACM to a CPG, as specified in 13A.4. The CPG shall transport all parameters of the received ACM.

13A.7.2 Action at an intermediate or gateway SN

Clauses 7.7.2, 7.7.3, or 7.7.4 shall apply as appropriate. The Echo control device indicator in the Backward Call Indicator parameter shall be ignored.

13A.7.3 Action at an ACM controlling SN

On the receipt of ACM, the CSF shall cancel the awaiting address complete timer (T7). The Echo control device indicator in the Backward Call Indicator parameter shall be ignored.

13A.7.4 Action at the originating SN

On the receipt of ACM, the CSF shall cancel the awaiting address complete timer (T7). When the Notification Indicator indicates Call Completion Delay, appropriate progress indication shall be sent to the calling user, if possible. The Echo control device indicator in the Backward Call Indicator parameter shall be ignored.

13A.8 Service activation

The procedure described in this clause gives a node in the signaling network the capability to request a simple action to be performed at another node. The procedure can be used to report the acceptance or rejection of the requested action. The procedures described in this clause can only be used if no additional information specific to the requested action or its acknowledgment needs to be included in the message, unless that information is provided for other purposes as well.

If additional information specific to the requested action or its acknowledgment is to be sent and if this information is not provided in the message for other purposes, other procedures such as the Remote Operations Capability described in 13A.9 can be used.

13A.8.1 Service activation procedure

Whenever a node in the signaling network determines that there is a need for the invocation of a simple action at another node or to report the result of such an action, the node will indicate this by including the Service Activation parameter in a call control message which is ready for transmission at the appropriate time. If no such call control message is available, the Facility message is used. The specific action to be performed or acknowledged is identified by the value of the feature code(s) carried in the Service Activation parameter.

The service activation procedure can be used in a request-response mode, limited to one-cycle or in a unidirectional mode.

It is possible to include multiple feature codes requesting the invocation or acknowledgment of multiple independent actions in a single Service Activation parameter.

The assignment of feature codes and the application of the service activation procedure is up to individual supplementary service definition.

13A.9 Remote operations capability

13A.9.1 General description

The procedures described in this clause give a node in the signaling network the capability to request that a particular operation be performed at a remote node; the remote node attempts to perform the operation and then reports the outcome of the attempt.

The generic structure of an operation is an elementary request/reply interaction. Remote operations provide, in a structured way, an interactive capability which allows nodes to request an operation and receive result or error indications depending on the outcome of the operation. Remote Operations Service is defined in ITU-T Recommendation X.219 and the protocol in X.229.

The Remote Operation procedure makes use of the Remote Operations parameter. This parameter can be carried in any call control message of end-to-end significance, and if there is no call control message available, the Remote Operations parameter can be carried in the Facility message.

In addition, the use of the Facility message allows the actions and events related to supplementary services to be clearly separated from those associated with basic call control, hence providing improved stability to the basic call control procedures.

The supplementary services definition will make use of this capability, along with the basic call control procedures described in this chapter.

13A.9.2 Remote operations procedure

Whenever a node determines that there is a need to invoke an operation at the remote node, the originating node will format a Remote Operations parameter containing the Invoke component, which will

include the appropriate operation code and the associated parameters. The Remote Operations parameter is sent in any call control message of end-to-end significance (if one is available), otherwise the Facility message is used.

Intermediate nodes may attempt to perform the operation upon receipt of this parameter. If the intermediate node does not understand the operation, it shall pass it to the next node. Similarly, any results or rejects not used by the intermediate nodes shall be passed to the next node.

The terminating node will attempt to perform the operation. If the operation can be successfully performed, the outcome is reported in the Remote Operations parameter containing a Return Result component and related parameters. If the operation was unsuccessful, a Return Error component is included in the Remote Operations parameter, instead of the Return Result component. If a problem is detected in the requested operation, a Reject component is sent. The Remote Operations parameter is sent in any call control message of end-to-end significance (if one is available), otherwise the Facility message is used to send this parameter to the originating node.

13A.9.3 Error procedures

If a node is unable to process a Remote Operations parameter included in a call control message, then the following options apply:

- 1) The node may reject the call request. The call request is cleared using the procedures described in this chapter. A Return Error or a Reject component with appropriate parameter(s) is also sent to the originating node indicating the terminating node's inability to process Remote Operations parameter.
- 2) The node may continue to process the call request according to normal call control procedures and reject the supplementary service invocation by sending a Return Error or a Reject component with appropriate parameter(s) in the Remote Operations parameter. This parameter can be sent either in the Facility message or in any appropriate call control message.
- 3) The node may continue to process the call request according to normal call control procedures and ignore the supplementary service invocation. In this case, the supplementary service at the originating node, which requested the supplementary service invocation at a remote node, will have to recover from the non-receipt of a reply.

The choice of an option depends on the individual supplementary service procedures. If the node does not have knowledge of the specific supplementary service, option 2) is preferred for each component that cannot be processed. Continuation of the call shall be subject to the control of the supplementary service procedures at the originating node. The originating node may allow the call to continue or may clear the call.

If a node is unable to process a Remote Operations parameter included in the Facility message then the following options apply:

- 1) The node may clear the call using the procedures described in clause 9. The node will also send a Return Error or a Reject component with appropriate parameter(s) in the Remote Operations parameter. This parameter will be sent either in the Facility message or in any appropriate call control message.
- 2) The node may continue with the call but reject the supplementary service invocation. A Return Error or a Reject component with appropriate parameter(s) in the Remote Operations parameter is sent to the originating node. The Remote Operations parameter is sent either in the Facility message or in any appropriate call control message.

- 3) The node may ignore the supplementary service invocation. In this case, the supplementary service at the originating node, which requested the supplementary service invocation at a remote node, will have to recover from the non-receipt of a reply.

The choice of an option depends on the individual supplementary service procedures. If the node does not have knowledge of the specific supplementary service, option 2) is preferred for each component that cannot be processed. Continuation of the call shall be subject to the control of the supplementary service procedures at the originating node. The originating node may allow the call to continue or may clear the call.

If a call is cleared and there is an operation pending, the operation is aborted and no response is sent to the originating node. The supplementary service at the originating node will have to recover from this situation.

The supplementary service procedures will clearly describe the handling of components and error procedures specific to the service.

13A.10 Facility Message

A Facility message may be sent in either direction at any phase of the call. The Facility message could be sent or received after a call is answered. The CSF at an originating SN, an intermediate SN/CMN, a gateway SN/CMN, and a destination SN is required to recognize the Facility message and shall not treat a Facility message as an unexpected message. Receiving and sending of a Facility message shall not cause change of basic call state.

Facility messages contain action request and response elements (collectively action elements). Examples of action request elements are Service Activation feature codes and ROSE invokes components. Examples of action response elements are Service Activation feature codes and ROSE return result or error components. Other parameters may also contain action elements (for further study).

The CSF in any SN or CMN may initiate an action request element. A CSF that initiates an action request element is an initiating CSF. A CSF that performs the action requested by a received action request element is an action CSF. There may be one or more intermediate or gateway SNs between an initiating CSF and an action CSF; each of their CSFs is functioning as a relay CSF.

An initiating CSF generates a Facility message when it initiates an action request element, and has no other message ready to transmit the action request element toward the action CSF.

When a CSF receives a Facility message, it separates the message into action elements. For each element received, the CSF may act as an action CSF or a relay CSF.

The CSF may delete some of the action request elements from the message. The CSF may initiate new action request elements based on service requirements. If any action request elements remain after this process, the Facility message is forwarded to the next CSF.

An action CSF deletes the action element from the received Facility message. It is the responsibility of the service executing the action to determine if a response is required. If so, the service will generate an appropriate action response element. An action CSF generates a Facility message when it returns a response element and has no other message ready to transmit the response elements towards the initiating CSF. Transmission of the message containing these response elements is independent of further relaying the originally received Facility message.

A relay CSF passes the action element on unchanged.

In the course of processing the received Facility message the CSF may initiate additional action request elements for transfer in the same direction. These elements will be added to the received message.

Any action elements remaining or added after this process are forwarded to the next CSF in the same direction in a Facility message.

A CSF, which receives an action request element but does not act on the contents of the element, should pass the element on unchanged. If a relay CSF receives a Facility message containing an unrecognized parameter, the Facility message parameter shall be passed on by the relay CSF without affecting the call.

13A.11 Network specific facilities

When the length of the network identification field is set to zero in the Network Specific Facilities (NSF) information element received from a DSS1 access, then the services identified in this information element are to be provided by the network side of the DSS1 interface receiving the information element.

If the CSF at an originating SN receives an NSF information element from an ISDN interface identifying a network provider with non-zero length of network identification, and the identified network provider is consistent with the existing Transit Network Selection procedures, the CSF at an originating SN routes the call to the indicated network provider and includes the NSF parameter in the outgoing IAM. The network specific facility indicator in the NSF parameter shall be coded identically to the corresponding field in the received NSF information element.

If the CSF at an originating SN receives an NSF information element from an ISDN interface identifying a network provider with non-zero length of network identification, and the identified network provider is not consistent with the existing Transit Network Selection procedures, the call shall be rejected.

13A.12 Bearer redirection

13A.12.1 Introduction

Bearer redirection is a generic mechanism for optimizing the bearer path when an endpoint of a call changes due to the operation of an application layer service.

For example, in the case of the ISDN supplementary service Call Forwarding on No Reply, a call and bearer connection is initially made to the Served User, and subsequently a new connection is made to the Forwarded-To User. By default, the new connection would be made from the Served User's SN to the Forwarded-To user's SN, placing a requirement on the Served User's SN to tandem the bearer connection.

Bearer redirection provides the capability for the new bearer connection to be made directly from the Calling User's SN to the Forwarded-To User's SN while the call control path is tandemmed through the Served User's SN. This is assuming there is bearer connectivity directly between these SNs (i.e., that they are part of the same network). Otherwise the mechanism is limited to operation between SNs in a single network.

13A.12.2 Interaction with services invoking bearer redirection

The bearer redirection procedure itself is not responsible for addition or removal of call legs between the nodes. However, call legs may be added or removed by the service that is invoking bearer redirection (e.g., when Call Forwarding adds a new call leg to the Forwarding-To node). The service then makes use of bearer redirection to optimize the bearer. Hence the description of bearer redirection must take account of the addition/removal of call legs by the service.

Bearer redirection is therefore modeled using four types of node, each of which provides a particular piece of functionality required for performing bearer redirection. The four node types are as follows:

- 1) *CC-Anchor node*: The SN or CMN at which the service invoking bearer redirection is operating. This node serves as an anchor point for the call control during the bearer redirection procedure. A CC-Anchor node remains in the call path for the duration of the call. How the CC-Anchor node determines that bearer redirection is required is beyond the scope of this American National Standard.
- 2) *BC-Anchor node*: The SN which serves as an anchor point for the bearer control during the bearer redirection procedure. Both old and new bearer connections terminate at the BC-Anchor node.
- 3) *Redirecting-from node*: The SN to which the call and bearer are initially connected, before redirection.
- 4) *Redirecting-to node*: The SN to which the call and bearer are subsequently connected, after the redirection.

The node types are functional entities and some may be combined together in a physical node in different ways, depending on the requirements of the service. For example, if the service does not require the removal of any call leg, but does require the addition of a new call leg, then the CC-Anchor node and Redirecting-from node will be combined. This is illustrated in Figure 2/T1.673.4, and is the configuration which would operate, for example, in the case of Call Forwarding.

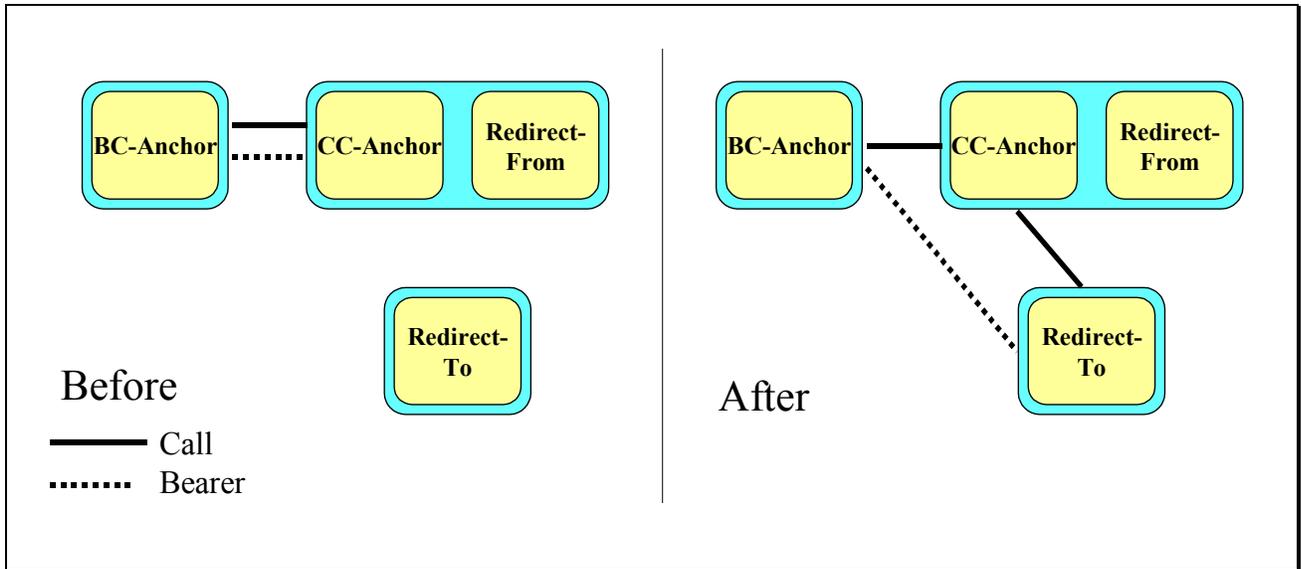


Figure 2/ T1.673.4 - CC-Anchor and Redirecting-from nodes combined

Conversely, if the service requires a call leg to be removed without the creation of a new call leg, the CC-Anchor node and Redirecting-to node are combined. This is shown in Figure 3/T1.673.4.

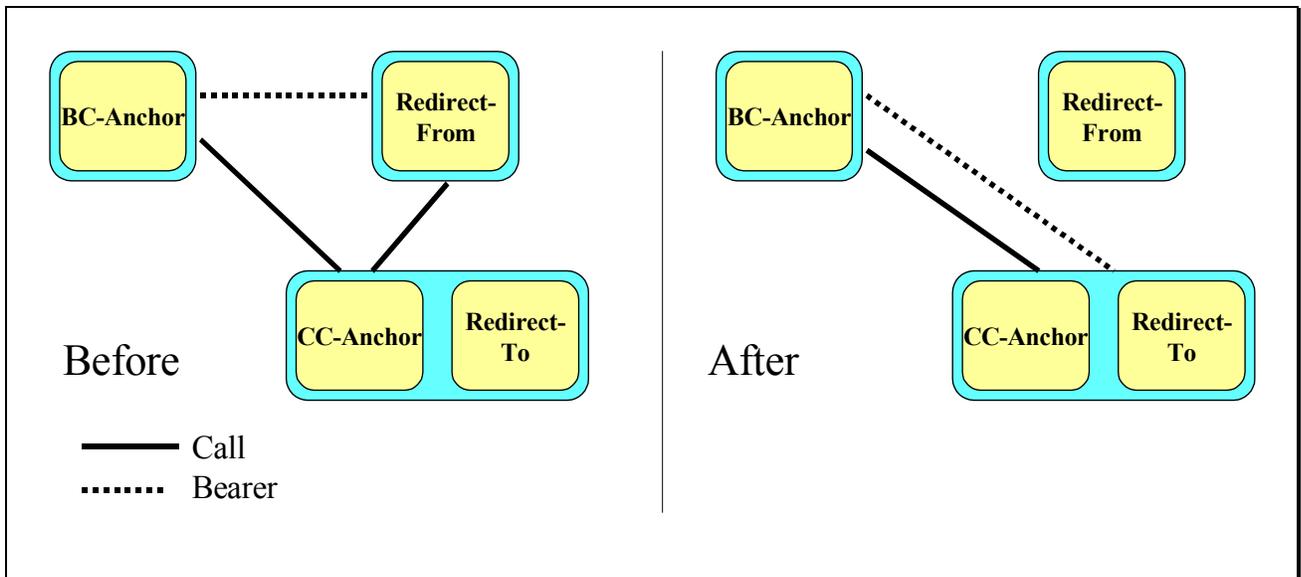


Figure 3/T1.673.4 - CC-Anchor and Redirecting-to nodes combined

The procedures here describe the most general case where all of the functional entities are located in separate physical nodes. By modeling the bearer redirection in this way, a completely generic mechanism is obtained which meets a range of possible service scenarios.

When functional entities are combined, the links between them are not externally visible. From a protocol point of view, this simply means that the signaling which would have taken place between such entities is internalized in the physical node.

13A.12.3 Cut-through of new bearer connection

Two possibilities are provided for the cut-through of the new bearer connection at the BC-Anchor node:

- Immediate Cut-Through; and
- Late Cut-Through.

In the case of Immediate Cut-Through, the new bearer connection is cut-through immediately as it is established, according to the procedures for standard bearer setup.

In the case of Late Cut-Through, cut-through of the new bearer connection is under control of the CC_Anchor node, which sends an explicit cut-through request to the BC-Anchor to trigger cut-through.

13A.12.4 Use of BAT ASE

Bearer Redirection makes use of the services of the BAT ASE described in chapter T1.673.6 to transport bearer redirection related information between the nodes. The services of the BAT ASE are accessed by means of primitives (such as 'BICC_data'), which are defined in that same chapter.

13A.12.5 Procedures

13A.12.5.1 Indication of Bearer Redirection Capability

An SN that supports the Bearer Control Anchor node capabilities shall indicate this within the IAM and first backward Call Control message (ACM or CON) of the original call by including the Bearer Redirection Capability Information element within the BAT APP within those messages.

In the case of ISNs and GSNs, this indication may be included only if the node itself supports the Bearer Redirection procedures for a BC-Anchor node. In the case of TSNs it may additionally be included if received from the preceding or succeeding node and if the procedures of 13A.12.5.2.3 are supported. (A CMN has no Bearer Interworking Function and so cannot perform the Bearer Control Anchor function).

If the Late Cut-Through option is supported, the Late Cut-Through Indicator shall be set to "*Late Cut-Through Supported*," otherwise it shall be set to "*Late Cut-Through Not Supported*."

The compatibility information of the Bearer Redirection Capability shall be set so as to cause the information element to be discarded by nodes that do not support Bearer Redirection.

13A.12.5.2 Bearer redirection takes place in the same direction as the call

13A.12.5.2.1 Actions at a CC-Anchor node

An invoking application at the CC-Anchor node may determine a new endpoint for the call at any time (either before or after ACM). If the Bearer Redirection Capability Information element has been received from the preceding node, the application may then invoke bearer redirection. How an application determines whether it is to be the CC-Anchor node for the call or whether bearer redirection is required is beyond the scope of this American National Standard.

The invoking application is responsible for storing any relevant IAM information required for the service. This information may be released when no further bearer redirections are required to be invoked by the application.

Bearer redirection is invoked at the CC-Anchor node which signals invocation to the BC-Anchor node. The new bearer will be established between this BC-Anchor and the Redirecting-to node.

Bearer redirection involves the moving of one bearer end point from one destination to another. At any one time, however, only one of these destinations is considered to be the real bearer end point for the call. The CC-Anchor node controls the cutover point: that is the point in time at which the bearer end point changes from the initial destination to the final destination.

13A.12.5.2.1.1 Negotiation of bearer redirection capabilities

When the CC-Anchor node has decided to invoke bearer redirection, an APM is sent to the preceding node with the action indicator in the BICC_Data request primitive set to "*Bearer Redirect*," and including Bearer Redirection Indicator "*Redirect Backward Request*" or "*Redirect Forward Request*" as appropriate depending on the capability of the Redirecting-to node (i.e., the CC-Anchor node determines whether the Forward or Backward procedures are to be used towards the Redirecting-to node in a way similar to how a node initiating a new call determines whether the Forward or Backward procedure should be used towards that node). The Bearer Redirection Indicators are also included in the BICC_Data request primitive.

If Late Cut-Through is desired and the Late Cut-Through indicator received in the Bearer Redirection Capability Information Element in the IAM was set to "*Late Cut-Through Supported*," then a Bearer Redirection Indicator "*Late Cut-Through Requested*" shall be included.

On receipt of a BICC_Data indication primitive -- corresponding to an APM message received from the preceding node (BC-Anchor) -- with action indicator set to "*Connect Backward*" or "*Connect Forward*," CC-Anchor node the procedures of 13A.12.5.2.1.2 followed by 13A.12.5.2.1.3 apply.

13A.12.5.2.1.2 Setup of new call leg and bearer connection

To initiate set-up of the new call leg and bearer connection, the service at the CC-Anchor node uses the stored IAM information to construct an IAM to be sent to the Redirecting-to node. The APP with Application Context Identifier "*BAT ASE*" included in the IAM shall only include the information elements from the APP received by the CC-Anchor node in 13A.12.5.2.1.1.

The CC-Anchor node subsequently behaves as follows:

- BAT ASE information received from the Redirecting-from node is passed on to the BC-Anchor according to standard CMN procedures.

- BAT ASE information received from the Redirecting-to node is passed on to the BC-Anchor according to standard CMN procedures, but with a Bearer Redirection Indicator “*new connection identifier*” included.
- BAT ASE information received from the BC-Anchor node containing a Bearer Redirection Indicator “*new connection identifier*” is passed on to the Redirecting-to node according to standard CMN procedures, but with the Bearer Redirection Indicator “*new connection identifier*” removed.
- BAT ASE information received from the BC-Anchor node not containing a Bearer Redirection Indicator “*new connection identifier*” is passed on to the Redirecting-from node according to standard CMN procedures.

The behavior of the CC-Anchor node with respect to other messages/information depends on the application invoking Bearer redirection.

The CC-Anchor node waits for a BICC_Data indication primitive (corresponding to an APM) with Action Indicator set to “*Connected*” or with Action Indicator set to “*Bearer Redirect*” and including Bearer Redirection Indicator “*redirect bearer connected*” to be received from the BC-Anchor node. In the former case, this indication is passed onwards to the Redirecting-to node.

In the case of Late Cut-Through, when Cut-through of the new connection is required, the CC-Anchor node shall send a BICC_Data request primitive (in association with any suitable message) with Action indicator set to “*Bearer Redirect*” and including Bearer Redirection Indicator “*redirect cut-through request*” towards the BC-Anchor node.

The new bearer setup procedure is now complete.

13A.12.5.2.1.3 Release of old call leg and bearer connection

When the controlling application requires the release of the old call leg and bearer to the Redirecting-from node, the CC-Anchor node sends an APM to the preceding node with the action indicator in the BICC_Data request primitive set to “*Bearer Redirect*” and including Bearer Redirection Indicator “*redirect bearer release request*.”

On receipt of an APM from the preceding node with the action indicator in the BICC_Data indication primitive set to “*Bearer Redirect*” and including Bearer Redirection Indicator “*redirect bearer release proceed*,” a REL message is sent to the Redirecting-from node as per the normal release procedures. The release cause value is determined by the application. The CC-Anchor node awaits receipt of the RLC from the Redirecting-from node.

On receipt of the RLC from the Redirecting-from node, an APM is sent to the preceding node with the action indicator in the BICC_Data request primitive set to “*Bearer Redirect*” and including Bearer Redirection Indicator “*redirect bearer release complete*.”

13A.12.5.2.2 Actions at a BC-Anchor

13A.12.5.2.2.1 Negotiation of bearer redirection capabilities

On receipt of a BICC_Data indication primitive (corresponding to an APM received from the succeeding node) with action indicator set to “*Bearer Redirect*” and including Bearer Redirection Indicator “*redirect forward request*” or “*redirect backward request*,” the node determines whether it will perform the BC-Anchor node functions, or, in the case that Bearer Redirection Capabilities Information Element was

received from the preceding node, whether the request will be sent to the preceding node. How this determination is made is beyond the scope of this American National Standard.

In the case that the BC-Anchor node functions are to be performed, the normal BICC outgoing set-up procedures for outgoing bearer set-up (see clause 7) are followed with the following exceptions:

1. The BC-Anchor node selects the BIWF that is already associated with the call.
2. An IAM is not sent. Instead an APM is sent to the succeeding node containing the BAT ASE information that would have been sent in the IAM; other IAM parameters are not included.

13A.12.5.2.2.2 Setup of new bearer connection

13A.12.5.2.2.2.1 Handling of APP parameters

Subsequent to the procedures of 13A.12.5.2.2.1, receipt of any message containing an APP parameter with Application Context Identifier "BAT ASE" shall be handled as follows:

- Messages containing Bearer Redirection Indicator "*new connection identifier*" shall be handled by the normal BICC outgoing call setup procedures with respect to the new connection.
- Messages not containing Bearer Redirection Indicator "*new connection identifier*" shall be handled by the procedures for existing bearers with respect to the old connection.

Where it is required to send an APP parameter relating to the old connection, this shall be sent as for the non-bearer redirection case.

Where it is required to send an APP parameter relating to the new connection, a Bearer Redirection Indicator "*New connection identifier*" shall also be included.

13A.12.5.2.2.2.2 Confirmation and Cut-Through of the new bearer connection

If the Bearer Redirection Indicators information element received with the bearer redirection request indication in 13A.12.5.2.2.1 above did not include "*late cut-through requested*," then the newly established bearer connection is cut-through immediately it is established, according to the normal connection setup procedures.

On completion of the outgoing setup procedure then -- except in the case of Forward Setup with Connect Type set to "*Forward Notify*" -- the BC-Anchor node shall send a BICC_Data request primitive with Action Indicator set to "*Bearer Redirect*" and including Bearer Redirection Indicator "*redirect bearer connected*" to the CC-Anchor node.

In the case of Forward setup with Connect Type set to "*Forward Notify*," the BC-Anchor node shall behave as described in the normal Forward setup procedures.

If the Bearer Redirection Indicators information element received with the bearer redirection Request indication in 13A.12.5.2.2.1 above indicated "*late cut-through requested*," then -- on receipt of a BICC_Data indication primitive (corresponding to any message) with action indicator set to "*Bearer Redirect*" and including Bearer Redirection Indicator "*redirect cut-through request*" -- the BC-Anchor node cuts through the new bearer connection.

13A.12.5.2.2.3 Release of old bearer connection

On receipt of an APM from the succeeding node with the action indicator in the BICC_Data indication primitive set to "*Bearer Redirect*" and including Bearer Redirection Indicator "*redirect release request*," the BC-Anchor requests the BCF to disconnect the internal through-connection of the old bearer path connection between the BC-Anchor and the Redirecting-from node. A normal cause value is passed from the CSF to the BCF.

At the same time as the start of the release of the switched path, the BC-Anchor sends an APM to the succeeding node with the action indicator in the BICC_Data request primitive set to "*Bearer Redirect*" and including Bearer Redirection Indicator "*redirect release proceed*."

The BC-Anchor awaits receipt of an APM from the succeeding node with the action indicator in the BICC_Data indication primitive set to "*Bearer Redirect*" and including Bearer Redirection Indicator "*redirect release complete*." On receipt of this indication, the BC-Anchor instructs the BCF to release remaining resources associated with the old bearer connection.

13A.12.5.2.3 Actions at an intermediate node which is not a BC-Anchor or CC-Anchor node

An intermediate node that is not a BC-Anchor or a CC-Anchor node shall pass on unchanged all received indications related to bearer redirection.

In the case that the Bearer Redirection Capability information element was sent to the succeeding node at call setup, then on receipt of a BICC_Data indication from the preceding node with Action Indicator set to "*Bearer Redirect*" and including Bearer Redirection Indicator "*redirect release proceed*," the node shall note that Bearer Release should be expected. Subsequent to receipt of this Bearer Release, the node shall behave according to the CMN procedures.

NOTE - In the case that the Bearer Redirection Capability information element was not sent to the succeeding node at call setup, then this scenario will not occur, since the succeeding node will not invoke Bearer Redirection.

13A.12.5.2.4 Actions at a Redirecting-to node

A Redirecting-to node shall follow the normal call set-up procedures described in this chapter.

13A.12.5.2.5 Actions at a Redirecting-from node

A Redirecting-from node shall follow the normal call set-up procedures described in this chapter.

13A.12.5.3 Redirection takes place in the opposite direction to the original call setup

The procedures in 13A.12.5.2 apply with the word "preceding" replaced by "succeeding" and vice versa.

13A.12.5.4 Special Cases

13A.12.5.4.1 Handling of multiple bearer redirection requests

The following procedures ensure that multiple bearer redirection requests sent along the same call leg are handled in series rather than in parallel.

A CC-Anchor node may not initiate more than one bearer redirection procedure at a time for a given call.

A CC-Anchor node that receives a bearer redirection request from the succeeding node while waiting for the response to a bearer redirection request sent to the preceding node shall return to the succeeding node a BICC-Data indication primitive (corresponding to an APM) with the Action Indicator set to “*Bearer Redirect*” and including Bearer Redirection Indicator “*redirect temporary reject*.”

A CC-Anchor node that receives a bearer redirection request from the preceding node while waiting for the response to a bearer redirection request sent to the succeeding node shall return to the preceding node a BICC-Data indication primitive (corresponding to an APM) with the Action Indicator set to “*Bearer Redirect*” and including Bearer Redirection Indicator “*redirect temporary reject*.”

A CC-Anchor node that receives a bearer redirection request from the preceding node while waiting for the response to a bearer redirection request sent to the preceding node shall return to the preceding node a BICC-Data indication primitive (corresponding to an APM) with the Action Indicator set to “*Bearer Redirect*” and including Bearer Redirection Indicator “*bearer redirect temporary reject*.”

A node that receives a bearer redirection request from the succeeding node while waiting for the response to a bearer redirection request sent to the succeeding node shall act on the received bearer redirection request received according to section 13A.12.5.2.2.

13A.12.5.4.2 Temporary Reject

If the request for Bearer Redirection cannot be honored by the BC-Anchor node, it shall send to the CC-Anchor node a BICC-Data indication primitive (corresponding to an APM) with the Action Indicator set to “*bearer redirect*” and including a Bearer Redirection Indicator “*redirect temporary reject*.”

A “*redirect temporary reject*” indication received by an intermediate node shall be passed on unmodified.

If the indication is received by the CC-Anchor node originating the request then the invoking application shall take appropriate action (which could involve requesting bearer redirection again after a suitable period of time).

13A.12.5.4.3 Bearer redirection abandoned by CC-Anchor node

Prior to the procedures of 13A.12.5.2.1.3, the service at the CC-Anchor node may determine that the bearer redirection be abandoned, returning to the old bearer.

13A.12.5.4.3.1 Actions at the CC-Anchor node

When the service at the CC-Anchor node determines that the bearer redirection should be abandoned, the procedures of 13A.12.5.2.1.3 are followed except that the Bearer Redirection Indicator “*new connection identifier*” is included in each APM message sent by the CC-Anchor node to the BC-Anchor.

13A.12.5.4.3.2 Actions at the BC-Anchor node

On receipt of an APM from the succeeding node with the action indicator in the BICC_Data indication primitive set to "*Bearer Redirect*" and including Bearer Redirection Indicator "*Redirect Release Request*" and including Bearer Redirection Indicator "*new connection identifier*," the procedures of 13A.12.5.2.2.3 are followed with respect to the new bearer.

The Bearer Redirection Indicator "*new connection identifier*" is included in each APM sent by the BC-Anchor to the CC-Anchor node.

13A.12.5.4.4 Bearer redirection failure at BC-Anchor Node

13A.12.5.4.4.1 Actions at the BC-Anchor node

Subsequent to the procedures of 13A.12.5.2.2.1, if the new connection cannot be established at the BC-Anchor node, a BICC_Data request shall be sent to the CC-Anchor node with Action Indicator set to "*Bearer Redirect*" and including Bearer Redirection Indicator "*Redirect Failure*."

13A.12.5.4.4.2 Actions at the CC-Anchor node

On receipt of a BICC_Data indication (corresponding to an APM) from the BC-Anchor node containing a Bearer Redirection Indicator "*Redirect Failure*," the call leg towards the Redirecting-to node shall be release according to the standard call release procedures described in this chapter.

Further action (e.g., re-attempt of bearer redirection) may be taken according to the service at the CC-Anchor node.

13A.12.5.4.5 Unexpected Bearer Redirection Request

If a node receives a Bearer Redirection Request which is unexpected (e.g., because the Bearer Redirection Capabilities Information Element was not included in the BAT APP in the IAM), then this is handled according to the standard procedures for unexpected BAT ASE information described in this chapter.

13A.12.5.4.6 Unexpected New Connection Identifier

The Bearer Redirection Indication "*New Connection Identifier*" is only meaningful in the state where two bearer connections exist, or where one exists and the other is in the process of being set up. If this indication is received at other times, it shall be treated as unrecognized according to the procedures of this chapter.

13A.12.5.5 Interaction with Facility Request to Pivot (T1.668-1999)

Once bearer redirection has been invoked, the use of the Facility Request to Pivot in order to redirect the call control to the same location may disconnect the call. Therefore, for any node that offers support of bearer redirection on a given call:

- a) If an offer allowing for a Facility Request to Pivot is received from a previous SN, it shall be passed forward unchanged.
- b) If an actual Facility Request to Pivot is received, it shall be passed unchanged and the SN shall not act on the invocation.
- c) An originating SN shall not make simultaneous offers related to the Facility Request to Pivot and to bearer redirection.

13A.12.5.6 Interaction with Release to Pivot (T1.661-2000)

Once bearer redirection has been invoked, the use of Release to Pivot to redirect the call control to the same location will temporarily interrupt the bearer path between the calling and called parties.

Annex A/T1.673.4

(normative)

A Timers

Table A.1/T1.673.4 – Timers in the BICC basic call protocol

Symbol	Time-out value	Cause for initiation	Normal termination	At expiry	Reference
T1	4-15 seconds	When REL is sent	At receipt of RLC	Retransmit REL and restart timer T1	11 13.7.4
T5	5-15 minutes	When initial REL is sent	At receipt of RLC	Send RSC, alert maintenance personnel and remove the CIC value from service, stop T1, start T17.	11 13.7.4
T6	10-32 sec. (Specified in ITU-T Rec. Q.118)	When controlling CSF receives SUS (network)	At receipt of RES (network)	Initiate release procedure	10.2
T7	20-30 seconds	When the IAM is sent	When the condition for normal release of address and routing information is met (receipt of ACM or ANM)	Initiate release procedure	7.2 7.3 7.7
T8	10-15 seconds	When the CSF at an SN receives IAM indicating that COT is to be expected	At receipt of Continuity message	Initiate release procedure (cause #41)	7.6
T9 (Not specified for North American networks)	Specified in ITU-T Rec. Q.118	When outgoing international gateway CSF receives ACM	At the receipt of ANM	Initiate release procedure	7.7 7.8
T16	4-15 seconds	When RSC is sent, not due to expiry of T5	At the receipt of the RLC	Retransmit RSC and restart T16	13.7.1
T17	1 minute	When initial RSC is sent	At the receipt of the RLC	Alert maintenance personnel, retransmit RSC, restart T17, stop T16.	13.7.1
T18	4-15 seconds	When CIC Group Blocking message is sent	At receipt of CIC Group Blocking Acknowledgment	Retransmit CIC Group Blocking message and restart T18	13.7.3
T19	1 minute	When initial CIC Group Blocking message is sent	At receipt of CIC Group Blocking Acknowledgment	Retransmit CIC Group Blocking message, alert maintenance personnel, restart T19, stop T18.	13.7.3
T20	4-15 seconds	When CIC Group Unblocking message is sent	At receipt of CIC Group Unblocking Acknowledgment	Retransmit CIC Group Unblocking message and restart T20	13.7.3

Symbol	Time-out value	Cause for initiation	Normal termination	At expiry	Reference
T21	1 minute	When initial CIC Group Unblocking message is sent	At receipt of CIC Group Unblocking Acknowledgment	Retransmit CIC Group Unblocking message, alert maintenance personnel, restart T21, stop T20.	13.7.3
T22	4-15 seconds	When CIC Group Reset message is sent	At receipt of CIC Group Reset acknowledgment	Retransmit CIC Group Reset message and restart T22	13.7.2
T23	1 minute	When initial CIC Group Reset message is sent	At the receipt of CIC Group Reset acknowledgment	Alert maintenance personnel and restart T23, retransmit CIC Group Reset message, stop T22.	13.7.2
T28	10 seconds	When CQM is sent	At receipt of CQR	Alert maintenance	12.6
T33	12-15 seconds	When INR is sent	On receipt of INF (or expiration of service-specific timer)	Initiate release procedure, alert maintenance personnel	13.7.5
T36	2-4 seconds	When a message is received indicating that another segment follows.	At receipt of a Segmentation message	Proceed with call	12.2
T40	10 seconds	When out of band start signal (DTMF or tone) is sent and notification is requested	At receipt of positive or negative notification	Send notification to requesting side	8.20.2.1
T41	10 seconds	When out of band stop signal (DTMF or tone) is sent and notification is requested	At receipt of notification	No action	8.20.2.1
T42	5-30 seconds	When a modification is initiated during codec modification or mid-call codec negotiation procedures	At receipt of indication of successful or failed codec modification	Initiate release procedure	10.4
T43	5-30 seconds	When a mid-call codec negotiation is initiated	At receipt of successful or failed mid-call codec negotiation	Notify mid-call codec negotiation nodal functions	10.4
T _{EXM,d}	Network dependent	When IAM is sent to succeeding network	On expiry	Send Exit message to preceding CSF	8A
T _{CRA}	20 seconds	When CRA is sent	At receipt of IAM or REL	Initiate release procedure	G.4.5
T _{CRM}	3-4 seconds	When CRM is sent	At receipt of CRA	Initiate release procedure	G.4.5

Annex B/T1.673.4

(normative)

B Procedures for re-use of idle bearers (network option)

B.1 Introduction

This Annex describes the procedures to be performed for re-use of idle bearers. When this option is supported a new bearer is not set-up for the call, but a pre-existing bearer is associated with the call during the set-up procedure.

NOTE - Re-use of idle bearers is a network option. Network connections are "owned" by the SN which originally set them up. The management of a set of idle bearers is therefore a local issue in the BCF which has established them.

- This specification does not define the procedures used at the node which owns a network connection to determine whether and when network connections should be retained (left idle) and released.
- To protect against the error case in which the node owning a network connection neglects to release it when it has not been re-used for a long period, it is recommended that the BCF at the node which does not own the connection nevertheless should have a protection timer. This timer is started on release of a call on a particular bearer and stopped on re-use or release of that bearer. On timer expiry the bearer is released with cause value #31, "Normal unspecified." The value of the timer is a local matter and is not covered in further detail in this specification.
- Re-use of idle bearers may not be applicable to all bearer technologies.

B.2 Procedures

The following procedures are applied, as increments to the BICC protocol, as described in the main body of this American National Standard.

B.2.1 Outgoing bearer set-up procedures

B.2.1.1 Re-use of forward idle bearer

During the forward bearer set-up procedure (see 7.4.1), in response to the Bearer Set-up request (item 2.3), the BCF may indicate that an existing bearer is to be used for this call. In this case a BICC_Data request primitive is issued, (corresponding to an APM message), with the following information:

- BNC-ID (the value provided by the BCF, indicating the connection to re-use); and
- Action indicator set to "Use idle."

The outgoing bearer set-up procedure awaits a BICC_Data indication primitive (corresponding to an APM message), with Action indicator set to "Switched."

The outgoing bearer set-up procedure is now successfully completed.

B.2.1.2 Re-use of backward idle bearer

During the backward set-up procedure (see 7.4.2), while awaiting a Bearer Set-up indication from the BCF (item 2), reception of a BICC_Data indication primitive (corresponding to an APM message), including Action indicator set to *“Use idle”* indicates that an existing bearer is to be used for this call. In this case a request to re-use idle bearer is passed to the BCF, including the BNC-ID (value received in the BICC_Data indication primitive).

1. If the BCF accepts this request, a BICC_Data request primitive is issued (corresponding to an APM message), including:

- Action indicator set to *“Switched.”*

This indicates successful completion of the outgoing bearer set-up procedure.

2. If the BCF fails to accept this request, the call instance is reset according to 13.3. (Use of reset causes the re-alignment of system resources.)

B.2.2 Incoming bearer set-up procedures

B.2.2.1 Re-use of forward idle bearer

During the forward bearer set-up procedure (see 7.5.1), while awaiting a Bearer Set-up indication from the BCF (item 3), reception of a BICC_Data indication primitive (corresponding to an APM message), containing Action indicator set to *“Use idle,”* indicates that an existing idle bearer is to be used for this call. In this case a request to re-use idle bearer is passed to the BCF, including the BNC-ID (value received in the BICC_Data indication primitive).

1. If the BCF accepts this request, a BICC_Data request primitive is issued (corresponding to an APM message), including the following information:

- Action indicator set to *“Switched.”*

The incoming bearer set-up procedure is now successfully completed.

2. If the BCF fails to accept this request, the call instance is reset according to 13.3. (Use of reset causes the re-alignment of system resources.)

B.2.2.2 Re-use of backward idle bearer

During the backward bearer set-up procedure (see 7.5.2), in response to the Bearer Set-up request (item 2), the BCF may indicate that an existing idle bearer is to be used for this call. In this case:

1. The response from the BCF indicates the BNC-ID to be used for the connection.
2. A BICC_Data request primitive is issued (corresponding to an APM message), including the following information:
 - BNC-ID (the value provided by the BCF, indicating the connection to re-use); and
 - Action indicator set to *“Use idle.”*
3. When a BICC_Data indication primitive is received with Action indicator set to *“Switched,”* incoming bearer set-up procedure is now successfully completed.

B.2.3 Continuity message

The procedure in 7.6 applies, except that the completion of set-up of the bearer path is indicated by completion of the incoming bearer set-up procedure described in this Annex, instead of the various bearer events listed in the subclause 7.6.2.1.

B.2.4 Codec negotiation

Codec negotiation is not applicable when re-using idle bearers.

B.2.6 Release procedure

NOTE - In support of this procedure, the BCFs may decide not to release the bearer network connection when call release occurs.

Annex C/T1.673.4

C Test calls

[Not applicable to this Standard.]

Annex D/T1.673.4
(normative)

D Semi-automatic CIC turn-up procedure

D.1. Introduction

The turn-up procedure for BICC CICs is a manually controlled procedure.

The purpose of the turn-up procedure is to ensure that two CSFs have the same values of the CICs provisioned between them. A method of verifying this is the sending of (Group) Reset messages in both directions between the two CSFs. The CSFs have the same perception of their CIC connectivity if the proper acknowledgments are received.

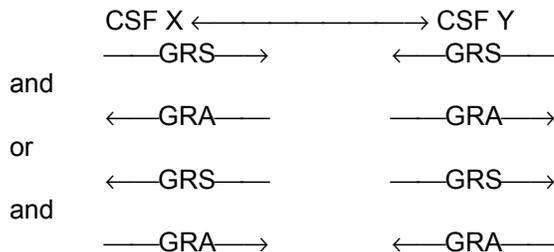
During the process of placing CICs into service, unacknowledged CIC supervision messages will most likely be reported to maintenance systems. In order to minimize this impact, it is recommended that coordination take place between CSFs, and established procedures for placing CICs into service be followed. Lack of coordination may result in inefficient use of CSF and maintenance resources.

The CIC turn-up procedure is executed between two CSFs and consists of sending (Group) Reset messages in both directions. As an operational option, a test to verify that a bothway bearer path exists to the intended destination may be performed on selected CICs after the (Group) Reset messages have been acknowledged.

Abbreviations used in messages sequences:

ACM	Address complete
ANM	Answer
GRA	Group reset acknowledgment
GRS	Group Reset
IAM	Initial Address
RLC	Release Complete

D.2 Procedure for putting CICs into service

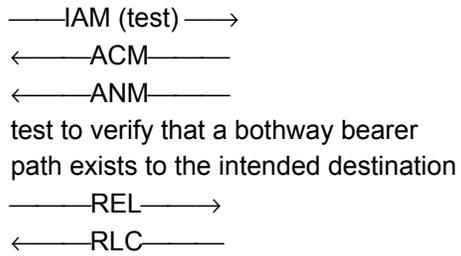


NOTE – It is also possible to have individual Reset CIC messages. The diagrams do not intend to cover all possible exchange of messages (see 13.3).

D.3 Test procedures

This subclause describes a test procedure which may be used after the turn-up of the CICs. As a minimum, it is required that an SN can actively perform the test procedure.

Procedure using a test to verify that a bothway bearer path exists to the intended destination:



Annex E /T1.673.4

(normative)

E Procedures for use of Structured AAL1 bearers (network option)**E.1 Introduction**

This Annex describes the procedures to be performed for the use of Structured AAL1 bearers. A Structured AAL1 bearer carries multiple independent channels within one network bearer connection, see ITU-T Recommendation I.363.1, *B-ISDN ATM Adaptation Layer Specification: Type 1 AAL*. When this option is supported, a new structured AAL1 bearer is set-up only if no such bearer exists, or if there are no idle channels on an existing structured AAL1 bearer. If there is an idle channel on an existing structured AAL1 bearer, a new bearer is not set-up for the call; instead an idle channel on a pre-existing bearer is associated with the call during the set-up procedure.

NOTE - Structured AAL1 bearers and the channels associated with them are "owned" by the SN that originally set them up. The management of a set of idle bearers is therefore a local issue in the BCF that has established them.

- This specification does not define the procedures used at the node that owns a structured AAL1 bearer to determine whether and when the bearer should be released after all of the channels within the bearer have become idle.
- To protect against the error case in which the node owning a structured AAL1 bearer neglects to release it when it has not been re-used for a long period, it is recommended that the BCF at the node which does not own the bearer nevertheless should have a protection timer. This timer is started upon release of the call that is using the last active channel within a particular structured AAL1 bearer and stopped on re-use of any of the channels within the structured AAL1 bearer or upon release of that structured AAL1 bearer. On timer expiry the structured AAL1 bearer is released with cause value #31 "Normal unspecified." The value of the timer is a local matter and is not covered in further detail in this specification.

E.2 Procedures

If a new structured AAL1 bearer needs to be established for the setup of a call, BICC protocol procedures in clause 7 are applicable. The BNC characteristics shall be coded "*structured AAL1*." At the bearer level based on the coding of BNC-ID, a structured AAL1 bearer consisting of a set of bearer network connections shall be established and the call shall be associated with the BNC-ID carried in BICC. The remaining bearer network connections (channels within the structured AAL1 bearer) shall be marked idle by the concerned BCFs to be used for other calls. From the viewpoint of BICC procedures, the set of channels associated with a structured AAL1 bearer shall be treated as a pool of idle bearer connections each with an associated BNC-ID (see Annex J/T1.673.4).

If an idle bearer network connection associated with a structured AAL1 bearer can be used for the setup of a call, the procedures for re-use of idle bearers (B.2.1 to B.2.3) shall be used.

E.2.3 Codec negotiation

Codec negotiation is not applicable to the use of Structured AAL1 bearers.

E.2.4 Release procedure

NOTE - In support of this procedure the BCFs may decide not to release the structured AAL1 bearer even though all of the channels associated with it are idle.

Annex F/T1.673.4
(normative)

F Interworking between Signaling System 7 ISDN User Part and the Bearer Independent Call Control protocol

F.1 Scope

This Annex defines the signaling interworking between the Bearer Independent Call Control (BICC) protocol and the ISDN User Part (ISUP) of Signaling System 7 (SS7).

The interworking between BICC and ISUP takes place in the CSF at an ISN.

The scope of this Annex is as shown in Figure F.1.

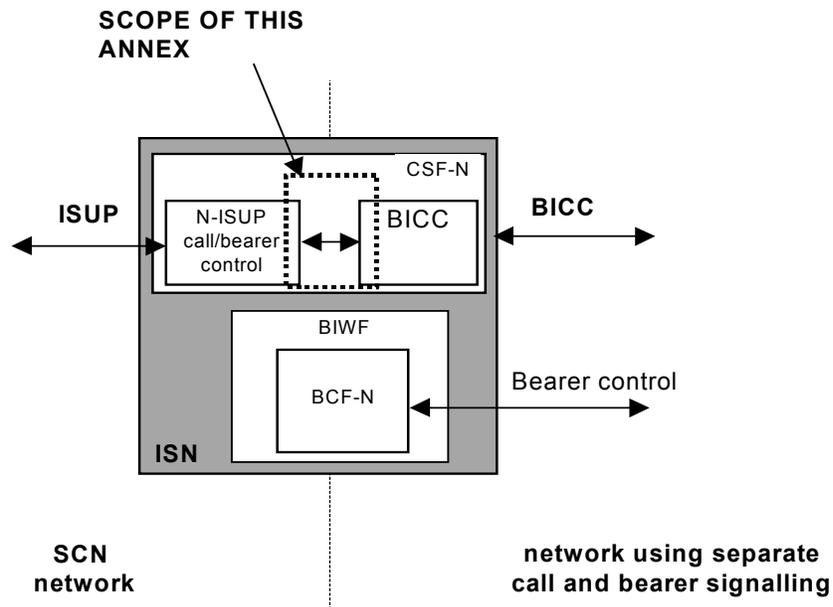


Figure F.1/T1.673.4 - Scope of this Annex

F.2 Interworking with ISUP at an ISN

F.2.1 General

The protocol at the ISUP interface shall be according to American National Standard T1.113-2000.

The protocol at the BICC interface shall be according to American National Standard T1.673-2002.

Transfer of signaling information between the two signaling interfaces shall be done as if the CSF was an ISUP intermediate exchange. Where the signaling information defined for ISUP and for BICC are identical, a one-to-one mapping is performed (unless explicitly specified to the contrary in this Annex).

BICC includes a Compatibility procedure in T1.673.4 identical to the Compatibility procedure defined for ISUP in T1.113.4. The CSF may act as a Type A or Type B exchange for the purposes of this Compatibility procedure.

The following subclauses detail the only exceptions to the above statements.

F.2.2 Incoming ISUP, outgoing BICC, (Incoming ISN)

F.2.2.1 Successful basic call set-up

F.2.2.1.1 Forward address signaling

Incoming ISUP (as in T1.113.4, subclause 2.1) and outgoing BICC (as in T1.673.4, subclause 7.2) procedures apply with the following exception:

- When sending the IAM, the Continuity indicator in the Nature of Connection Indicators parameter is set according to T1.113.4 procedures. (Either “*COT to be expected*” or “*no COT to be expected*” can be sent.)

F.2.2.1.2 Continuity message

The incoming ISUP Continuity check procedures in T1.113.4 apply.

T1.673.4, subclause 7.6.1, is replaced by:

- The Continuity message, with the Continuity Indicators parameter set to “*continuity*,” is sent when an ISUP COT with the Continuity Indicators parameter set to “*continuity check successful*” is received from ISUP, according to T1.113.4 intermediate exchange procedures.

F.2.2.1.3 Through connection of the bearer path

The bearer path shall be connected in both directions when both of the following conditions are satisfied:

- The BICC Outgoing bearer set-up procedure (see T1.673.4, subclause 7.4) is successfully completed; and
- If the ISUP continuity check procedure is being performed, when conditions on the incoming circuit allow (see T1.113.4, subclause 2.1.6).

In addition, if BICC is performing the “Per-call bearer set-up in the forward direction” Outgoing bearer set-up procedure and the Connect Type is “*notification not required*,” the bearer path shall be connected in both directions when the Bearer Set-up request is sent (and any ISUP continuity check is complete).

F.2.2.1.4 Connection type allowing fallback

F.2.2.1.4.1 Actions in the forward direction

F.2.2.1.4.1.1 Succeeding network does have the capability of performing fallback

The CSF will set up the call on a route according to the USI' parameter set to "64 kbit/s UDI-TA" whenever available.

If congestion on the route is encountered, and if there is no alternative route available supporting the connection type allowing fallback, fallback procedures will be initiated according to F.2.2.1.4.1.2.

F.2.2.1.4.1.2 Succeeding network does not have the capability of performing fallback

In case there is no route available being capable of satisfying the connection type requirements of "64 kbit/s UDI-TA," the CSF will continue the call, discard the USI' parameter, and maintain the USI parameter.

F.2.2.1.4.2 Actions in the backward direction

F.2.2.1.4.2.1 Succeeding network does have the capability of performing fallback

The CSF will know that fallback has occurred by receiving the TMU parameter. This parameter indicates the fallback connection type.

If echo control is required on the connection, appropriate procedures will be initiated (see T1.113.4, subclause 2.9C.6).

F.2.2.1.4.2.2 Succeeding network does not have the capability of performing fallback

The CSF will include a TMU parameter (which has been set according to the fallback connection type indicated in the USI parameter) in the ACM or CPG, indicating that fallback has occurred for this call.

If echo control is required on the connection, appropriate procedures will be initiated (see T1.113.4, subclause 2.9C.6).

F.2.2.2 Call release

On receipt of an ISUP REL from the preceding exchange, the CSF immediately requests the disconnection of the internal bearer path and invokes the BICC Release sending procedure (T1.673.4, subclause 11.5) towards the succeeding CSF. When the ISUP circuit is re-selectable, an ISUP RLC is returned to the preceding exchange.

On receipt of a REL from the succeeding CSF, the CSF invokes the BICC Release reception procedure and sends an ISUP REL to the preceding exchange. Timers T1 and T5 are started to ensure that a RLC is received from the preceding exchange (expiration of timers T1 and T5 is covered in T1.113.4, subclause 2.9.6).

F.2.3 Incoming BICC, outgoing ISUP, (Outgoing ISN)

F.2.3.1 Successful call set-up

F.2.3.1.1 Forward address signaling

Incoming BICC (as in T1.673.4, subclause 7.2) and outgoing ISUP (as in T1.113.4, subclause 2.1) procedures apply, with the following clarifications and exceptions with regards to when ISUP IAM and Continuity messages are to be sent:

Two cases are supported:

1. Sending an early ISUP IAM, using the continuity check protocol to withhold call completion until establishment of the bearer is complete.
2. Withholding the sending of the ISUP IAM until establishment of the bearer is complete.

For the early IAM case (where the subsequent network supports the continuity check protocol), the ISUP IAM is sent when the incoming procedure decides that the call can be routed. The Continuity Check indicator in the Nature of Connection Indicators parameter is set to indicate "*continuity check performed on previous circuit,*" or "*continuity required on this circuit*" may alternatively be sent if the continuity check is to be performed.

The Continuity message, with the Continuity Indicators parameter set to "*continuity check successful,*" is sent when all the following conditions are satisfied:

1. If the incoming IAM indicated "*COT to be expected,*" a Continuity message, with the Continuity Indicators parameter set to "*continuity,*" shall be received.
2. One of the following events, which indicate successful completion of bearer set-up, shall also be received by the Incoming bearer set-up procedure (see T1.673.4, subclause 7.5), depending on the procedure being applied:
 - 2.1. Bearer Set-up indication – for the forward bearer set-up case where the incoming Connect Type is "*notification not required.*"
 - 2.2. BICC_Data indication primitive with Action indicator set to "*Connected*" – for the forward bearer set-up cases (with, or without bearer control tunneling) where the incoming Connect Type is "*notification required,*" and for the fast set-up (backward) case.
 - 2.3. Bearer Set-up Connect indication – for the backward bearer set-up case.
 - 2.4. BNC set-up success indication for cases using bearer control tunneling, except as identified in item 2.2 above.
3. If the continuity check is being performed on the outgoing ISUP circuit, the test shall be successfully completed.

For the late IAM case (where the subsequent network does not support the continuity check protocol), the sending of the ISUP IAM is delayed until all the following conditions are satisfied:

1. If the incoming IAM indicated "*COT to be expected,*" a Continuity message, with the Continuity Indicators parameter set to "*continuity,*" shall be received.
2. One of the following events, which indicate successful completion of bearer set-up, shall be received by the Incoming bearer set-up procedure (see T1.673.4, subclause 7.5):
 - 2.1. Bearer Set-up indication – for the forward bearer set-up case where the incoming Connect Type is "*notification not required.*"

- 2.2. BICC_Data indication primitive with Action indicator set to *“Connected”* – for the forward bearer set-up cases (with, or without bearer control tunneling) where the incoming Connect Type is *“notification required,”* and for the fast set-up (backward) case.
- 2.3. Bearer Set-up Connect indication – for the backward bearer set-up case.
- 2.4. BNC set-up success indication for cases using bearer control tunneling, except as identified in item 2.2 above.

F.2.3.1.2 Through connection of the bearer path

The bearer path shall be connected in both directions when both of the following conditions are satisfied:

- The Incoming bearer set-up procedure (see T1.673.4, subclause 7.5) is successfully completed; and
- If the ISUP continuity check procedure is being performed, when conditions on the outgoing circuit allow (see T1.113.4, clause 2.1.6).

F.2.3.1.3 Connection type allowing fallback

F.2.3.1.3.1 Actions in the forward direction

F.2.3.1.3.1.1 Succeeding network does have the capability of performing fallback

The CSF will set up the call on a circuit according to the USI' parameter set to *“64 kbit/s UDI-TA”* whenever available, and the USI and USI' parameters are passed on unchanged.

If congestion on the route is encountered, and if there is no alternative route available supporting the connection type allowing fallback, fallback procedures will be initiated according to F.2.3.1.3.1.2.

F.2.3.1.3.1.2 Succeeding network does not have the capability of performing fallback

In case of either:

- Interworking to an ISDN User Part not supporting the USI' parameter set to *“64 kbit/s UDI-TA”*; or
- There is no circuit available being capable of satisfying the connection type requirements of *“64 kbit/s UDI-TA”*;

the CSF will continue the call, discard the USI' parameter, and maintain the USI parameter. This will typically be the case when the succeeding network consists of an ISDN User Part not supporting the procedures.

If echo control is required on the connection, appropriate procedures will be initiated (see T1.113.4, subclause 2.9C.6).

F.2.3.1.3.2 Actions in the backward direction – fallback indicated before answer

F.2.3.1.3.2.1 Succeeding network does have the capability of performing fallback

The CSF will know that fallback has occurred by receiving the TMU parameter. This parameter indicates the fallback connection type.

If echo control is required on the connection, appropriate procedures will be initiated (see T1.113.4, subclause 2.9C.6).

F.2.3.1.3.2.2 Succeeding network does not have the capability of performing fallback

The CSF will include a TMU parameter (which has been set according to the fallback connection type indicated in the USI parameter) in the ACM or CPG indicating that fallback has occurred for this call.

Appropriate actions to modify network resources (e.g., echo control) will be initiated if applicable.

F.2.3.1.3.3 Actions in the backward direction – fallback indicated at answer

The CSF will know that fallback has occurred by receiving the TMU parameter. This parameter indicates the fallback connection type.

If echo control is required on the connection, appropriate procedures will be initiated (see T1.113.4, subclause 2.9C.6).

F.2.3.2 Call release

On receipt of a REL from the preceding CSF, the CSF invokes the BICC Release reception procedure and sends an ISUP REL to the succeeding exchange. Timers T1 and T5 are started to ensure that a RLC is received from the succeeding exchange (expiration of timers T1 and T5 is covered in T1.113.4, subclause 2.9.6).

On receipt of an ISUP REL from the succeeding exchange, the CSF immediately requests the disconnection of the internal bearer path and invokes the BICC Release sending procedure (see T1.673.4, subclause 11.5) towards the preceding CSF. When the ISUP circuit is re-selectable, an ISUP RLC is returned to the succeeding exchange.

Annex G/T1.673.4
(normative)

G Interworking between selected signaling systems (PSTN access, DSS1, MF) and the Bearer Independent Call Control protocol

G.1 Scope

This Annex defines the signaling interworking between the Bearer Independent Call Control (BICC) protocol and narrowband signaling systems for which interworking is defined with the ISDN User Part (ISUP) protocol of Signaling System 7 (SS7).

This Annex builds upon:

- The signaling interworking between selected signaling systems (PSTN access, DSS1, MF) and the ISUP protocol of Signaling System 7 as defined in T1.609-1999 and other applicable interworking specifications
- The signaling interworking between the BICC protocol and the ISUP protocol of SS7 as defined in Annex F/T1.673.4.

The interworking between the selected signaling systems (i.e., for which the interworking is defined with ISUP) and BICC takes place via ISUP in a CSF at an ISN. The scope of this Annex is thus as shown in Figure G.1/T1.673.4.

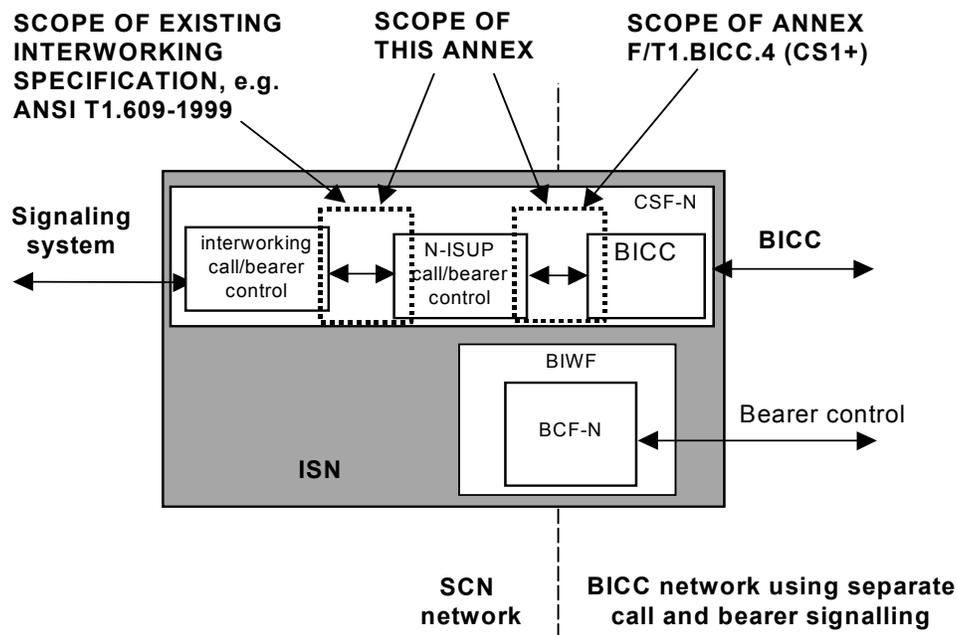


Figure G.1/T1.673.4 - Scope of this Annex

G.2 General considerations

This Annex specifies the interworking principle between BICC and signaling systems for which the interworking is defined with ISUP. This refers to the signaling systems that are available in the SCN at the access or within the networks. This interworking takes place at the ISN. Figure G.2/T1.673.4 shows the signaling systems covered.

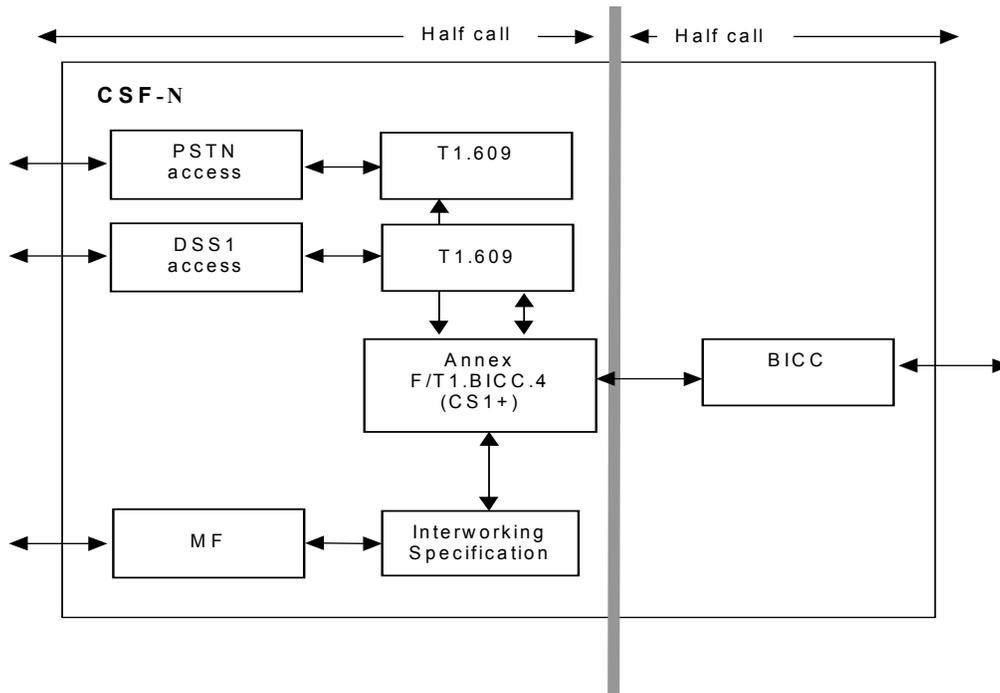


Figure G.2/T1.673.4 - Coverage of signaling interworking cases

G.3 Interworking with access signaling systems

G.3.1 PSTN access signaling system

PSTN access signaling systems are implemented based on applicable specifications. The interworking between a specific PSTN access signaling protocol and BICC shall act according to the interworking between the PSTN access signaling protocol and ISUP with the guidance provided in T1.609-1999 and the additional interworking considerations in T1.113-2000, concatenated with the interworking between ISUP and BICC in Annex F/T1.673.4.

If an incoming BICC call carries the USI' parameter set to "64kbit/s UDI-TA," the ISUP procedures for fallback (clause F.2.3.1.3.1.2 in Annex F/T1.673.4) shall be initiated, because the PSTN access signaling system does not support this connection type.

G.3.2 ISDN access signaling system DSS1

The ISDN access signaling DSS1 is specified in American National Standards T1.603-1990 (R2000), T1.604-1990 (R2000), T1.607-2000, T1.620-1991 (R2002), and T1.620a-1992 (R1999). The interworking between DSS1 and BICC shall act according to the interworking between ISUP and DSS1 in T1.609-1999 and the additional interworking considerations in T1.113-2000, concatenated with the interworking between ISUP and BICC in Annex F/T1.673.4.

G.3.3 Multiplexed access signaling systems

The same interworking considerations as in clause G.3.2 apply when the signaling of multiple access lines is multiplexed (e.g., over a V5 transmission system, as defined in ITU-T Recommendations G.964 and G.965 or an DSL type of transmission system as defined in G.995.1). In these situations, the non-ISDN access signaling system or the ISDN access signaling system is extracted by the transmission system. From a signaling perspective, the access line is terminated as indicated in Figure G.2/T1.673.4 for a single access line.

G.4 Interworking with the MF network signaling system

G.4.1 General

G.4.1.1 Interworking specifications

The MF signaling is defined by applicable specifications. The interworking between MF and BICC shall act as defined in applicable interworking specifications, and the additional interworking considerations in T1.113-2000, concatenated with the interworking between ISUP and BICC in Annex F/T1.673.4.

G.4.1.2 Return of Address Complete Message in interworking situations

An Address Complete Message indicating "interworking encountered" shall not be sent until the cross-office check is made, if applicable (see ITU-T Recommendation Q.543), and the Continuity message is received, if awaited.

If the succeeding network does not provide electrical called-party's-line-condition indications, the CSF at the ISN shall originate and send an Address Complete Message if:

- a) The complete address has been received; and
- b) An outgoing circuit is successfully seized (e.g., a seize signal has been sent and acknowledged).

If in normal operation, a delay in the receipt of an Address Complete signal from the succeeding network is expected, the CSF at the ISN shall originate and send an Address Complete Message 15 to 20 seconds (timer T11 in T1.113.4) after receiving the Initial Address Message. The time-out condition is an upper limit considering the clauses of section 2.9.8.3 of T1.113.4 (20 to 30 seconds waiting for Address Complete Message timer).

When timer T11 expires, an ACM is sent to the preceding CSF. CSFs that run timer T11 do not run timer T7.

G.4.1.3 Internal through connection of the bearer path

In general, completion of the internal bearer path at an interworking point should occur as soon as possible during the call set-up phase. The actual point of switch-through will vary depending on the interworking signaling system (e.g., whether in-band or out-of-band signaling is used).

G.4.1.4 Alerting of the called party

If the interworking point has received an IAM with the indication "COT to be expected," appropriate measures must be taken to prevent alerting of the called party until the Continuity message has arrived.

The last digit(s) of the national number have to be withheld in any (interworking) intermediate SN, gateway SN or destination SN in case of DDI (direct dialing in), or the alerting of the called party is postponed in the destination SN in case of non-DDI.

G.4.2 Number portability

Using BICC signaling, additional call related information can be transported during call setup. For a portable user/address, routing through the network(s) is done based on the routing information received in the IAM. If the call encounters a route that is inband signaling, the end user's public address will be signaled for routing to the subsequent switch via the inband signaling. This converts the routing information for call setup back to the form expected for inband signaling interface.

G.4.3 Hop counter

A CSF at a SN interworking with MF and receiving a REL with ANSI cause 25, "*SN/CMN routing error*," shall notify the management system of the SN/CMN routing error and provide the called party number, identity of the succeeding SN/CMN, and an indication that interworking occurred. Normal release treatment shall be passed back over the incoming MF circuit (e.g., play announcement or reorder tone).

G.4.4 Jurisdiction information

When the CSF at an intermediate or gateway SN receives a call over a trunk group with inband signaling, the CSF may optionally include a Jurisdiction Information parameter in the outgoing IAM. The CSF shall populate a Jurisdiction Information parameter with an NPA-NXX associated with incoming trunk group.

G.4.5 CIC reservation

The following signaling procedure using a CIC Reservation Message (CRM) and a CIC Reservation Acknowledgment Message (CRA) is an optional procedure for call setup between SNs in different networks. The procedure may be initiated by an ISN only when the incoming call uses Exchange Access Signaling as specified in T1.104-1991 (R2003), and the outgoing call is routed to a SN in another network using BICC.

G.4.5.1 Actions at the ISN initiating CIC reservation

1. *Sending a CIC Reservation Message:* The ISN sends a CIC Reservation Message to the succeeding SN. The CIC Reservation Message contains the Nature of Connection Indicators coded as for an Initial Address Message. The Continuity Indicator in the Nature of Connection Indicators parameter is coded "no COT to be expected." The CIC Reservation Message does not request the set-up of any bearer path. On sending the CIC Reservation Message, the ISN sets a timer (T_{CRM}) awaiting an on-hook indication on the incoming circuit or a CIC Reservation Acknowledgment Message for the outgoing CIC.
2. *Receipt of CIC Reservation Acknowledgment Message:* On receipt of a CIC Reservation Acknowledgment Message the ISN cancels timer (T_{CRM}) and returns an off-hook wink on the incoming circuit. This wink will prompt the preceding exchange to send routing information, on receipt of which the ISN formulates and sends an Initial Address Message for the outgoing CIC (see G.4.1.1) and returns an acknowledgment wink to the preceding exchange. The Continuity Indicator in the Nature of Connection Indicators parameter is coded "no COT to be expected."
3. *Abnormal conditions:*
 - If timer T_{CRM} expires a first time for a call, the ISN should release the outgoing CIC following the normal release procedures (see G.4.1.1). The ISN should then again select an outgoing CIC and send a CIC Reservation Message for this CIC, again setting timer T_{CRM} . If timer T_{CRM} expires a second time, the ISN returns off-hook on the incoming circuit and provides reorder tone or an announcement to the calling party.
 - If an on-hook is received on the incoming circuit while timer T_{CRM} is active, the timer is canceled and the outgoing CIC is released.

G.4.5.2 Actions at the SN receiving a CIC Reservation Message

1. *Return of CIC Reservation Acknowledgment Message:* An SN receiving a CIC Reservation Message marks the CIC busy and returns a CIC Reservation Acknowledgment Message.
2. *Receipt of subsequent messages:* After returning the CIC Reservation Acknowledgment Message, the SN sets a timer T_{CRA} , awaiting receipt of an Initial Address Message or a Release Message. On receipt of either message, timer T_{CRA} is canceled.

If a Release Message is received, the SN follows the usual procedure of idling the CIC (see G.4.1.1) and returning a Release Complete Message.

If an Initial Address Message is received, the SN proceeds with normal call processing and, as appropriate, routes the call forward. Information carried in the Nature of Connection Indicators of the received Initial Address Message should be used to code the Nature of Connection Indicators in the outgoing Initial Address Message.

3. *Abnormal conditions:* If timer T_{CRA} expires before the receipt of an appropriate message, the SN proceeds with release procedures for the incoming CIC (i.e., sends a Release Message, sets a timer awaiting receipt of a Release Complete Message, etc.).

G.4.5.3 Interworking of answer indication

When interworking between Exchange Access Signaling and BICC occurs at an ISN and the CIC reservation procedure (see G.4.2.1) is used, it is possible that an Answer Message is received at the ISN for the outgoing CIC before the acknowledgment wink (third wink) from the ISN to the preceding exchange has been completed. If this occurs, the ISN should delay the sending of the off-hook answer indication on the incoming circuit until the acknowledgment wink to the preceding office is completed.

G.4.5.4 Interworking with Facility/Service Selective Signaling

If Facility/Service Selective Signaling as specified in T1.104-1991 (R2003) is used on the incoming circuit at an ISN and a Facility Code has been dialed for the call, then the first stage of outpulsing from the preceding exchange to the ISN includes the Facility Code.

When interworking between such signaling and BICC occurs at the ISN and the CIC reservation procedure (see G.4.2.1) is used, the ISN uses the Facility Code along with the other information it receives in the first stage of outpulsing to select a suitable route and/or to send an appropriate internodal traffic group identifier to the succeeding network. The Facility Code is not included in the CIC Reservation Message but may be indicated in the Service Code parameter in the Initial Address Message for the call.

G.4.5.5 Interactions

The CRM is treated in the same way as the IAM and the CRA is treated in the same way as the ACM in case of interaction with the:

- CIC group blocking and unblocking procedures (see clause 12.5 of T1.673.4);
- CIC query procedures (see clause 12.6 of T1.673.4);
- Dual seizure detection and resolution procedures (see clause 13.2 of T1.673.4);
- Reset CIC and CIC Group Reset procedures (see clause 13.3 of T1.673.4); and
- Unequipped CIC procedures (see clause 13.5 of T1.673.4).

G.4.5.6 Additional handling of unexpected messages

There are two additions to the handling of unexpected messages as described in clause 13.4.2 of T1.673.4:

1. If after receipt of a Circuit Reservation Acknowledgment Message, unexpected messages other than REL and RLC are received for a CIC in use for a call, the unexpected signaling information is discarded.
2. If before receipt of a Circuit Reservation Acknowledgment Message, unexpected messages other than REL and RLC are received for a CIC in use for a call, the Reset Circuit Message is sent and an automatic repeat attempt is provided on another CIC value.

Annex H /T1.673.4
(normative)

H Interworking between B-ISDN access signaling system DSS2 for 64 kbps ISDN Circuit Mode Services and the Bearer Independent Call Control protocol

H.1 Scope

This Annex defines the signaling interworking between the Bearer Independent Call Control (BICC) protocol and B-ISDN access signaling system DSS 2.

This Annex builds upon:

- The signaling interworking between existing DSS 2 and the B-ISDN User Part (B-ISUP) protocol as defined in T1.657-1996 (R2000).
- The signaling interworking between existing B-ISUP signaling systems and the ISDN User Part (ISUP) protocol of Signaling System 7 as defined in T1.656-1996 (R2000).
- The signaling interworking between the BICC protocol and the ISUP protocol of Signaling System 7 as defined in Annex F/T1.673.4.

The scope of this Annex is thus as shown in Figure H.1.

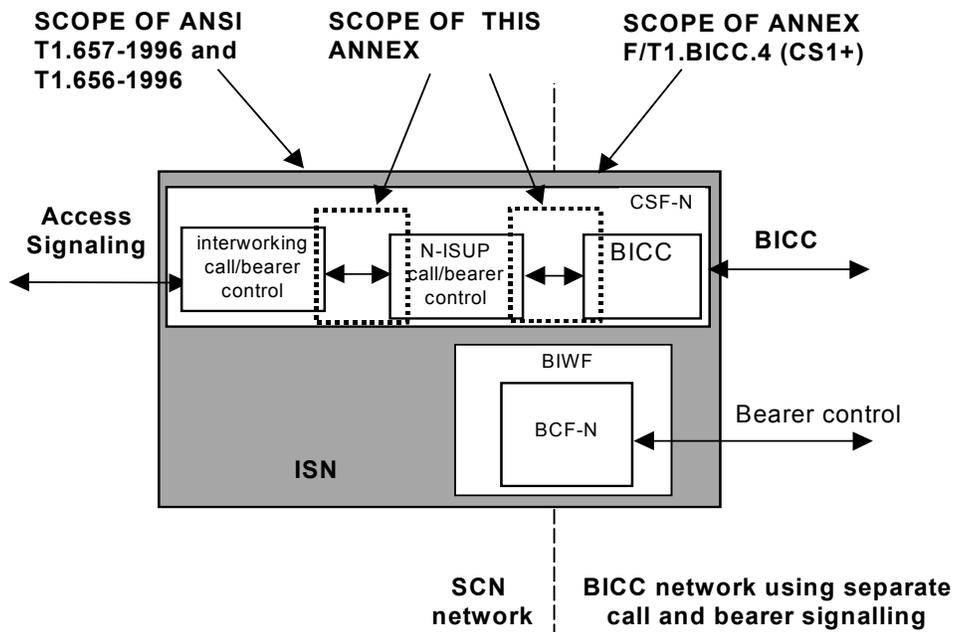


Figure H.1/T1.673.4 - Scope of this Annex

H.2 Interworking with broadband access signaling systems

This Annex specifies the interworking principle between BICC and broadband access signaling systems for which the interworking is defined with ISUP. Figure H.2/T1.673.4 provides the signaling systems covered.

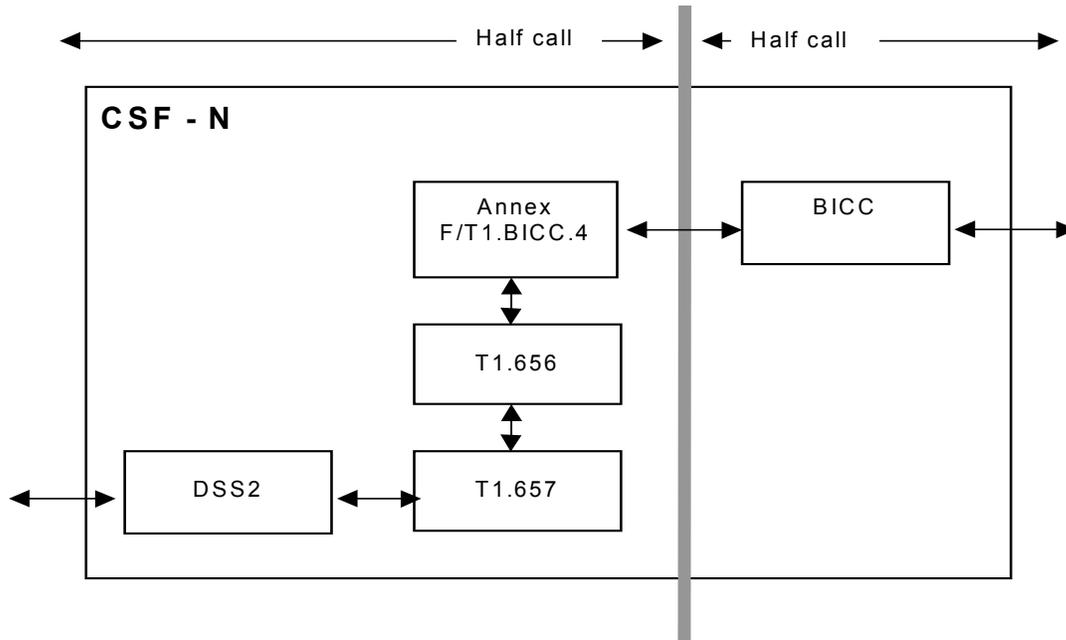


Figure H.2/T1.673.4 - Coverage of signaling interworking cases

H.2.1 B-ISDN access signaling system DSS2 for 64 kbps ISDN Circuit Mode Services

The interworking between DSS2 for 64 kbps ISDN Circuit Mode Services and BICC is the sequential application of the DSS2 to/from B-ISUP interworking, and the B-ISUP to/from ISUP interworking, and the ISUP to/from BICC interworking. The interworking between DSS2 and B-ISUP shall be according to T1.657-1996 (R2000). The interworking between B-ISUP and ISUP shall be in according to T1.656-1996 (R2000). Additional interworking considerations in T1.113-2000 shall be considered. The interworking between ISUP and BICC is specified in Annex F/T1.673.4.

Annex I/T1.673.4

(informative)

I Message Flow Examples**I.1 Introduction to message flows**

This Annex contains a number of example message flows.

- Many other sequences are possible.
- Flows are shown for the network scenario where a call uses two ISNs with an intermediate TSN. (The presence of a TSN between ISNs is optional depending on network configuration.)
- All ISNs are shown interworking to ISUP. Interworking (at the ISN) to other signaling systems is also possible according to the relevant interworking Annexes G/T1.673.4 and H/T1.673.4.
- The flows mention for each message the minimum set of BICC information elements that are specific to this flow example. Other parameters and information elements may also be included according to the relevant protocol procedures.
- If no TSN is used, the flows between ISN-A and ISN-B would be as shown for ISN-A to TSN.
- Between each SN, two SWNs are shown. The number of such nodes depends on network configuration.
- Message sequences in the case of a GSN to GSN connection would be as shown in between ISN and TSN, except that no SWNs would exist.
- The signaling flows between BCFs are generalized flows, not relating to any specific bearer control protocol.
- The only flows shown between CSF and BCF are those directly related to BICC signaling events; other interactions between CSF and BCF are not shown.
- BICC and ISUP messages are shown as solid lines; other flows are shown as dashed lines.
- Through connection of the bearer path is not shown in the Figures.

I.2 Contents

1. Call set-up:

- 1.1. Forward establishment of backbone network connection, no notification of bearer connect required.
- 1.2. Forward establishment of backbone network connection, notification of bearer connect is required.
- 1.3. Backward establishment of backbone network connection.
- 1.4. Per-call bearer set-up using bearer control tunneling - fast forward.
- 1.5. Per-call bearer set-up using bearer control tunneling - delayed forward.
- 1.6. Per-call bearer set-up using bearer control tunneling - backward.
- 1.7. Use of idle backbone network connection, established in the forward direction.
- 1.8. Use of idle backbone network connection, established in the backward direction.
- 1.9. Multi-network example.

2. Codec negotiation and modification:
 - 2.1. Forward establishment of backbone network connection with Codec negotiation.
 - 2.2. Backward establishment of backbone network connection with Codec negotiation.
 - 2.3. Codec modification.
 - 2.4. Mid-call codec negotiation.
 - 2.5. Codec modification collision.
 - 2.6. Mid-call codec negotiation collision.
 - 2.7. Collision between mid-call codec negotiation and codec modification.
 - 2.8. Collision between mid-call codec negotiation and codec modification (error following collision resolution).
3. Release:
 - 3.1. Forward call and bearer release. Forward bearer set-up.
 - 3.2. Forward call and bearer release. Backward bearer set-up.
 - 3.3. Forward call release. Bearers not released.
 - 3.4. Forward call and bearer release. Gateway interworking between forward and backward bearer set-up.

The following note applies to all the call set-up flows:

NOTE - The messages AAA and BBB are dependent on whether the Continuity procedure is supported in the subsequent SCN:

Case	Message AAA	Message BBB
Continuity is supported:	IAM indicating <i>"continuity check performed on previous circuit"</i>	COT indicating <i>"continuity check successful"</i>
Continuity is not supported:	No message is sent at this time	IAM indicating <i>"continuity check not required"</i>

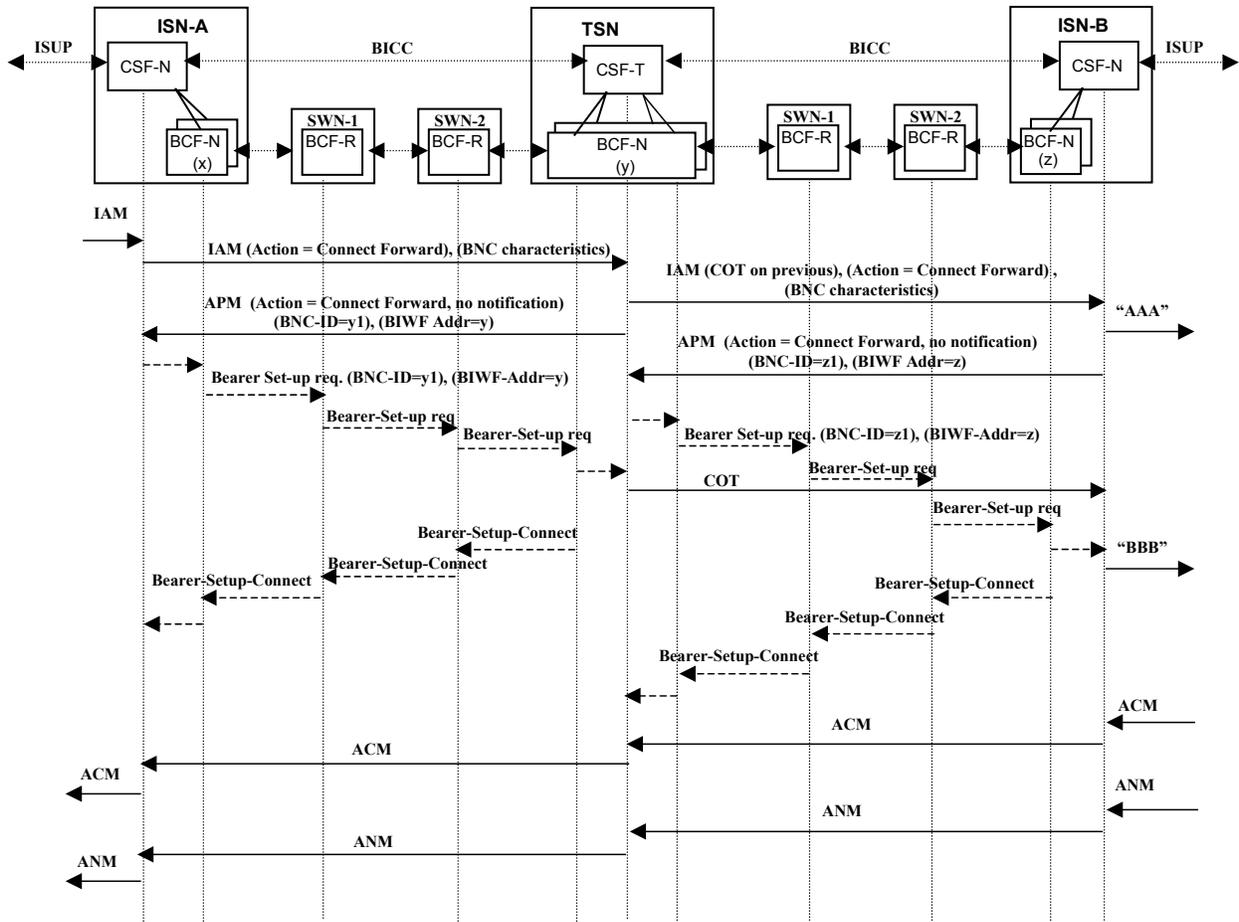


Figure I.1/T1.673.4 - Forward establishment of backbone network connection, no notification of bearer connect required

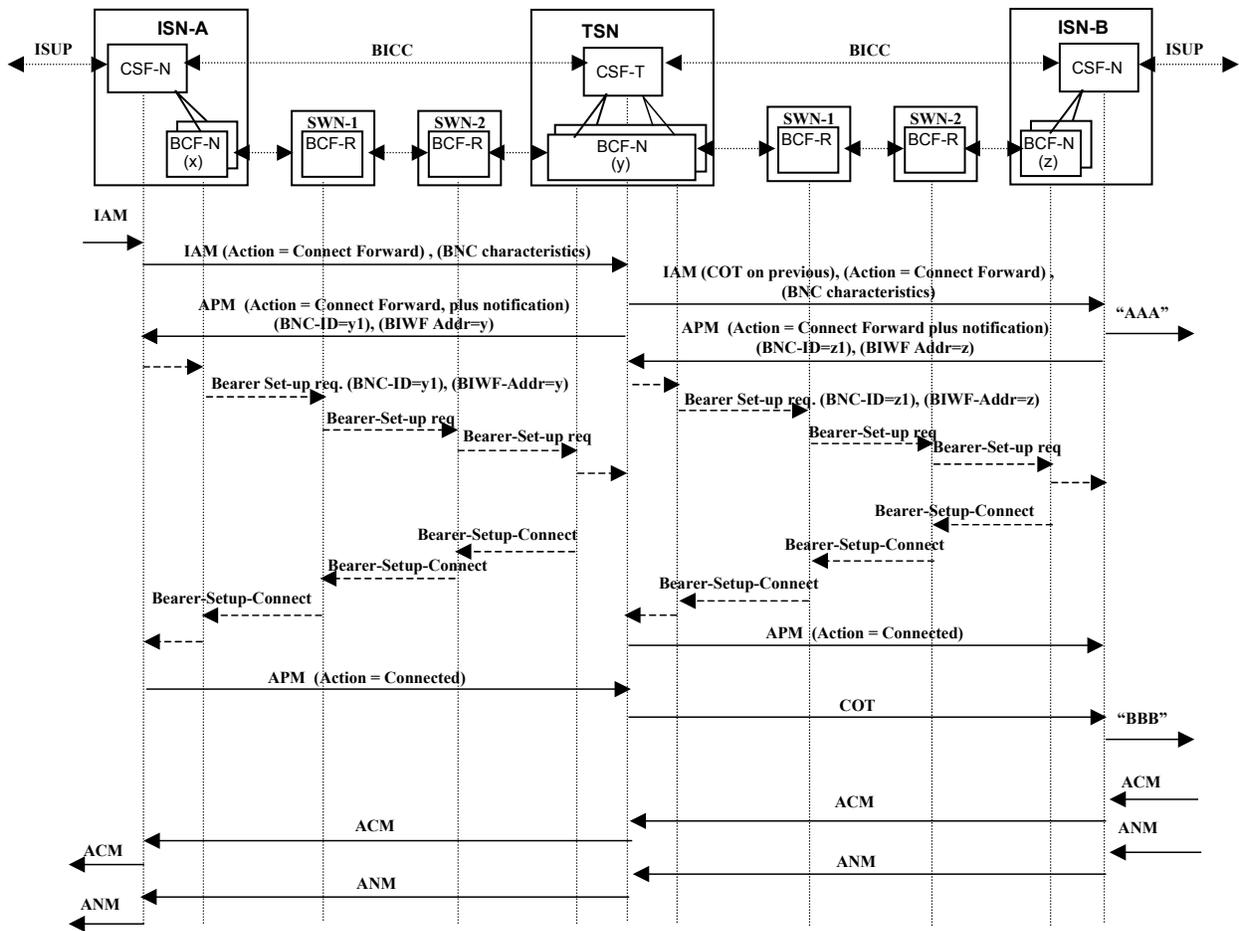


Figure I.2/T1.673.4 - Forward establishment of backbone network connection, notification of bearer connect is required

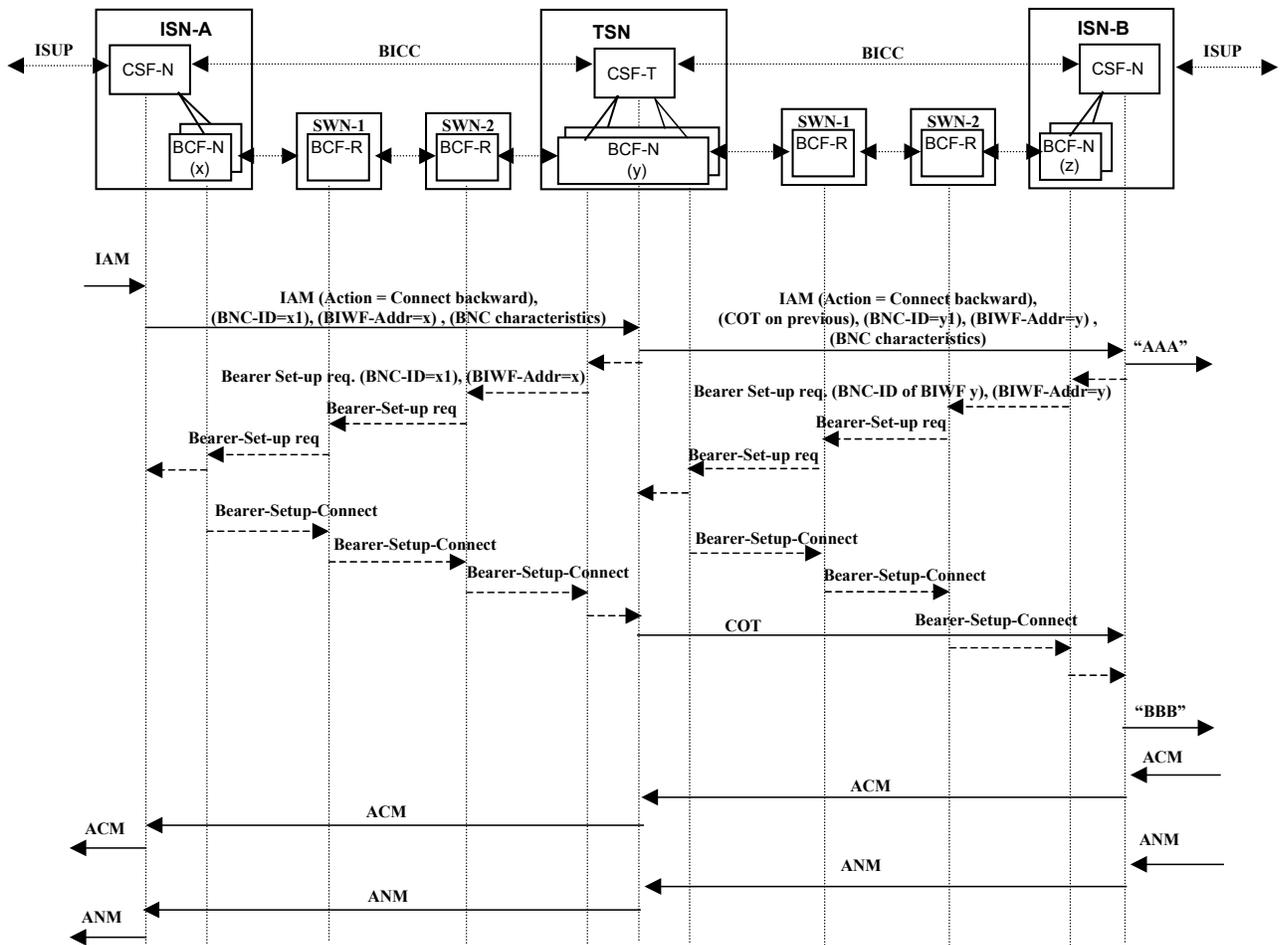


Figure I.3/T1.673.4 - Backward establishment of backbone network connection

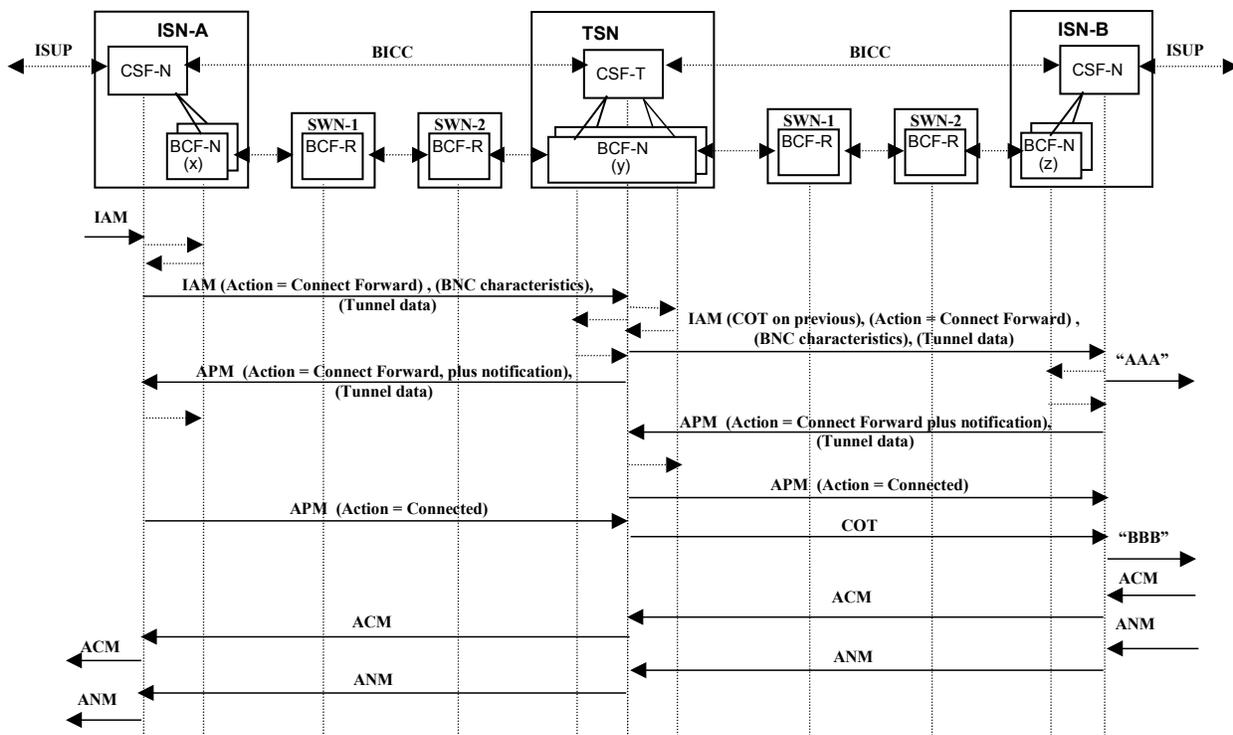


Figure I.4/T1.673.4 - Per-call bearer set-up using bearer control tunneling - fast set-up (forward)

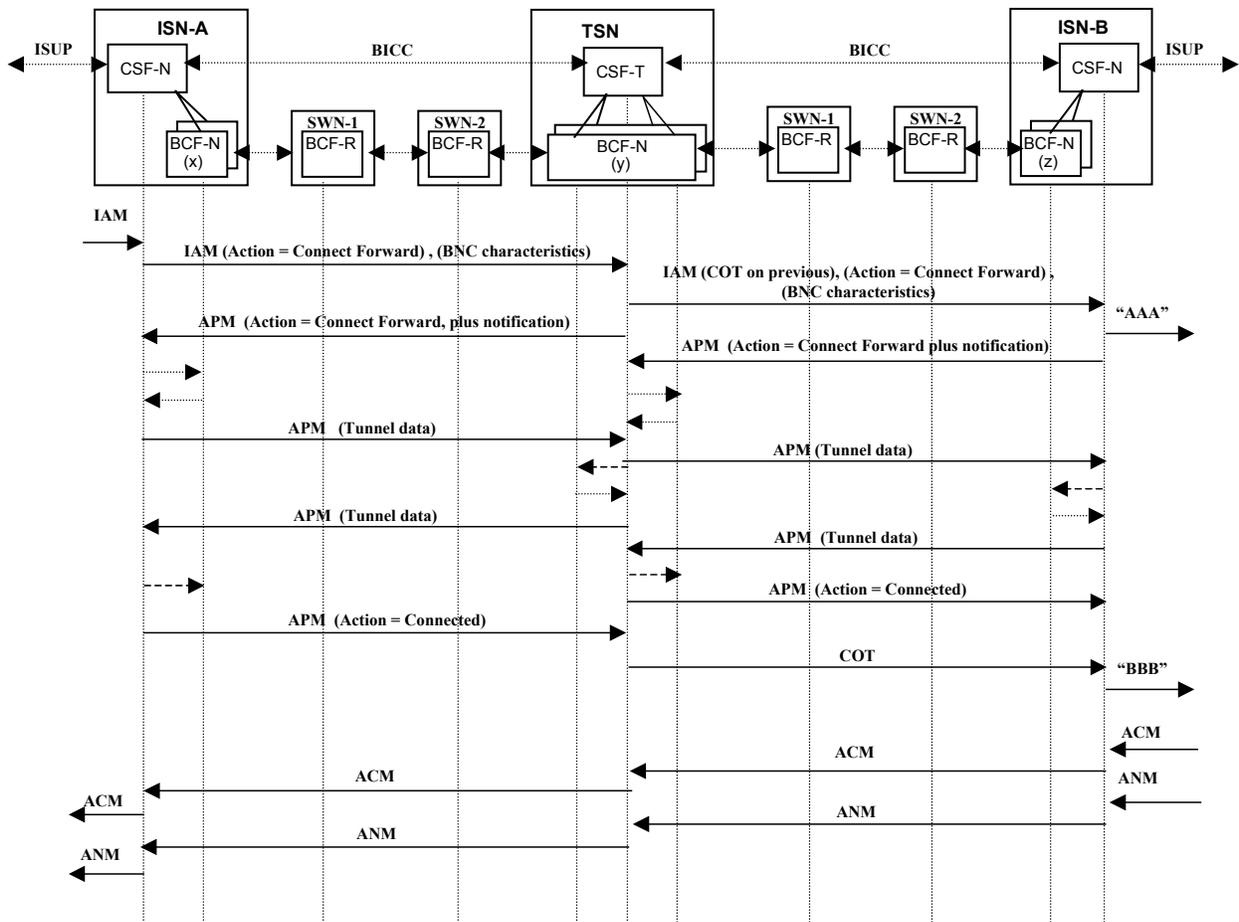


Figure I.5/T1.673.4 - Per-call bearer set-up using bearer control tunneling - delayed forward

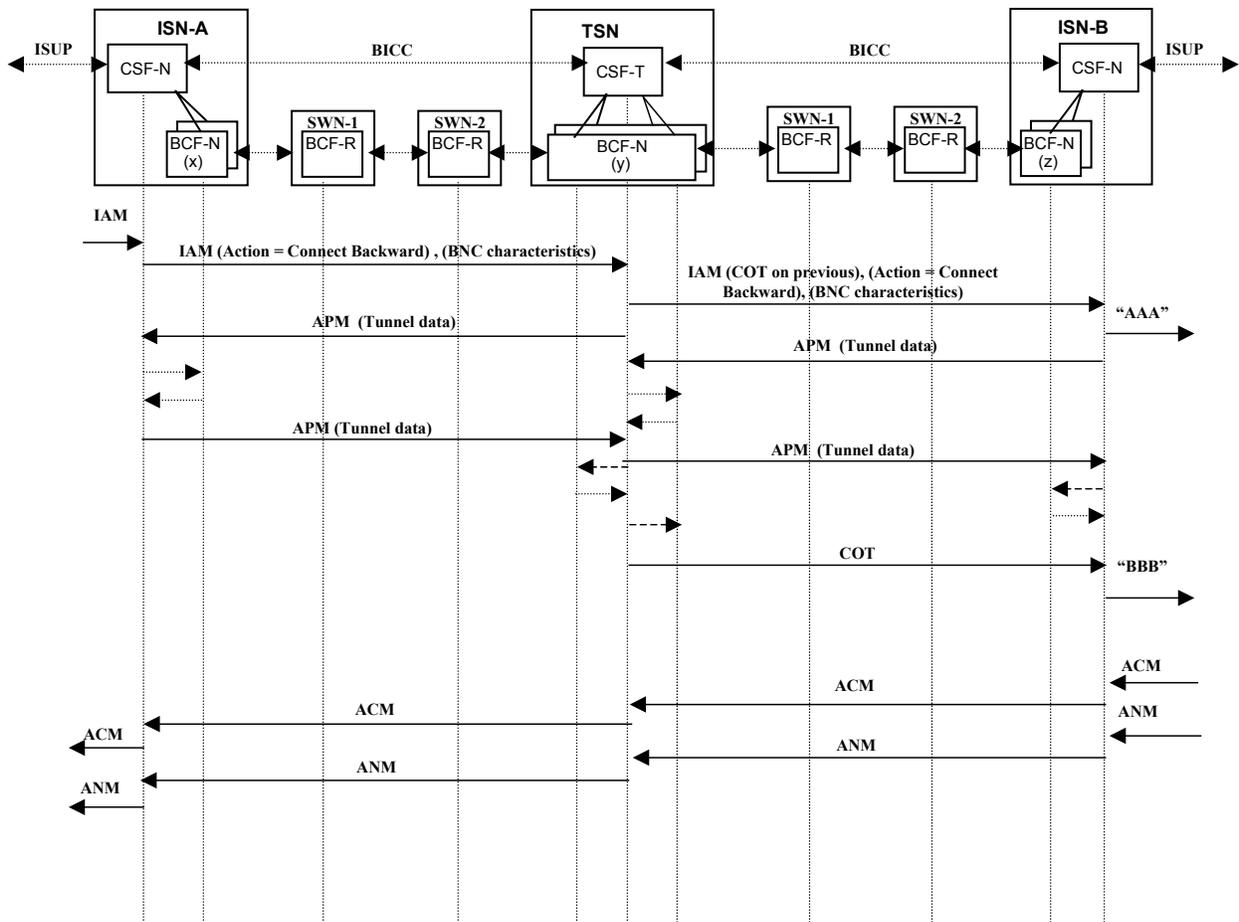


Figure I.6/T1.673.4 - Per-call bearer set-up using bearer control tunneling - delayed backward

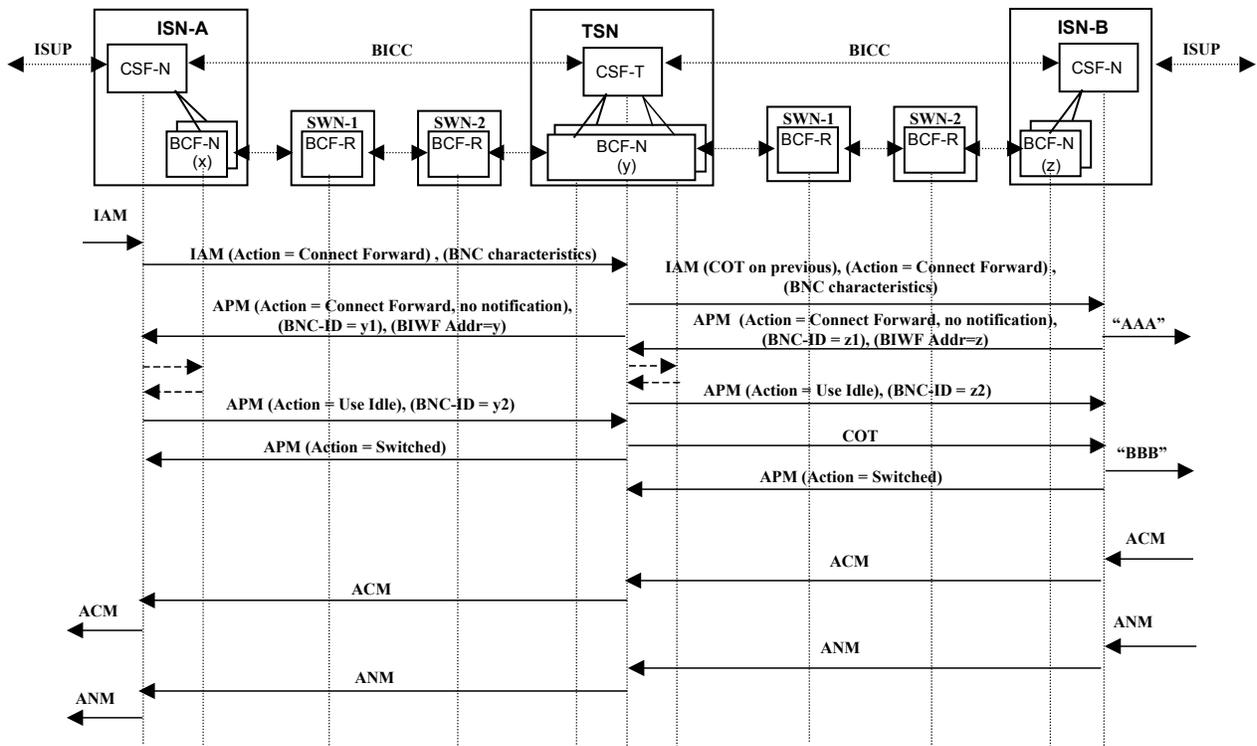


Figure I.7/T1.673.4 - Use of idle backbone network connection, established in the forward direction

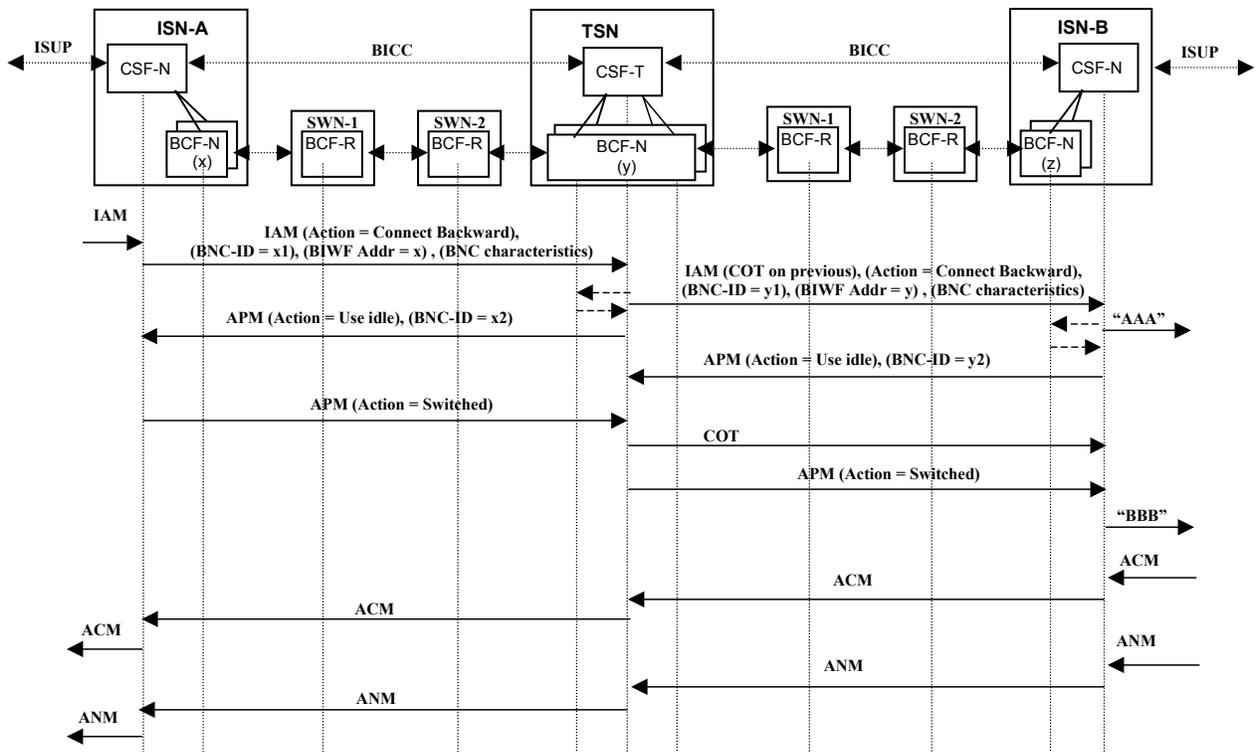


Figure I.8/T1.673.4 - Use of idle backbone network connection, established in the backward direction

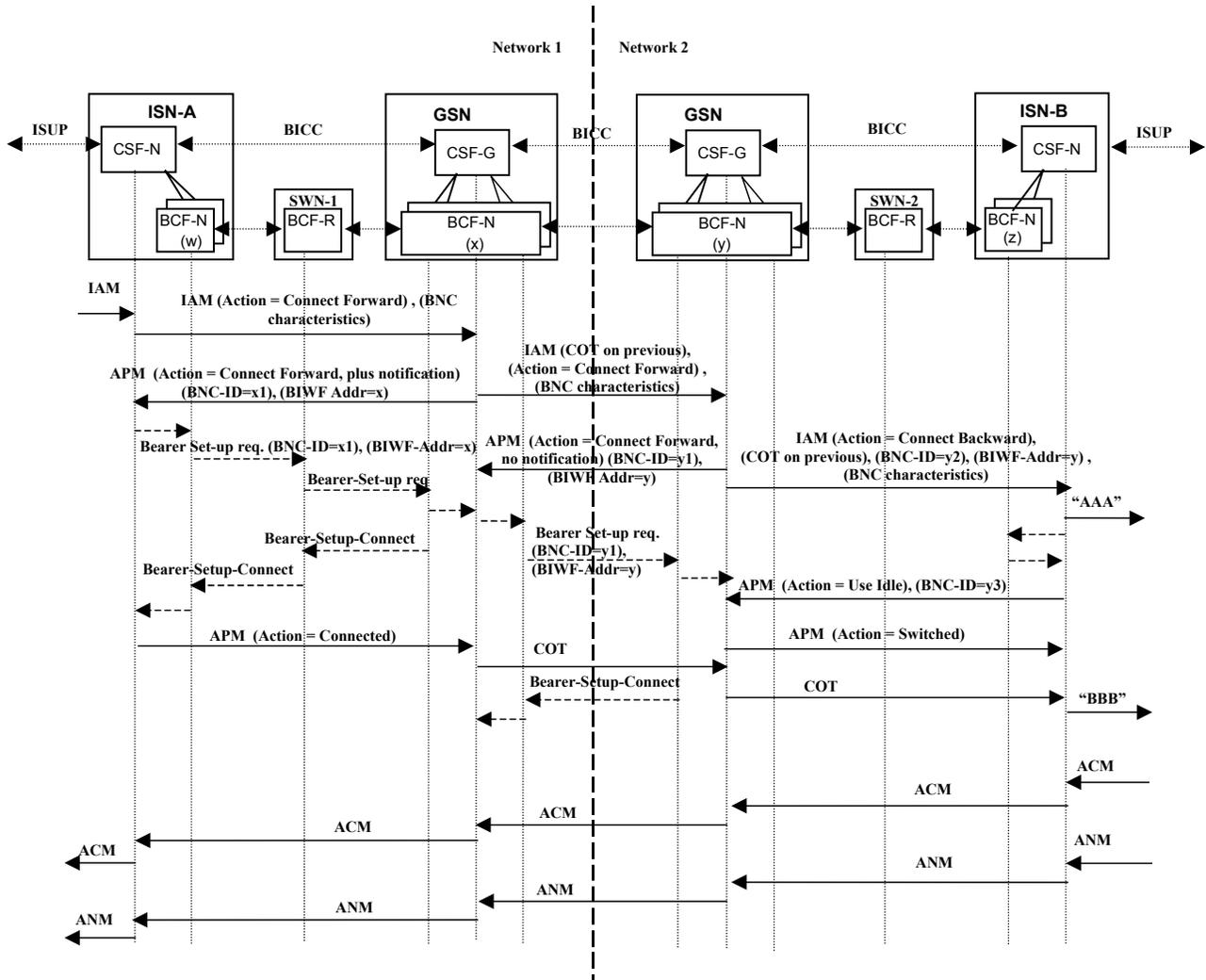


Figure I.9/T1.673.4 - Multi-network example: Connect forward, plus notification, followed by Connect forward, no notification, followed by Connect backward, re-use of idle bearer

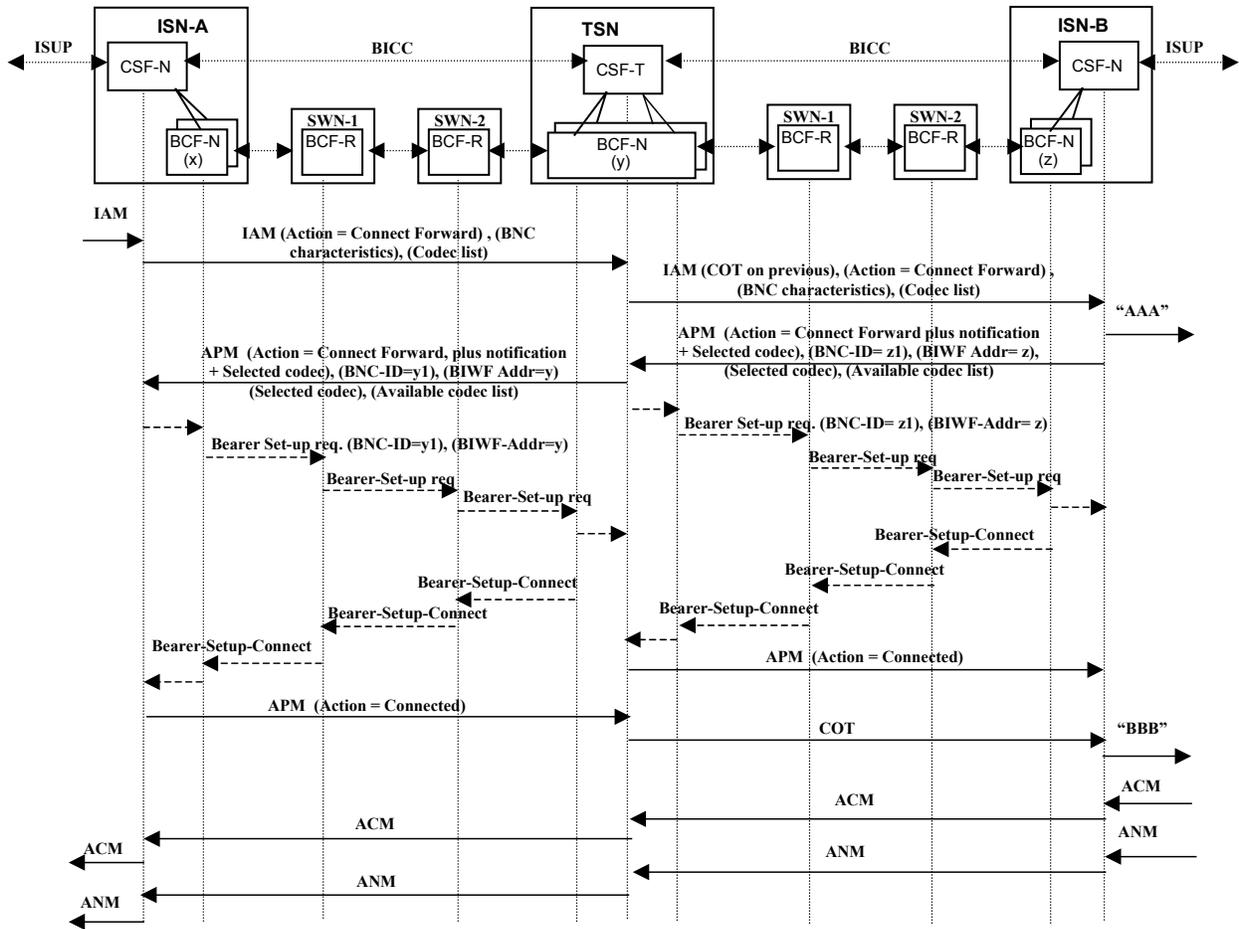


Figure I.10/T1.673.4 - Forward establishment of backbone network connection, (plus notification of bearer connect), with Codec negotiation

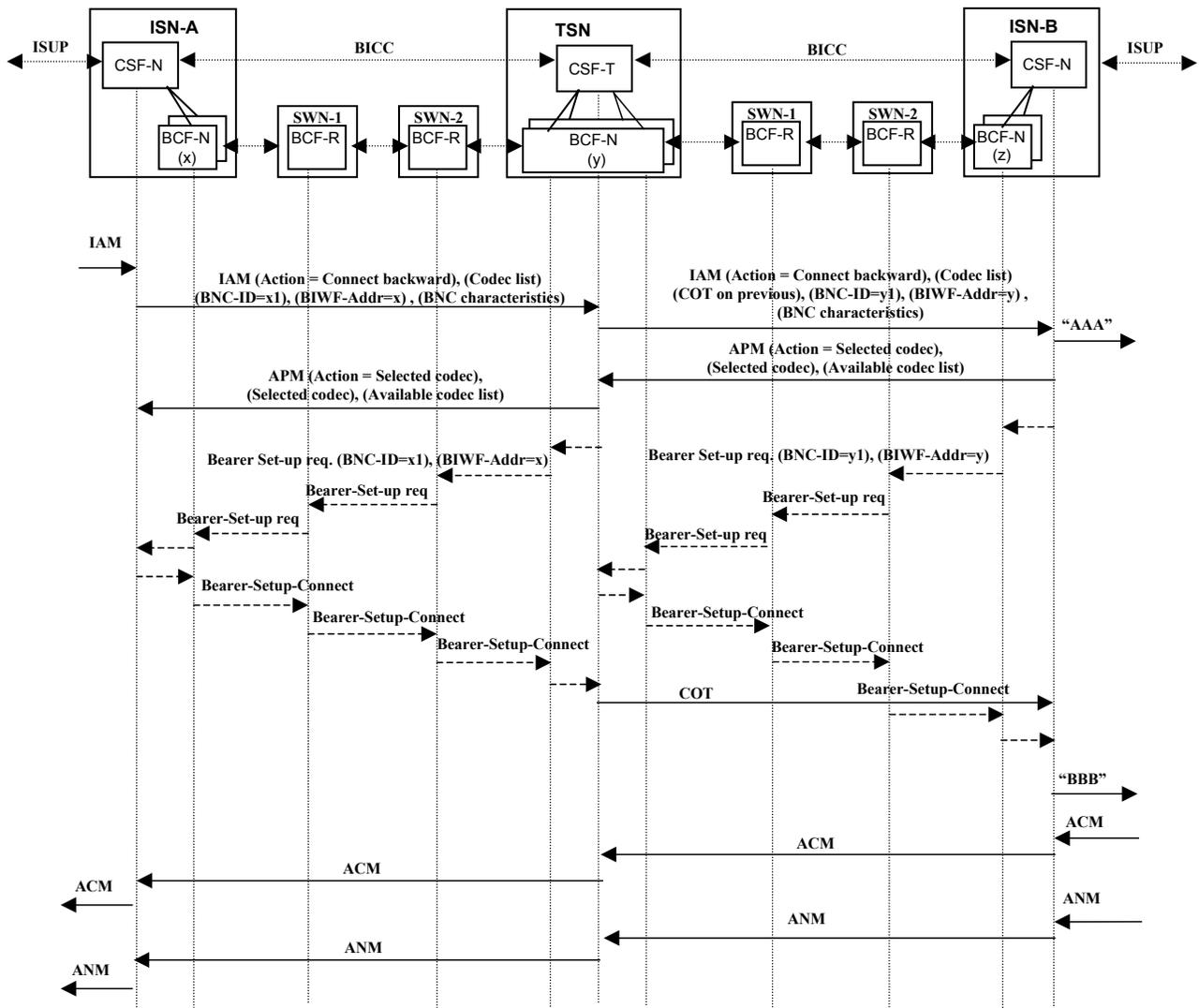


Figure I.11/T1.673.4 - Backward establishment of backbone network connection, with Codec negotiation

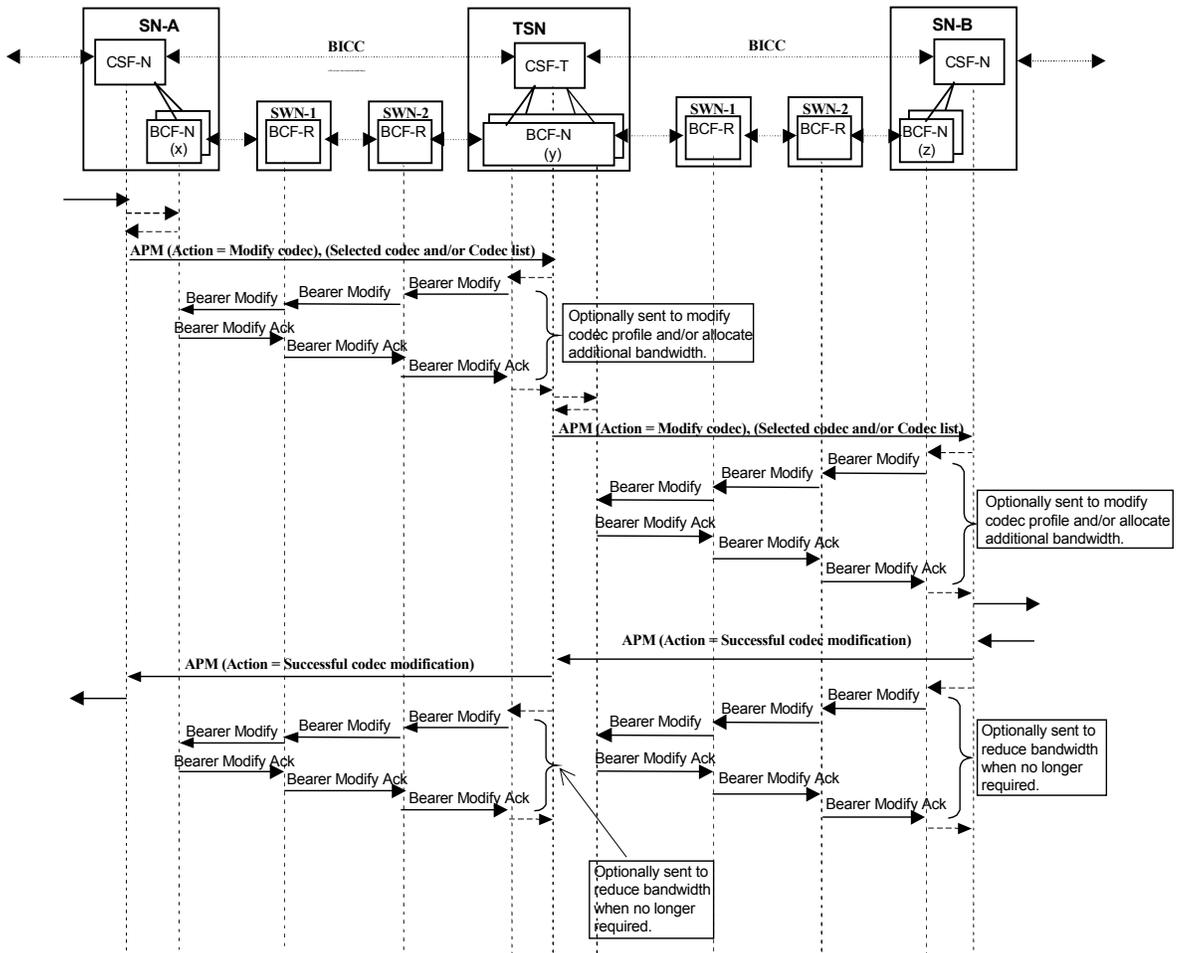


Figure I.12/T1.673.4 - Codec modification

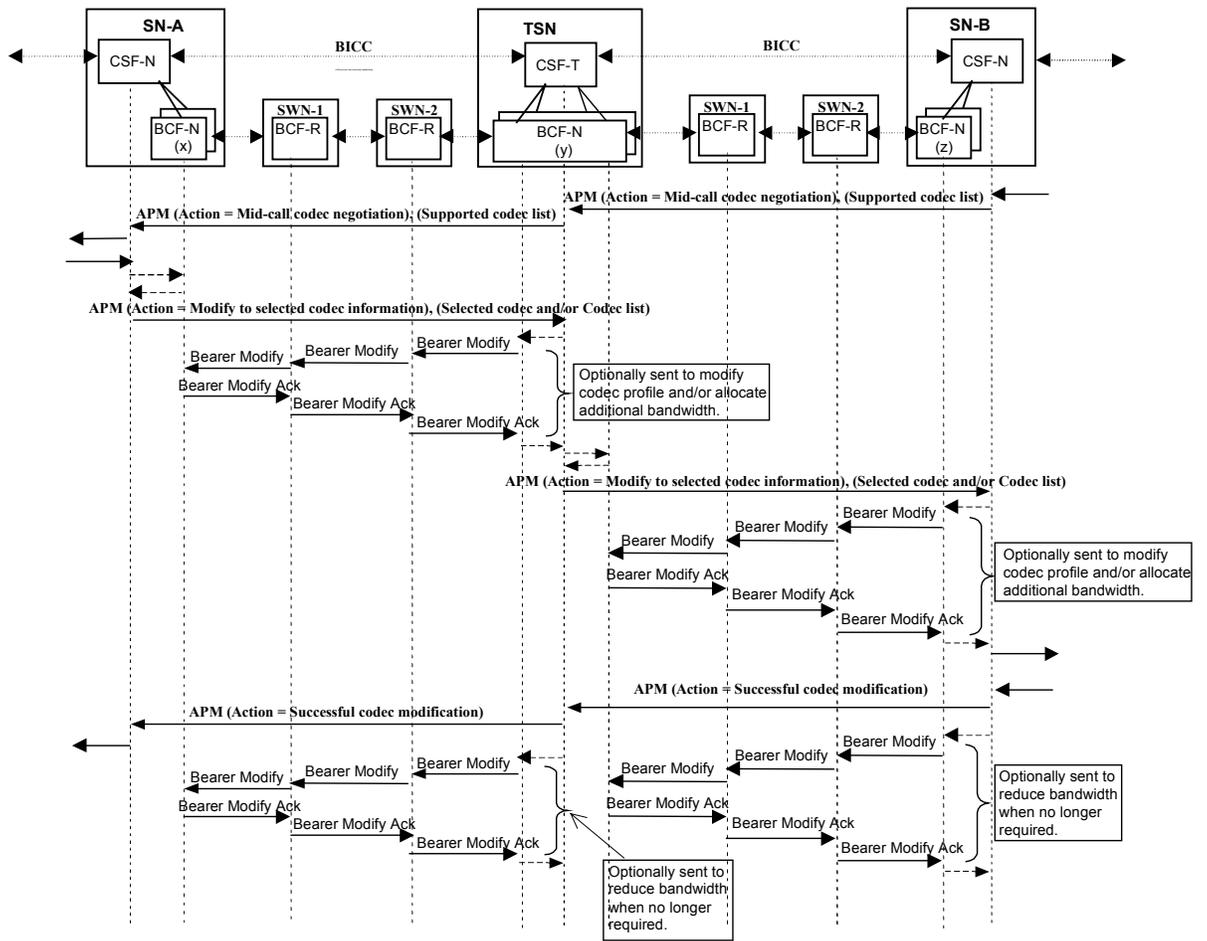


Figure I.13/T1.673.4 - Mid-Call Codec Negotiation

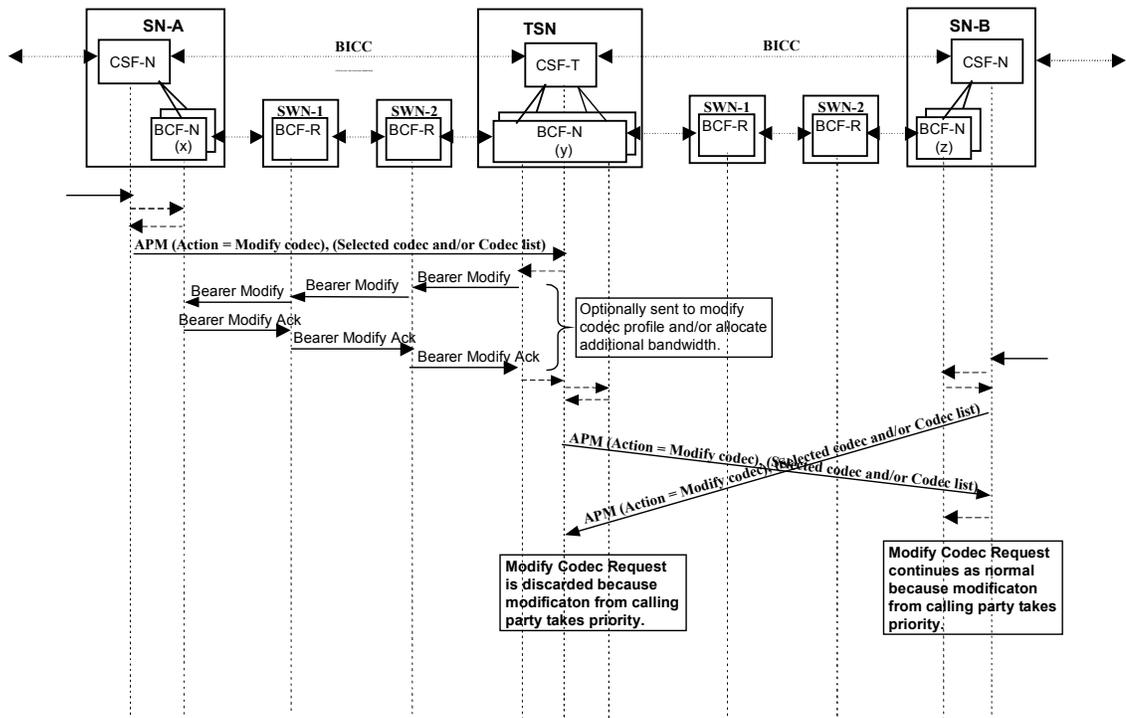


Figure I.14/T1.673.4 - Codec Modification Collision

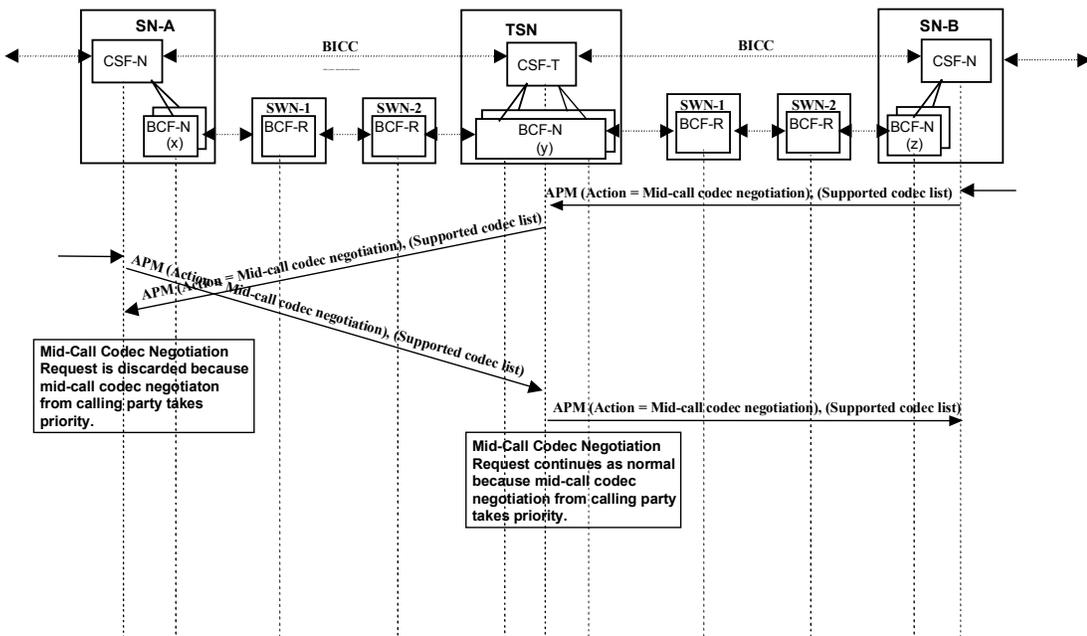


Figure I.15/T1.673.4 - Mid-Call Codec Negotiation Collision

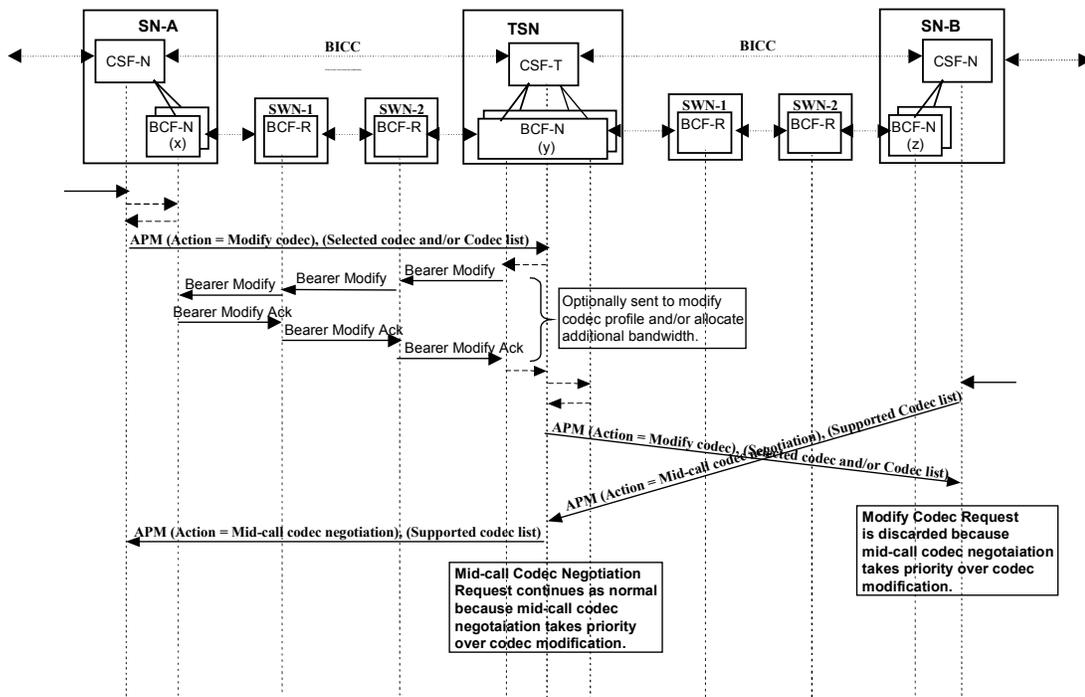


Figure I.16/T1.673.4 - Collision between Mid-call Codec Negotiation and Codec Modification

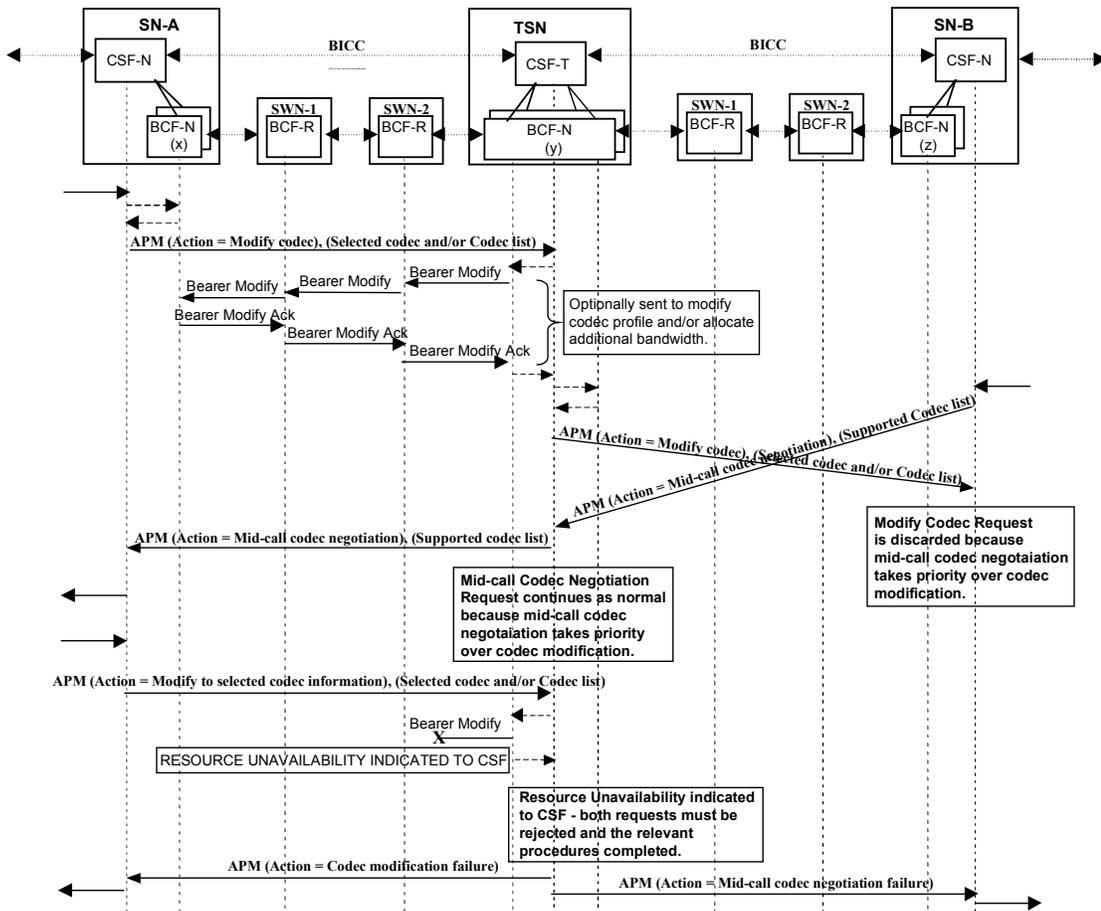


Figure I.17/T1.673.4 - Collision between Mid-call Codec Negotiation and Codec Modification (error following collision resolution)

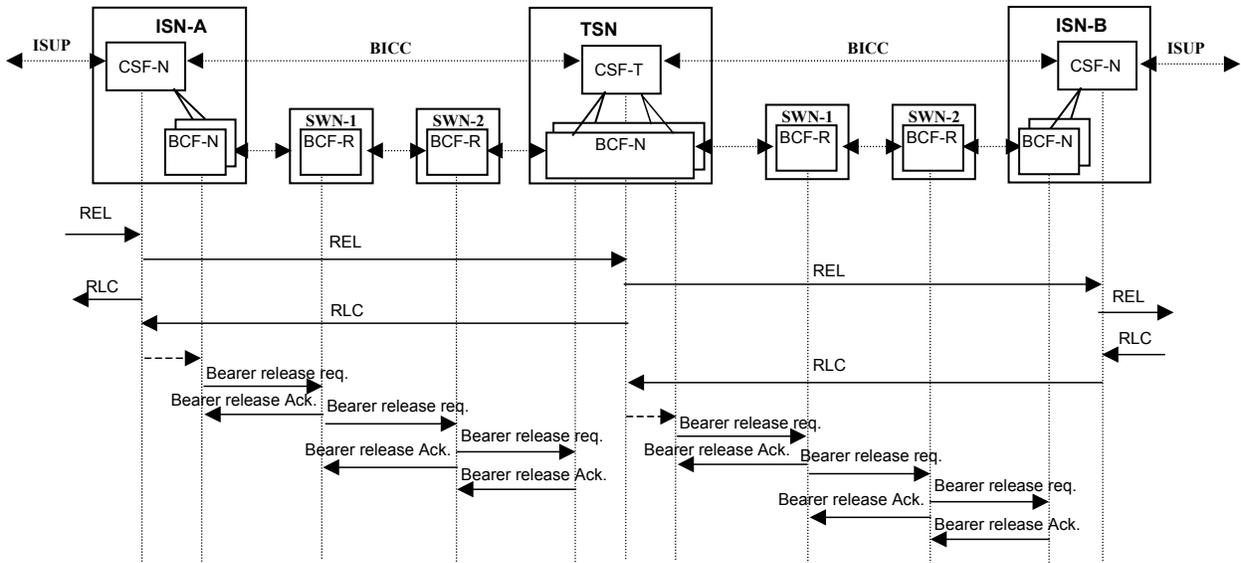


Figure I.18/T1.673.4 - Forward call and bearer release - forward bearer set-up

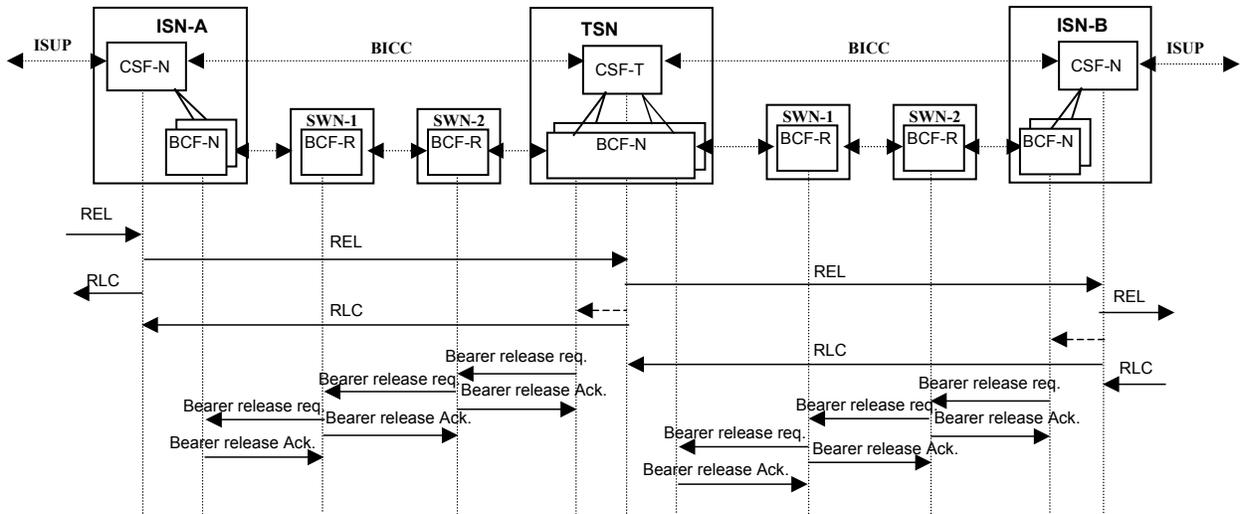


Figure I.19/T1.673.4 - Forward call and bearer release - backward bearer set-up

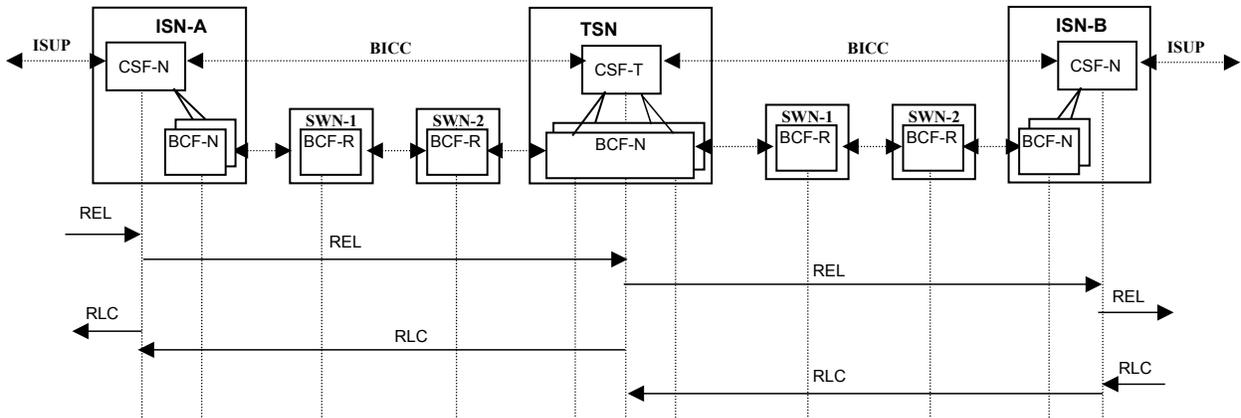


Figure I.20/T1.673.4 - Forward call release - bearers not released

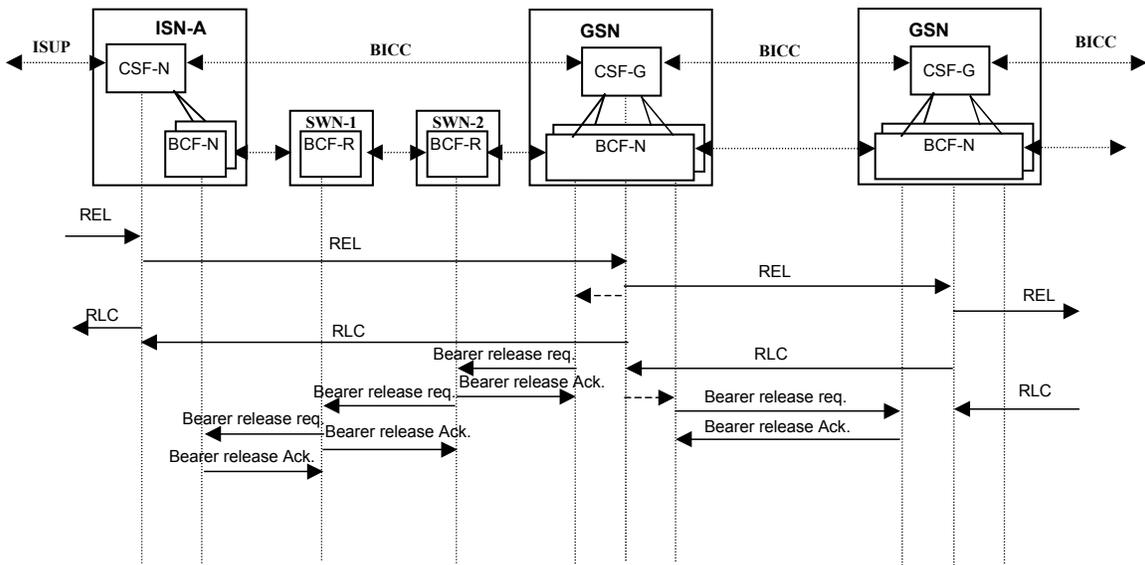


Figure I.21/T1.673.4 - Forward call and bearer release - gateway interworking between forward and backward bearer set-up

Annex J/T1.673.4

(informative)

J Generic BCF functions**J.1 Introduction**

According to the functional model, as shown in chapter T1.673.4, the BCF contains a number of discrete types of functionality. The BCF switching and bearer signaling functions are beyond the scope of this American National Standard, but this Annex describes certain procedures to be performed by the BCF that are independent of the switching functions and technology employed to provide bearers.

NOTE - This Annex is not applicable when bearer control tunneling is used.

J.2 BNC-ID

A Backbone Network Connection identifier (BNC-ID) is an identity, unique within the scope of one BCF, that identifies a Backbone Network Connection. It is exchanged between SNs for the purposes described below.

J.2.1 BNC-ID usage during call and bearer set-up

For the cases where a new bearer is set-up for a new call, using a bearer type that has a set-up protocol, the BNC-ID is:

- Allocated by the BCF at one SN, when a BCF-CSF association is instantiated;
- Sent to the adjacent SN via the BICC protocol;
- Returned to the BCF at the original SN via the bearer set-up protocol; and
- Used to identify the relevant call for the newly set-up bearer connection.

J.2.2 BNC-ID usage for idle bearer re-use procedure (Network option)

For the network option that provides for re-use of idle bearers, each BCF may manage pools of idle bearers to adjacent SNs. Within each pool there are 2 sets of bearers: those set-up (and thus “owned” by) this BCF, and those set-up by the remote BCF (and thus not “owned” by this BCF). At any moment of time, any of these pools may be non-existent or empty. The management of bearers within the pools, i.e., what bearers are in which pools, is beyond the scope of this American National Standard.

The bearers within the pools are labeled with BNC-IDs. For bearers owned by this BCF, the BNC-ID was allocated by the far BCF, and for those bearers owned by the far BCF, the BNC-ID was allocated by this BCF.

During the call set-up procedure, when a bearer is to be re-used, the BNC-ID is transferred by the BICC protocol to indicate to the remote BCF which bearer is to be re-used. A BCF can only select a bearer for re-use that it originally set-up, i.e., one that it owns.

J.2.3 BNC-ID usage for Structured AAL1 bearers

For networks that provide for the use of structured AAL1 bearers, each BCF manages pools of bearer network connections to adjacent SNs. Within each pool there are two sets of bearers: those set-up (and thus “owned”) by this BCF, and those set-up by the remote BCF (and thus not “owned” by this BCF). Both sets are further divided into subsets, each subset associated with a structured AAL1 bearer. At any moment in time any of these pools may be non-existent or empty. The management of bearers within the pools, sets, and subsets (i.e., what bearers are in which pools, sets, and subsets) is not subject to standardization.

The bearers within the pools are labeled with BNC-IDs. For bearers owned by this BCF, the BNC-ID was allocated by the far BCF, and for those bearers owned by the far BCF, the BNC-ID was allocated by this BCF.

For a bearer network connection associated with a structured AAL1 bearer, the BNC-ID is four octets long and structured as (X, n). The first three octets (X) are used to identify the structured AAL1 connection. The fourth octet (n) is used to identify a particular channel within the structured AAL1 bearer. The fourth octet is interpreted as a binary number indicating the channel within the structured AAL1 bearer. The values of 0000 0000 and 1111 1111 within the fourth octet are reserved and should not be used to indicate channels within a structured AAL1 bearer.

During the call setup procedure, when a new bearer connection is to be setup, a structured AAL1 bearer consisting of N channels is setup, N being the value coded in the fourth octet of the BNC-ID (X, N) carried in the BICC protocol. The call is associated with the BNC-ID (X, N), and the remaining (N-1) BNC-IDs are marked as corresponding to idle bearer network connections associated with the structured AAL1. In other words, the BNC-IDs (X, 1) to (X, N-1) are idle and can be used for new calls.

During the call set-up procedure, when an idle bearer network connection associated with a structured AAL1 bearer is to be re-used, the corresponding BNC-ID is transferred by the BICC protocol to indicate to the remote BCF which bearer network connection is to be re-used for the call. A BCF can only select a bearer network connection for re-use that it originally set-up (i.e., one that it owns).

J.3 Bearer release control

Under normal call handling situations, a bearer shall only be released by the BCF that originally set it up (i.e., by the BCF that “owns” the bearer). Thus, when a request to release a bearer is received from the BICC CSF procedures the BCF shall only initiate the bearer release protocol if it owns the bearer. It may also choose not to release a bearer it owns if it is determined by the BCF management function that it is needed for the re-use of idle bearer procedure. (This is a network option.) In the case of structured AAL1 bearer, the BCF shall not release the structured AAL1 bearer until such time as all of the channels associated with the structured AAL1 bearer have become idle.

Under abnormal conditions, the BICC CSF procedures can request reset of the bearer connection; in this case, the BCF shall unconditionally initiate the bearer release protocol.

J.4 BIWF Address

The BIWF Address is information exchanged between SNs to identify the address of the BCF within the BIWF at the peer SN.

J.5 BNC Characteristics

The BNC Characteristics is information exchanged between SNs to identify the selected BNC type (i.e., AAL1, Structured AAL1, or AAL2).

Annex K/T1.673.4

(informative)

K Hop counter procedure logic diagram

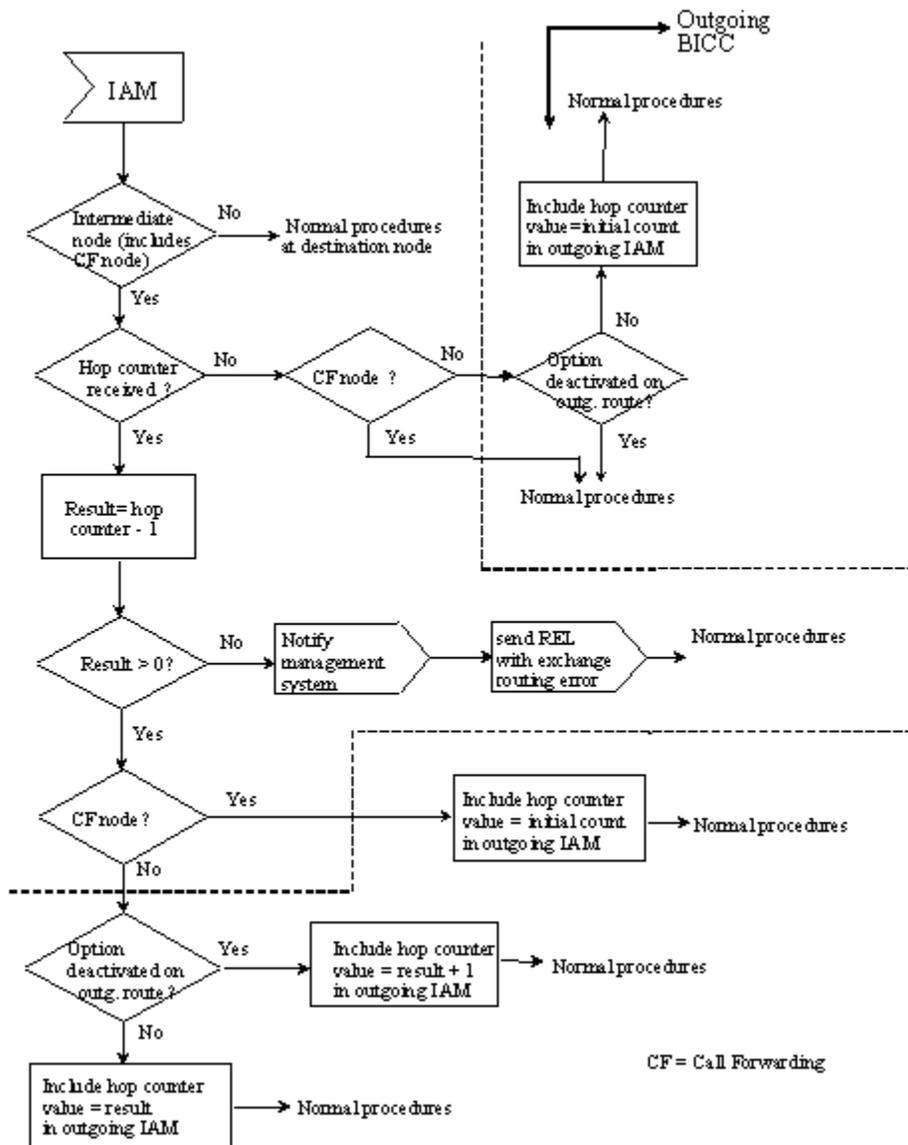


Figure K.1/T1.673.4 - Hop counter procedure logic diagram

Chapter T1.673.5

Exceptions to the Application Transport Mechanism in the Context of Bearer Independent Call Control

Table of Contents

1 SCOPE.....1

2 REFERENCES.....1

3 DEFINITIONS1

4 ABBREVIATIONS1

5 CONVENTIONS.....2

6 EXCEPTIONS TO T1.113.7.....2

 6.6.2.2.1 GENERAL MODEL.....2

 6.10.2.1 NORMAL PROCEDURES - SENDING4

 6.12 NETWORK INTERFACE FUNCTION4

Table of Figures

FIGURE 1/T1.673.5 - BICC SPECIFICATION MODEL.....3

American National Standard
for Telecommunications –

Exceptions to the Application Transport Mechanism in the Context of Bearer Independent Call Control

1 Scope

This Chapter describes exceptions to T1.113.7, *Signaling System 7 – ISDN User Part, Application Transport Mechanism*, in the context of Bearer Independent Call Control (see T1.673.1).

2 References

Refer to T1.673.1.

3 Definitions

See T1.113.7 and T1.673.1.

4 Abbreviations

AEI	Application Entity Invocation
APM	Application Transport Mechanism
ASE	Application Service Element
BAT	Bearer Association Transport
BICC	Bearer Independent Call Control
CSF	Call Service Function
EH	Errors Handling
ISUP	ISDN User Part
MTP	Message Transfer Part
NI	Network Interface
SACF	Single Association Control Function
SAO	Single Association Object
STC	Signaling Transport Converter

5 Conventions

See Chapter T1.673.1, clause 5, *Conventions*.

6 Exceptions to T1.113.7

T1.113.7 applies with the following exceptions:

- The reference to Signaling System 7 in the title is not relevant. Where the text refers to ISUP, this shall be interpreted to mean BICC.
- The subsequent subclause numbers within this clause correspond to the numbering within T1.113.7.

6.6.2.2.1 General model

BICC is an adaptation of the narrowband ISUP protocol for use in a bearer and message transport independent environment. It thus includes significantly different procedures for basic call control, compared to ISUP. It also includes an APM User for the transport of BICC specific information between peer BICC entities.

The generalised model for the ISUP Application Transport Mechanism Application Process is presented in Figure 2/T1.113.7.

In this model the application logic for the APM users are considered to be within the Nodal functions (Application Process).

The ISUP basic call procedures as described in T1.113.4 includes specification of ISUP signaling procedures and nodal functions (Application Process functions) in a monolithic way (i.e., the partitioning of functionality between the ISUP ASE and ISUP Nodal functions is not defined). T1.113.7 also does not define the functionality split for ISUP basic call.

The model from Figure 2/T1.113.7 applied on the BICC basic call is shown in Figure 1/T1.673.5.

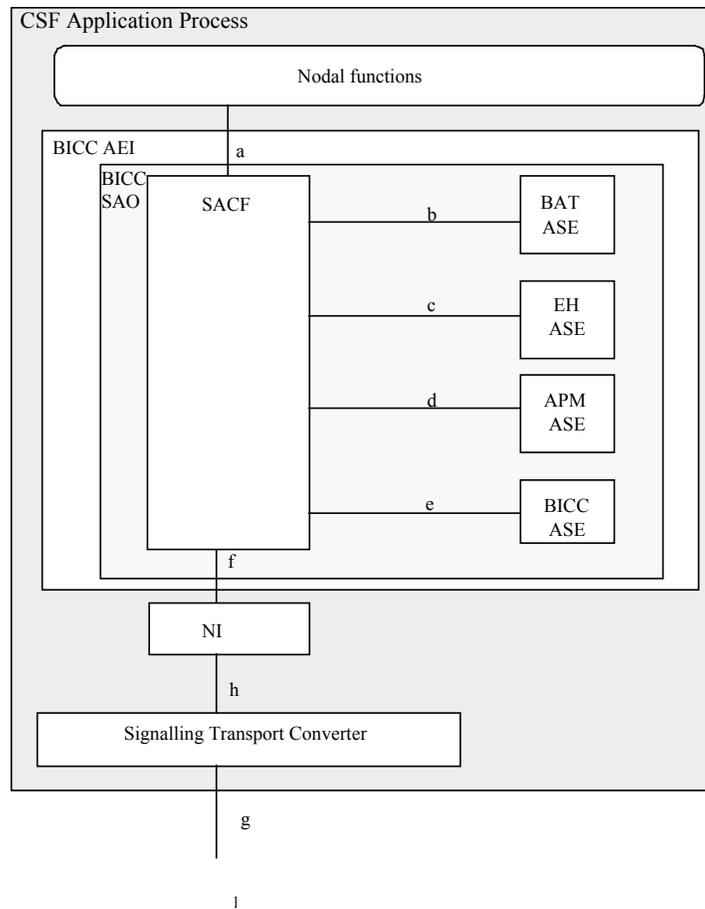


Figure 1/T1.673.5 - BICC specification model

In this model, the BAT ASE is introduced to provide the transport for the BICC data, and the ISUP ASE has been replaced by a BICC ASE. It should be noted that there is still no definition of the split of functionality between the BICC ASE and the Nodal functions. The replacement of the ISUP ASE by the BICC ASE just signifies that the BICC signaling is not the same as ISUP signaling. The BICC procedures, in so far as they are the user of the BAT ASE, should be considered as a part of the Nodal functions (in order to conform with the model expected in T1.113.7). The BICC procedures thus access the service provided by the BAT ASE by using the BICC_Data primitive at interface a.

The BICC procedures indicated by the BICC procedures block in Figure 4/T1.673.1, and described in T1.673.4, corresponds to the composite of the BICC Nodal functions (as a BAT ASE user) and the BICC ASE. No attempt is made to provide distinct descriptions of these two modeling entities.

The interface (h) is the BICC Signaling Transport Service primitive interface as specified in T1.674-2002 while interface (g) is the specific signaling transport service also described in T1.674-2002, and, in case of MTP-3 signaling transport, is the same as described in T1.113.7.

6.10.2.1 Normal procedures - Sending

T1.113.7, subclause 10.2.1, states that the 272 octet limit of the MTP is the reason that would cause APM segmentation to be invoked. This statement is applicable to BICC if the START-INFO.indication primitive received from the STC (see T1.674-2002) indicates that the underlying message transport mechanism can transport only 272 octets. However, if the transport can support greater than 272 octets, then APM segmentation is only applicable if the BICC application information exceeds the 255 octet limit imposed by the parameter formatting rules of T1.673.3.

6.12 Network Interface function

T1.113.7, clause 12, applies with the following exceptions:

1. When the text refers to MTP it shall be interpreted to mean the actual signaling transport.
2. When the text refers to CIC it shall be interpreted to mean Call Instance Code.
3. When the text refers to T1.113.3 it shall be interpreted to be a reference to T1.673.3.
4. When the text refers to T1.113.4 it shall be interpreted to be a reference to T1.673.4.
5. There is one instance of signaling transport converter per signaling route, and thus the distribution function performed by the NI acts only upon the CIC value. When the signaling transport is MTP the OPC, DPC, SIO, and SLS are handled within the MTP3/MTP3b signaling transport converter as described in T1.674-2002.
6. Primitive interface (g) shall be replaced by the primitive interface also described in T1.674-2002.

Chapter T1.673.6

Application Transport Mechanism -- Bearer Independent Call Control (BICC) CS1+

Table of Contents

1	SCOPE	1
2	NORMATIVE REFERENCES	1
3	DEFINITIONS	1
4	ABBREVIATIONS & ACRONYMS	1
5	CONVENTIONS	2
6	LAYOUT OF THIS CHAPTER	3
7	MODELING	4
7.1	NETWORK MODEL.....	4
7.2	SPECIFICATION MODEL.....	4
7.2.1	INTRODUCTION.....	4
7.2.2	GENERAL MODEL.....	5
7.2.3	SIGNALING FLOWS	6
8	BICC APPLICATION PROCESS FUNCTIONS	8
8.1	INTRODUCTION.....	8
8.2	PRIMITIVE INTERFACE (AP - BICC SACF).....	9
8.3	PRIMITIVE CONTENTS.....	9
9	SINGLE ASSOCIATION CONTROL FUNCTION (SACF) - BICC SACF	10
9.1	INTRODUCTION.....	10
9.2	INFORMATION FLOWS RELATED TO MESSAGES SENT BY THE NODE	11
9.3	INFORMATION FLOWS RELATED TO MESSAGES RECEIVED BY THE NODE.....	11
10	BAT ASE	12
10.1	PRIMITIVE INTERFACE	12
10.2	SIGNALING PROCEDURES	12
10.2.1	APPLICATION INITIATING NODE	12
10.2.1.1	SENDING PROCEDURES.....	12
10.2.1.2	RECEIVING PROCEDURES	12
10.2.1.3	APM_U_ERROR PRIMITIVE	13
10.2.2	APPLICATION ADDRESSED NODE	13
10.2.3	SIGNALING CONGESTION	13
10.3	PRIMITIVE CONTENTS.....	13
11	BICC TRANSPORT - FORMATS AND CODES OF APPLICATION DATA	14
11.1	ENCAPSULATED APPLICATION INFORMATION	14
11.1.1	GENERAL LAYOUT	14
11.1.2	LIST OF IDENTIFIERS.....	16
11.1.3	ACTION INDICATOR.....	16
11.1.4	BACKBONE NETWORK CONNECTION IDENTIFIER.....	17
11.1.5	INTERWORKING FUNCTION ADDRESS.....	18
11.1.6	CODEC LIST	18
11.1.6.1	FORMAT	18
11.1.6.2	LIST OF CODECS.....	19
11.1.7	SINGLE CODEC	19
11.1.7.1	ORGANIZATION IDENTIFIER SUBFIELD.....	19
11.1.7.2	CODEC INFORMATION SUBFIELD.....	20
11.1.7.2.1	ITU-T	20
11.1.7.2.1.1	CODEC TYPE SUBFIELD.....	20
11.1.7.2.1.2	CODEC CONFIGURATION SUBFIELD.....	20
11.1.8	BAT COMPATIBILITY REPORT.....	23
11.1.9	BEARER NETWORK CONNECTION CHARACTERISTICS	24

11.1.10	BEARER CONTROL INFORMATION.....	25
11.1.11	BEARER CONTROL TUNNELING.....	25
11.1.12	BEARER CONTROL UNIT IDENTIFIER.....	26
11.1.13	SIGNAL.....	26
11.1.14	BEARER REDIRECTION CAPABILITY.....	27
11.1.15	BEARER REDIRECTION INDICATORS.....	27
11.1.16	SIGNAL TYPE.....	28
11.1.17	DURATION.....	30
11.2	APPLICATION CONTEXT IDENTIFIER.....	30

Table of Figures

FIGURE 1/T1.673.6 - BICC NETWORK TOPOLOGY.....	4
FIGURE 2/T1.673.6 - BICC SPECIFICATION MODEL.....	5
FIGURE 3/T1.673.6.....	7
FIGURE 4/T1.673.6.....	7
FIGURE 5/T1.673.6.....	8
FIGURE 6/T1.673.6.....	8
FIGURE 7/T1.673.6 - ENCAPSULATED APPLICATION INFORMATION FIELD.....	14
FIGURE 8/T1.673.6 - LENGTH INDICATOR.....	15
FIGURE 9/T1.673.6 - COMPATIBILITY INFORMATION.....	15
FIGURE 10/T1.673.6 - ACTION INDICATOR.....	16
FIGURE 11/T1.673.6 - BACKBONE NETWORK CONNECTION IDENTIFIER.....	18
FIGURE 12/T1.673.6 - INTERWORKING FUNCTION ADDRESS.....	18
FIGURE 13/T1.673.6 - CODEC LIST.....	18
FIGURE 14/T1.673.6 - SINGLE CODEC.....	19
FIGURE 15/T1.673.6 - CODEC INFORMATION SUBFIELD.....	20
FIGURE 16/T1.673.6 - CODING FOR THE 1 OCTET LONG CONFIGURATION FIELD.....	21
FIGURE 17/T1.673.6 - BAT COMPATIBILITY REPORT.....	23
FIGURE 18/T1.673.6 - DIAGNOSTICS.....	24
FIGURE 19/T1.673.6 - BEARER NETWORK CONNECTION CHARACTERISTICS.....	24
FIGURE 20/T1.673.6 - BEARER CONTROL INFORMATION.....	25
FIGURE 21/T1.673.6 - BEARER CONTROL TUNNELING.....	25
FIGURE 22/T1.673.6 - BEARER CONTROL UNIT IDENTIFIER.....	26
FIGURE 23/T1.673.6 - SIGNAL.....	26
FIGURE 24/T1.673.6 - BEARER REDIRECTION CAPABILITY.....	27
FIGURE 25/T1.673.6 - BEARER REDIRECTION INDICATORS.....	28
FIGURE 26/T1.673.6 - SIGNAL TYPE.....	29
FIGURE 27/T1.673.6 - DURATION.....	30

Table of Tables

TABLE 1/T1.673.6 - PRIMITIVES BETWEEN AP AND BICC SACF.....	9
TABLE 2/T1.673.6 - CONTENTS OF THE BICC_DATA IND/REQ PRIMITIVE.....	10
TABLE 3/T1.673.6 - CONTENTS OF THE BICC_ERROR IND PRIMITIVE.....	10
TABLE 4/T1.673.6 - MAPPING BETWEEN BAT ASE AND APM ASE PRIMITIVES.....	11
TABLE 5/T1.673.6 - MAPPING BETWEEN AP AND BAT ASE PRIMITIVES.....	11
TABLE 6/T1.673.6 - MAPPING BETWEEN BAT ASE AND AP PRIMITIVE.....	11
TABLE 7/T1.673.6 - MAPPING BETWEEN APM ASE AND BAT ASE PRIMITIVES.....	11
TABLE 8/T1.673.6 - MAPPING BETWEEN EH ASE AND BAT ASE PRIMITIVES.....	11
TABLE 9/T1.673.6 - PRIMITIVES BETWEEN BICC SACF AND BAT ASE.....	12
TABLE 10/T1.673.6 - CONTENTS OF THE APM_U_DATA IND/REQ PRIMITIVE.....	13
TABLE 11/T1.673.6 - CONTENTS OF THE APM_U_ERROR IND PRIMITIVE.....	13
TABLE 12/T1.673.6 - LIST OF IDENTIFIERS.....	16
TABLE 13/T1.673.6 - CODING OF CONFIGURATION FIELDS.....	22

American National Standard
for Telecommunications –

Application Transport Mechanism -- Bearer Independent Call Control (BICC) CS1+

1 Scope

This Chapter describes the extensions required for the transport of bearer-related information associated with the Bearer Independent Call Control (BICC). The BICC is used to manage the call control instance that has been separated from the bearer control instance. The BICC needs to transport bearer-related information between call control instances. The Application Transport Mechanism (see T1.113.7 and T1.673.5) will be used for this purpose. This Chapter specifies the APM-user to support the transport of the bearer-related information for the BICC.

2 Normative References

ITU-T Recommendation E.182, *Application of tones and recorded announcements in telephone services*.¹

For further normative references, see T1.673.1, clause 2.

3 Definitions

Refer to T1.673.1.

4 Abbreviations & Acronyms

For the purpose of this Chapter, the following abbreviations are used:

AAL	Asynchronous Transfer Mode Adaptation Layer
AAN	Application Addressed Node
AE	Application Entity
AEI	Application Entity Invocation
AIN	Application Initiating Node
ALS	Application Level Specification

¹ This document is available from the International Telecommunications Union.
< <http://www.itu.int/ITU-T/> >

AP	Application Process
APM	Application Transport Mechanism
APM-user	Application Transport Mechanism User Application
APP	Application Transport Parameter
ASE	Application Service Element
ATII	Application Transport Instruction Indicator
BAT	Bearer Association Transport
BICC	Bearer Independent Call Control
CMN	Call Mediation Node
DTMF	Dual Tone Multi-Frequency
EH	Errors Handling
GSN	Gateway Serving Node
IAM	Initial Address Message
IP	Internet Protocol
ISDN	Integrated Services Digital Network
ISN	Interface Serving Node
ISUP	ISDN User Part
LE	Local Exchange
LSB	Least Significant Bit
M/O	Mandatory/Optional
MACF	Multiple Association Control Function
MSB	Most Significant Bit
NI	Network Interface
NNI	Network Node Interface
RTP	Real Time Transport Protocol
SACF	Single Association Control Function
SAO	Single Association Object
SCN	Switched Circuit Network
SN	Serving Node
TE	Transit Exchange
TSN	Transit Serving Node

5 Conventions

For the purpose of this Chapter, the following conventions apply:

- 1) The name of each element of the following classes of terms is capitalized:
 - Indicators;
 - Parameters;
 - Identifiers;
 - Information elements; and
 - Methods/functions.

Example: Backbone Network Connection Identifier information element.

- 2) For the name and the type of a service primitive, the following applies:
 - a) The name is capitalized; and
 - b) The type is separated from the name by "."

Example: BICC_Data.request primitive.
- 3) The definition of a parameter value is written in *italics* and is put between quotation marks.

Example: "BAT ASE"

6 Layout of this Chapter

The description of the BICC procedures in this Chapter are structured according to the model described in subclause 7.2. The description is thus divided into two main parts:

- 1) Protocol functions.
- 2) Non-protocol functions (i.e., exchange nodal functions); this is referred to as the "Application Process."

This Chapter describes only the part of the total Application Process and Protocol functions in the exchange that relates to NNI enhancements for the support of the transport of bearer-related information for BICC.

The signaling association is subdivided into three parts: Bearer Association Transport (BAT ASE), Application Transport Mechanism (APM ASE) and BICC ASE. These are coordinated by the Single Association Control Function (SACF).

The Application Process (AP) contains all Call Control functions; however, this Chapter will only describe the enhancements required to support the Bearer Independent Call Control. The Application Process relevant BICC functionality can be found in T1.673.4.

The service primitive technique, used to define the ASEs and the SACF specific to the application's signaling needs, is a way of describing how the services offered by an ASE, or SACF -- the provider of (a set) of service(s) -- can be accessed by the user of the service(s), that is, the SACF or the Application Process (AP), respectively.

The service primitive interface is a conceptual interface and is not a testable or accessible interface. It is a descriptive tool. The use of service primitives at an interface does not imply any particular implementation of that interface, nor does it imply that an implementation must conform to that particular service primitive interface to provide the stated service. All conformance to the BICC specifications is based on the external behavior at a node, i.e., on the generation of the correct message structure (as specified in T1.113.7 and T1.673.3), operation structure (as specified in this Chapter) and in the proper sequence (as specified in T1.673.4).

The structure and examples of its usage are illustrated in subclause 7.2.

The relationship between the existing ISDN network functionality and the Application Transport Mechanism service provided by the public NNI (BICC) is described as a network model in subclause 7.1.

7 Modeling

The models described in this clause introduce concepts and terminology used in this specification of the BICC use of the capability of the Application Transport Mechanism (APM).

7.1 Network model

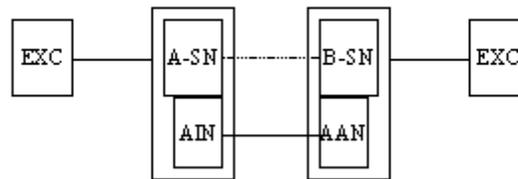


Figure 1/T1.673.6 - BICC Network Topology

This subclause provides an illustration of the use of the APM in the support of BICC. The APM provides the means to transport BICC specific information needed for the establishment of bearer connections across a core bearer network and the binding between the call control instance and the bearer control instance(s).

Figure 1/T1.673.6 shows an example of a network topology for the BICC (additional configurations are possible that include CMNs). A-SN is the incoming SN and B-SN is the outgoing SN. The SN exchanges are connected to other network exchanges (EXC) which may be ISDN exchanges within the existing narrow-band PSTN network with an ISUP interface to the SN or other SNs with a BICC interface.

The Application Initiating Node (AIN) and Application Addressed Node (AAN) concept is introduced in T1.113.7 to assist in the description of the APM. The AIN represents the point in the network where an APM-user, in this case BICC, wishes to initiate communications towards a peer APM-user. Since the APM implicit addressing mechanism (see T1.113.7) is used for the BICC, the Application Addressed Node (AAN) is the next node in the call path supporting the BAT-ASE.

The call flow examples that illustrate the use of the APM may be found in T1.673.4.

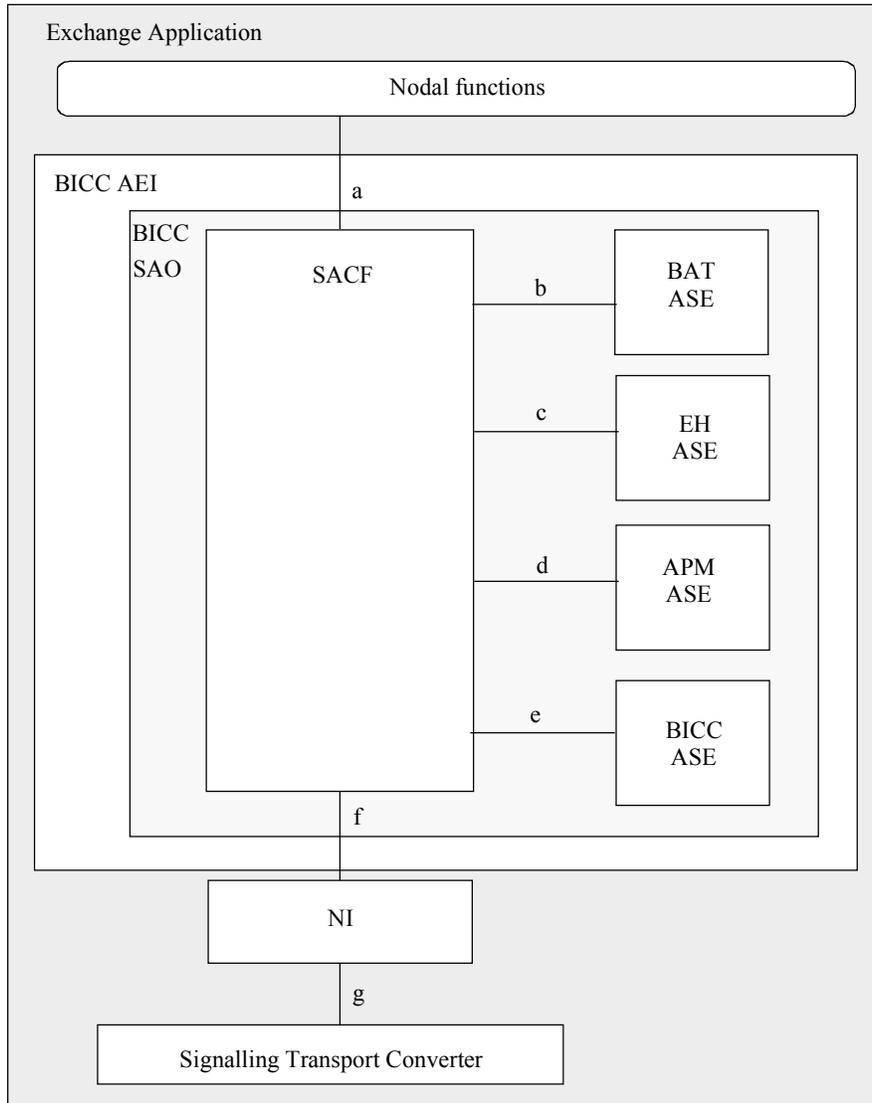
7.2 Specification model

7.2.1 Introduction

The model used to structure the description of BICC application procedures is based on the OSI Application Layer Structure (ALS) model (see ITU-T Recommendation Q.1400). This subclause presents the model, gives a general description of its operation and shows the generalized model for the "Exchange Application Process" for the support of BICC. It shows how the application makes use of the Application Transport Mechanism (APM) that is described in detail in T1.113.7 and T1.673.5.

7.2.2 General model

The generalized model for the BICC Process is shown in Figure 2/T1.673.6. This figure does not represent the situation at any specific point during a call, but instead it shows the full picture of the architecture. The specific application of this model is discussed below. Figure 2/T1.673.6 shows the primitive interfaces between the functional blocks, as used in the body of this Chapter for calls using BICC.



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Figure 2/T1.673.6 - BICC specification model

With respect to Figure 2/T1.673.6, all functions also have an interface to a "Maintenance application"; this is not defined as a formal primitive interface.

The term "Exchange Application Process" is used to describe all the Application functionality in an exchange. BICC is a part of the Exchange Application Process. Thus the BICC Nodal functions shown on the model are referred to as the BICC Application Process functions in the body of this Chapter.

The APM ASE and EH ASE are described in detail in T1.113.7 and T1.673.5.

The BICC AEI and BICC ASE are similar to the ISUP AEI and ISUP ASE. The ISUP AEI and ISUP ASE are described in detail in T1.113.7.

NOTE - Further clarifications about the BICC protocol modeling and relationships between BICC AEI, BICC ASE and ISUP AEI, ISUP ASE are given in T1.673.5.

The BAT ASE is a user of the services offered by the APM ASE. It is responsible for preparing the bearer-related information in a form that can be transported by the public Application Transport Mechanism (APM).

The SACF has the responsibility of coordinating the flow of primitives between its interfaces in the appropriate manner.

To handle any particular BICC function, the Exchange Application Process creates an instance of the required BICC Nodal functions. The AP will create instances, as required, of the BICC AEI. The Network Interface (NI) function exists to distribute messages received via the Signaling Transport Converter to the appropriate instance of the BICC AEI. There is only one instance of the NI in an exchange. The NI is described in detail in T1.113.7 and T1.673.5.

The SAO contained in the BICC AE is one of the following types:

- a) *Application Initiating Node*: This contains:
 - Outgoing BICC ASE, Initiating APM ASE, Initiating EH ASE, Outgoing BAT ASE, and BICC SACF.
- b) *Application Addressed Node*: This contains:
 - Incoming BICC ASE, Addressed APM ASE, Addressed EH ASE, Incoming BAT ASE, and BICC SACF.

7.2.3 Signaling Flows

Figure 3/T1.673.6 and Figure 4/T1.673.6 illustrate the dynamic primitive flows for a BICC call over the BICC for the case that a call control message is coincident with the application information flow. Figure 3/T1.673.6 shows the case when a message is being sent; Figure 4/T1.673.6 shows the case when a message is being received.

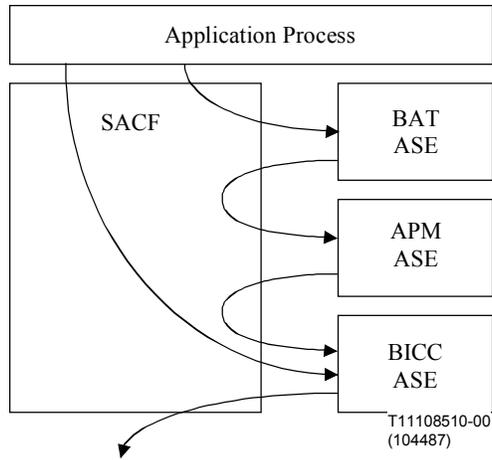


Figure 3/T1.673.6

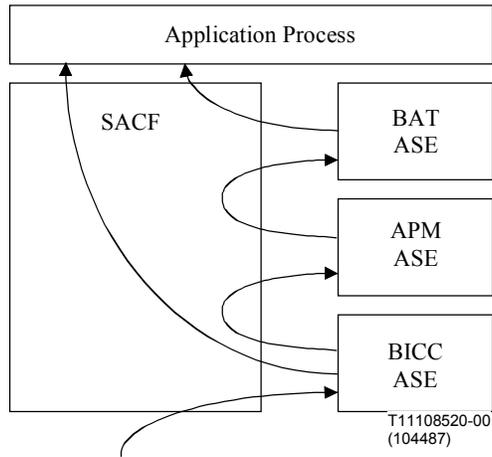


Figure 4/T1.673.6

Figure 5/T1.673.6 and Figure 6/T1.673.6 illustrate the dynamic primitive flows for the BICC support where no call control messages are sent coincidentally. That is, the APM ASE initiates a primitive towards the BICC ASE, which in turn sends an APM message that will provide a mechanism for supporting the information flows.

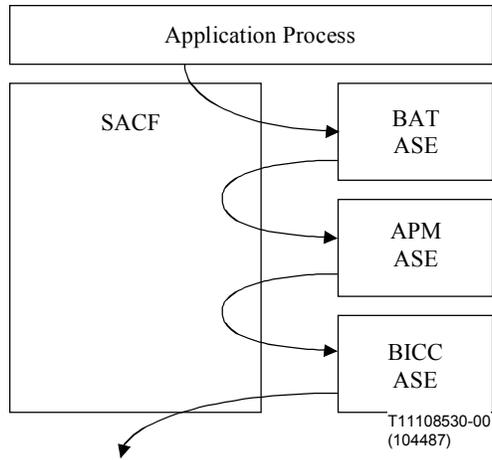


Figure 5/T1.673.6

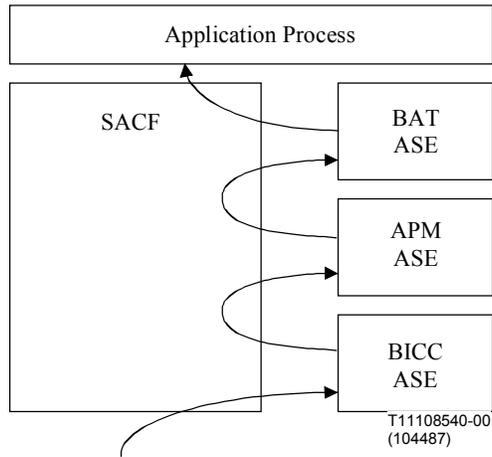


Figure 6/T1.673.6

8 BICC Application Process Functions

8.1 Introduction

The modeling of the AP is outside the scope of this Chapter. However, in order to appreciate the role of the AP for the purposes of this Chapter, this clause describes the service primitive interface between the AP and the BICC SACF.

NOTE - This Chapter specifies the APM-user to support the transport of the bearer-related information for the BICC. The Application Process functions relating to the handling of the bearer are outside the scope of this American National Standard. These AP-functions are specified in T1.673.4 and the relevant bearer specific Technical Reports.

8.2 Primitive interface (AP - BICC SACF)

The primitive interface (interface (a) in Figure 2/T1.673.6) between the AP and the BICC SACF consists of primitives required to support the public network basic call functionality, and those to support the BICC functionality. The primitives related to the public network functionality are outside the scope of this American National Standard, although references are made to them through functional inferences within the text. The public basic call (see T1.673.4) is not described using ALS concepts, hence the need for functional inferences to the public basic call functionality rather than specific references to primitives. The primitives related to the BICC functionality providing the interface between this Chapter and T1.673.4 are described in this Chapter, see Table 1/T1.673.6 and subclause 8.3.

Table 1/T1.673.6 - Primitives between AP and BICC SACF

Primitive name	Types	Direction (NOTE)
BICC_Data	Indication/Request	→/←
BICC_Error	Indication	→
NOTE - Primitive flow from SACF to AP: → Primitive flow from AP to SACF: ←		

8.3 Primitive contents

Table 2/T1.673.6 and Table 3/T1.673.6 contain the list of parameters in the primitives of Table 1/T1.673.6.

Mandatory/Optional (M/O) indications are provided as well as a reference for a detailed description of the parameters.

Table 2/T1.673.6 - Contents of the BICC_Data Ind/Req primitive

Parameter	Mandatory/Optional	Reference
ATI	M	See T1.BICC (CS1+)
Action Indicator	O	See subclause 11.1
Backbone Network Connection Identifier	O	See subclause 11.1
Interworking Function Address	O	See subclause 11.1
Codec List	O	See subclause 11.1
Single Codec	O	See subclause 11.1
BAT Compatibility Report	O	See subclause 11.1
Bearer Network Connection Characteristics	O	See subclause 11.1
Bearer Control Information	O	See subclause 11.1
Bearer Control Tunneling	O	See subclause 11.1
Bearer Control Unit Identifier	O	See subclause 11.1
Signal	O	See subclause 11.1
Bearer Redirection Capability	O	See subclause 11.1
Bearer Redirection Indicators	O	See subclause 11.1
Signal Type	O	See subclause 11.1
Duration	O	see subclause 11.1

Each parameter (except ATI) is accompanied by compatibility information, see T1.673.4 and subclause 11.1.

Table 3/T1.673.6 - Contents of the BICC_Error Ind primitive

Parameter	Mandatory/Optional	Reference
Error Notification	M	See subclauses 10.2.1.2 and 10.2.1.3

9 Single Association Control Function (SACF) - BICC SACF

9.1 Introduction

The main objective of BICC SACF is to receive/deliver primitives from/to the appropriate entity and to perform a distribution function where appropriate for the BICC AEI. The flow of information is from the AP [interface (a) in Figure 2/T1.673.6] towards NI [interface (f) in Figure 2/T1.673.6] or vice versa; therefore, the SACF is also responsible to ensure that when multiple primitives are generated by the ASEs towards the AP, they are delivered across the interface together to ensure the correct associations are maintained. The SACF described here only defines the mapping and functions related to the BICC support of BICC aspects of the model. The SACF functionality related to the public APM functionality is outside the scope of this Chapter. The mapping of primitives in Table 4/T1.673.6 and Table 7/T1.673.6 are in T1.113.7 and are included here for informative purposes only.

9.2 Information flows related to messages sent by the node

On receipt of a primitive (request or response) from the Application Process (AP) [interface (a) in Figure 2/T1.673.6], the SACF issues appropriate primitive(s) to the ASEs, populating the parameters in the generated primitives from the appropriate subset of the parameters received from the AP. The SACF also performs distribution of the responding primitives received from the ASEs prior to sending the resulting primitive to NI [interface (f) in Figure 2/T1.673.6].

Table 4/T1.673.6 - Mapping between BAT ASE and APM ASE primitives

Interface (b), from BAT ASE	Interface (d), APM ASE
APM_U_Data	APM_Data

Table 5/T1.673.6 - Mapping between AP and BAT ASE primitives

Interface (a), from AP	Interface (b), BAT ASE
BICC_Data	BICC_Data

9.3 Information flows related to messages received by the node

These procedures are described in T1.113.7, where the APM-user ASE corresponds with the BAT ASE.

Table 6/T1.673.6 - Mapping between BAT ASE and AP primitive

Interface (b), BAT ASE	Interface (a), from AP
BICC_Data	BICC_Data
BICC_Error	BICC_Error

Table 7/T1.673.6 - Mapping between APM ASE and BAT ASE primitives

Interface (d), from APM ASE	Interface (b), BAT ASE
APM_Data	APM_U_Data

Table 8/T1.673.6 - Mapping between EH ASE and BAT ASE primitives

Interface (c), from EH ASE	Interface (b), BAT ASE
APM_Error	APM_U_Error

10 BAT ASE

The BAT ASE is responsible for preparing the information in the appropriate form that can be passed to the APM for transportation.

10.1 Primitive interface

Table 9/T1.673.6 lists the primitive interface between the BAT ASE and BICC SACF [interface (b) in Figure 2/T1.673.6].

Table 9/T1.673.6 - Primitives between BICC SACF and BAT ASE

Primitive name	Types	Direction (NOTE)
APM_U_Data	Indication/Request	→/←
APM_U_Error	Indication	→
BICC_Error	Indication	←
BICC_Data	Indication/Request	←/→
NOTE - Primitive flow from SACF to BAT ASE: → Primitive flow from BAT ASE to SACF: ←		

10.2 Signaling procedures

10.2.1 Application Initiating Node

10.2.1.1 Sending procedures

On reception of the BICC_Data.request primitive, its contents are prepared in the appropriate format and the Context identifier value is set to "BAT ASE." The result is sent in the APM_U_Data.request primitive.

10.2.1.2 Receiving procedures

On reception of the APM_U_Data.indication primitive, its contents are checked for correct format and coding.

If an information element passes this check, it is added to the BICC_Data.indication primitive.

If an information element fails this check, the information element and the related problem report (indicating "*unrecognized information*") is added to the BICC_Error.indication primitive.

NOTE - If the top level information element is of "constructor" type, then it is handled as a single entity.

Once all information elements have been analysed, the BICC_Data.indication primitive and/or the BICC_Error.indication primitive shall be sent.

10.2.1.3 APM_U_Error Primitive

On reception of the APM_U_Error.indication primitive, the contents should be passed unchanged in the BICC_Error primitive.

10.2.2 Application Addressed Node

See subclause 10.2.1.

10.2.3 Signaling congestion

In order to avoid congestion in the signaling network, it is necessary that applications that contribute signaling load towards a congested destination limit their signaling traffic in a controlled manner. The congestion control procedures are outside the scope of this document. Refer to T1.673.4.

10.3 Primitive contents

Table 10/T1.673.6 and Table 11/T1.673.6 list the mandatory and optional contents for the BAT ASE service primitives. These primitives are defined in T1.113.7 and are included here for informative purposes only.

The contents of the BICC_Error and BICC_Data primitives defined at the AP/SACF interface (Table 1/T1.673.6) are described in subclause 8.3.

Mandatory/Optional (M/O) indications are provided.

NOTE - In the context of BAT, implicit addressing is used, see T1.113.7 and T1.673.4.

Table 10/T1.673.6 - Contents of the APM_U_Data Ind/Req primitive

Parameter	Mandatory/Optional
Application Context Identifier	M
Application Transport Instruction Indicators	M
Application Data	M

Table 11/T1.673.6 - Contents of the APM_U_Error Ind primitive

Parameter	Mandatory/Optional
Notification	M

11 BICC Transport - Formats and codes of application data

11.1 Encapsulated Application Information

11.1.1 General layout

The general layout of the Encapsulated Application Information field of the Application Transport parameter (see T1.113.7 and T1.673.4) is shown in Figure 7/T1.673.6.

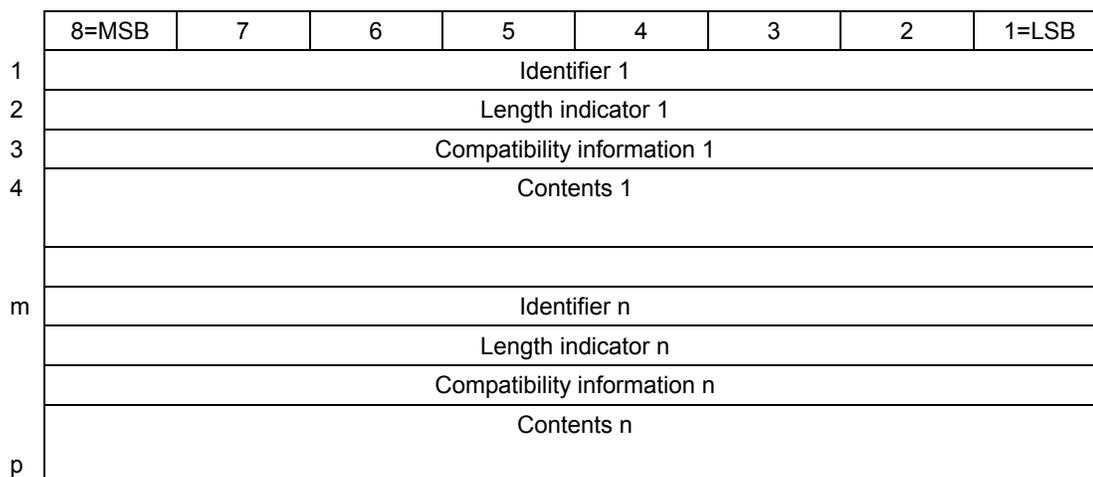


Figure 7/T1.673.6 - Encapsulated Application Information field

Each information element within the Encapsulated Application Information field has the same structure. An information element consists of four fields which always appear in the following order: Identifier (one octet), Length indicator, Compatibility information, and Contents.

The *Identifier* distinguishes one type from another one and governs the interpretation of the contents. There are two types of Identifiers: type "constructor," and type "simple." In case of "constructor," the Contents field shall again consist of one or more information elements, each of which is structured as described above (i.e., Identifier, Length indicator, Compatibility information, Contents). In case of "simple," the Contents field contains one value only.

When passing on an information element of type "constructor," the order of the information elements within this "constructor" shall be maintained.

The *Length indicator* specifies the length (i.e., integral number of octets in pure binary representation) of the Compatibility information and Contents. The length does not include the Identifier, nor the Length indicator. The format of the Length indicator is shown in Figure 8/T1.673.6. Bit 8 is defined as Extension indicator and indicates whether or not the information on the length continues through the next octet. Value "0" of the Extension indicator means "*information continues through the next octet*," while value "1" means "*last octet*." The Length indicator itself has a maximum length of 2 octets (i.e., if octet 1a is needed, the Extension indicator of octet 1a is always set to value "1").

	8	7	6	5	4	3	2	1
1	Ext.							LSB
1a	Ext.=1	0	0	0	MSB			

Figure 8/T1.673.6 - Length indicator

The *Compatibility information* contains corresponding instructions for the case that the received information element is unrecognized. The format of this field is shown in Figure 9/T1.673.6.

	8	7	6	5	4	3	2	1	
	Ext	pass-on not possible			reserved	general action			Octet 1
		send notification indicator	instruction indicator			send notification indicator	instruction indicator		

Figure 9/T1.673.6 - Compatibility information

The following codes are used in the subfields of the Compatibility information field.

- a) Bits 2, 1 Instruction indicator for general action
 - 00 Pass on information element
 - 01 Discard information element
 - 10 Discard BICC data
 - 11 Release call
- b) Bit 3 Send notification indicator for general action
 - 0 Do not send notification
 - 1 Send notification
- c) Bit 4: reserved
- d) Bits 6,5 Instruction indicator for pass-on not possible
 - 00 Release call
 - 01 Discard information element
 - 10 Discard BICC data
 - 11 reserved (interpreted as 00)
- e) Bit 7 Send notification indicator for pass-on not possible
 - 0 Do not send notification
 - 1 Send notification
- f) Bit 8: Extension indicator
 - 0 Information continues through the next octet
 - 1 Last octet

The *Contents* field is the substance of the element and contains the information the element is intended to convey.

11.1.2 List of Identifiers

Table 12/T1.673.6 contains the list of Identifiers.

The use and the meaning of these information elements are bearer specific and are specified in the relevant Technical Report.

Table 12/T1.673.6 - List of Identifiers

Value	Information Element Name	Type	Reference
0000 0000	Spare	-	-
0000 0001	Action Indicator	simple	11.1.3
0000 0010	Backbone Network Connection Identifier	simple	11.1.4
0000 0011	Interworking Function Address	simple	11.1.5
0000 0100	Codec List	constructor	11.1.6
0000 0101	Single Codec	simple	11.1.7
0000 0110	BAT Compatibility Report	simple	11.1.8
0000 0111	Bearer Network Connection Characteristics	simple	11.1.9
0000 1000	Bearer Control Information	simple	11.1.10
0000 1001	Bearer Control Tunneling	simple	11.1.11
0000 1010	Bearer Control Unit Identifier	simple	11.1.12
0000 1011	Signal	constructor	11.1.13
0000 1100	Bearer Redirection Capability	simple	11.1.14
0000 1101	Bearer Redirection Indicators	simple	11.1.15
0000 1110	Signal Type	simple	11.1.16
0000 1111	Duration	simple	11.1.17
0001 0000 to 1101 1111	ITU-T spare	-	-
1110 0000 to 1110 1111	ANSI spare	-	-
1111 0000 to 1111 1111	Reserved for network specific use (note)	-	-

NOTE - Code points marked as “reserved for network specific use” should be assigned in descending order.

11.1.3 Action Indicator

The format of the Action Indicator is shown in Figure 10/T1.673.6.

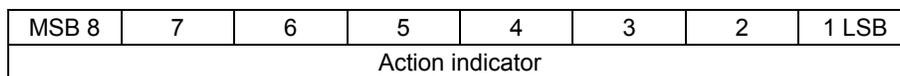


Figure 10/T1.673.6 - Action Indicator

The following codes are used in the Action Indicator field:

0000 0000		no indication
0000 0001		connect backward
0000 0010		connect forward
0000 0011		connect forward, no notification
0000 0100		connect forward, plus notification
0000 0101		connect forward, no notification + selected codec
0000 0110		connect forward, plus notification + selected codec
0000 0111		use idle
0000 1000		connected
0000 1001		switched
0000 1010		selected codec
0000 1011		modify codec
0000 1100		successful codec modification
0000 1101		codec modification failure
0000 1110		mid-call codec negotiation
0000 1111		modify to selected codec information
0001 0000		mid-call codec negotiation failure
0001 0001		start signal, notify
0001 0010		start signal, no notify
0001 0011		stop signal, notify
0001 0100		stop signal, no notify
0001 0101		start signal acknowledge
0001 0110		start signal reject
0001 0111		stop signal acknowledge
0001 1000		bearer redirect
0001 1001	}	
to	}	ITU-T spare
1101 1111	}	
1110 0000	}	
to	}	ANSI spare
1110 1111	}	
1111 0000	}	
to	}	reserved for network specific use (Note)
1111 1111	}	

NOTE - Code points marked as "reserved for network specific use" should be assigned in descending order.

11.1.4 Backbone Network Connection Identifier

The format of the Backbone Network Connection Identifier is shown in Figure 11/T1.673.6.

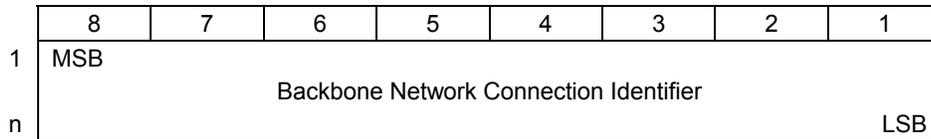


Figure 11/T1.673.6 - Backbone Network Connection Identifier

The contents of the Backbone Network Connection Identifier is bearer specific and is specified in the relevant Technical Report. The maximum length of this field is 4 octets.

11.1.5 Interworking Function Address

The format of the Interworking Function Address is shown in Figure 12/T1.673.6.

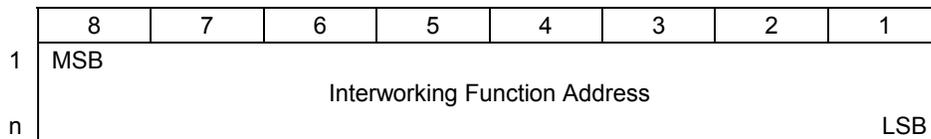


Figure 12/T1.673.6 - Interworking Function Address

The Interworking Function Address is in NSAP format according to Annex A of ITU-T Recommendation X.213 and its Amendment 1.

NOTE - Other formats may be defined in bearer specific documents in future.

11.1.6 Codec List

11.1.6.1 Format

The format of the Codec List is shown in Figure 13/T1.673.6.

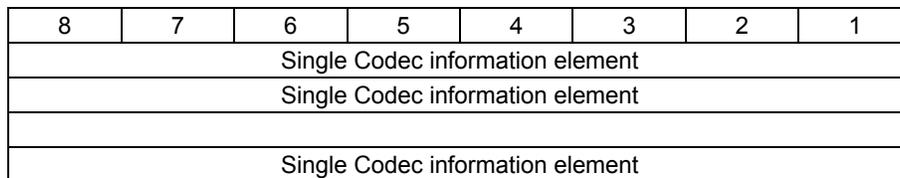


Figure 13/T1.673.6 - Codec List

The Single Codec information element is specified in subclause 11.1.7.

11.1.6.2 List of codecs

Figure 13/T1.673.6 shows the layout of the Codec List for codec negotiation. The Single Codec information elements are listed in decreasing order of preference level. The first Single Codec information element has the highest preference level, and the last Single Codec information element is the one with the lowest preference level.

11.1.7 Single Codec

The Single Codec information element for a specific codec is coded as a variable length field with the following subfields:

- OID - Organization identifier subfield - (1 octet): Identifies standardization/private organizations;
- Codec Information subfield.

Figure 14/T1.673.6 illustrates the layout of the Single Codec information element.

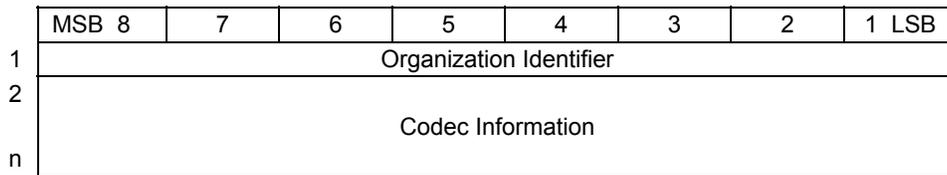


Figure 14/T1.673.6 - Single Codec

11.1.7.1 Organization Identifier subfield

The following codes are used for the Organization Identifier subfield:

00000000	no indication
00000001	ITU-T
00000010	ETSI (refer to TS 26.103)
00000011	}
to	}
00100001	}
00100010	}
to	}
11011111	}
11100000	}
to	}
1110 1111	}
1111 0000	}
to	}
11111111	}

NOTE - Code points marked as “reserved for network specific use” should be assigned in descending order.

11.1.7.2 Codec Information subfield

11.1.7.2.1 ITU-T

The format of the Codec Information subfield in case of Organization ID = ITU-T is shown in Figure 15/T1.673.6.

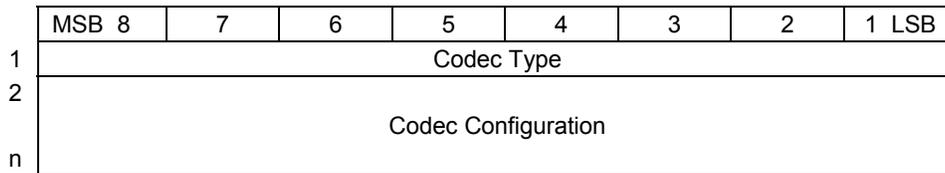


Figure 15/T1.673.6 - Codec Information subfield

11.1.7.2.1.1 Codec Type subfield

The following codes are used for the Codec Type subfield:

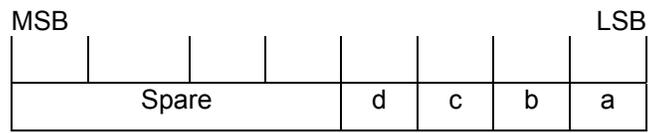
00000000	no indication
00000001	G.711 64 kbit/s A-law
00000010	G.711 64 kbit/s μ -law
00000011	G.711 56 kbit/s A-law
00000100	G.711 56 kbit/s μ -law
00000101	G.722 (SB-ADPCM)
00000110	G.723.1
00000111	G.723.1 Annex A (silence suppression)
00001000	G.726 (ADPCM)
00001001	G.727 (Embedded ADPCM)
00001010	G.728
00001011	G.729 (CS-ACELP)
00001100	G.729 Annex B (silence suppression)
00001101	} ITU-T spare
to	
11111111	}

11.1.7.2.1.2 Codec Configuration subfield

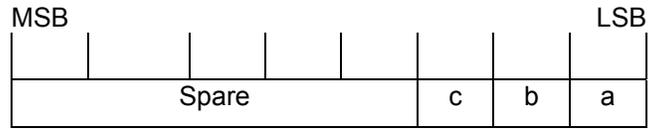
There are no configuration data in the case of ITU-T codec types G.711, G.722 and G.723.1.

ITU codecs G.726, G.727, G.728 and G.729 (with and without silence suppression) may operate at different bit rates. Common implementations of these codecs can operate in all the modes (bit rates) and switch from one mode to another upon command in a per frame basis (through in-band signaling). Therefore, the configuration field is optional for all aforementioned codec types. The configuration field is present when it is required to signal that only one or several modes of operation out of the full set are supported. The configuration field is not present if all the modes of operation of the codec are supported (the general case).

Figure 16/T1.673.6 and Table 13/T1.673.6 show the configuration data coding for each of the aforementioned codecs.



a) G.726 and G.727 codec types



b) G.728, G.729 and G.729 Annex B codec types

Figure 16/T1.673.6 - Coding for the 1 octet long configuration field

Table 13/T1.673.6 - Coding of configuration fields

Codec Type		Configuration Data	
		d c b a	
00001000	G.726	x x x 1	16 kbps supported
		x x x 0	16 kbps not supported
		x x 1 x	24 kbps supported
		x x 0 x	24 kbps not supported
		x 1 x x	32 kbps supported
		x 0 x x	32 kbps not supported
		1 x x x	40 kbps supported
		0 x x x	40 kbps not supported
00001001	G.727	x x x 1	16 kbps supported
		x x x 0	16 kbps not supported
		x x 1 x	24 kbps supported
		x x 0 x	24 kbps not supported
		x 1 x x	32 kbps supported
		x 0 x x	32 kbps not supported
		1 x x x	40 kbps supported
		0 x x x	40 kbps not supported
00001010	G.728	x x 1	9.6 kbps supported
		x x 0	9.6 kbps not supported
		x 1 x	12.8 kbps supported
		x 0 x	12.8 kbps not supported
		1 x x	16 kbps supported
		0 x x	16 kbps not supported
00001011	G.729	x x 1	6.4 kbps supported
		x x 0	6.4 kbps not supported
		x 1 x	8 kbps supported
		x 0 x	8 kbps not supported
		1 x x	11.8 kbps supported
		0 x x	11.8 kbps not supported
00001100	G.729 Annex B	x x 1	6.4 kbps supported
		x x 0	6.4 kbps not supported
		x 1 x	8 kbps supported
		x 0 x	8 kbps not supported
		1 x x	11.8 kbps supported
		0 x x	11.8 kbps not supported

Each one of the a, b, c, and d bits corresponds to one mode of operation (bit rate) for the codec. A value of "1" means that the mode is supported, a value of "0" that the mode is not supported and a value of "x" stands for "irrelevant."

11.1.8 BAT Compatibility Report

The format of the BAT Compatibility Report is shown in Figure 17/T1.673.6.

	MSB 8	7	6	5	4	3	2	1 LSB
1	Report reason							
2	Diagnostics							
n								

Figure 17/T1.673.6 - BAT Compatibility Report

a) *Report Reason*

The following report reasons are defined:

00000000	no indication
00000001	information element non-existent or not implemented
00000010	BICC data with unrecognized information element, discarded
00000011	}
to	{ ITU-T spare
11011111	}
11100000	}
to	{ ANSI spare
1110 1111	}
1111 0000	}
to	{ reserved for network specific use (note)
11111111	}

NOTE - Code points marked as "reserved for network specific use" should be assigned in descending order.

b) *Diagnostics*

Figure 18/T1.673.6 shows the format of the diagnostics.

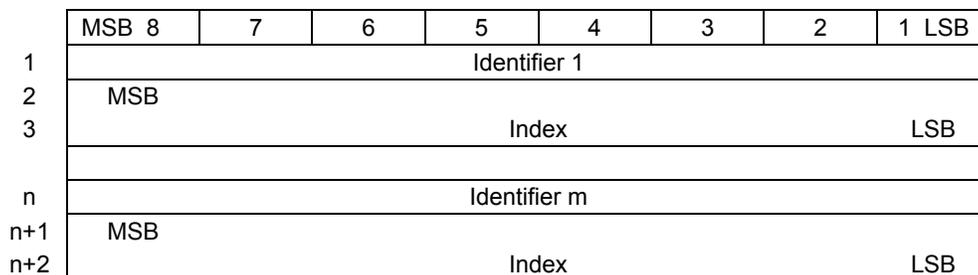


Figure 18/T1.673.6 - Diagnostics

The field "Identifier n" contains the Identifier value of the nth upgraded information element in accordance with Table 12/T1.673.6. The field "Index" has a fixed length of 2 octets and is a pointer (integral number of octets in pure binary representation) either to the Identifier value of the information element concerned or to an information element identifier octet within the information element concerned.

If an unrecognized Identifier value x is received, "Identifier n" contains this Identifier value x, and the value of "Index" is "0."

If an information element x of type "simple" is received which is recognized but its contents are unrecognized, the "Identifier n" contains the Identifier value of this information element x, and the value of "Index" is "0."

If an information element x of type "constructor" is received which is recognized but its contents are unrecognized (i.e., either unrecognized Identifier value or unrecognized contents of a recognized information element), the "Identifier n" contains the Identifier value of this information element x, and the value of "Index" is a pointer to the Identifier value octet of the information element which is unrecognized or whose contents are unrecognized. The value of "Index" is "1" plus the number of octets between the Constructor information element identifier octet and the unrecognized information element identifier octet, not including either information element identifier octet.

11.1.9 Bearer Network Connection Characteristics

The format of the Bearer Network Connection Characteristics is shown in Figure 19/T1.673.6.

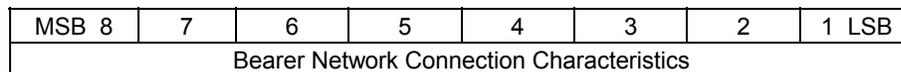


Figure 19/T1.673.6 - Bearer Network Connection Characteristics

The following codes are used in the Bearer Network Connection Characteristics:

- 00000000 no indication
- 00000001 AAL type 1
- 00000010 AAL type 2
- 00000011 Structured AAL 1
- 00000100 IP/RTP
- 00000101 }

```

to      }      ITU-T spare
11011111 }
11100000 }
to      }      ANSI spare
1110 1111 }
1111 0000 }
to      }      reserved for network specific use (note)
11111111 }
    
```

NOTE - Code points marked as “reserved for network specific use” should be assigned in descending order.

11.1.10 Bearer Control Information

The format of the Bearer Control Information is shown in Figure 20/T1.673.6.

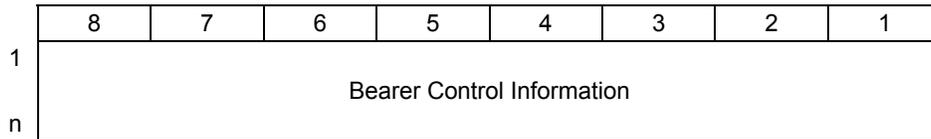


Figure 20/T1.673.6 - Bearer Control Information

The Bearer Control Information information element contains the bearer control tunneling protocol data unit, see T1.677-2001.

11.1.11 Bearer Control Tunneling

The format of the Bearer Control Tunneling is shown in Figure 21/T1.673.6.

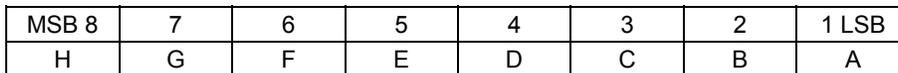


Figure 21/T1.673.6 - Bearer Control Tunneling

```

Bit   A:   Bearer Control Tunneling indicator
        0   no indication
        1   tunneling to be used
Bits  H-B:  spare
    
```

The Bearer Control Tunneling indicator (bit A) signals that bearer control tunneling is to be used.

11.1.12 Bearer Control Unit Identifier

The Bearer Control Unit Identifier information element contains information sent in the forward and backward direction to aid Bearer Interworking Function selection by the Call Service Function. A Bearer Interworking Function may consist of one or more Bearer Control Units (BCUs) where a BCU represents a physical grouping.

The definition of the Network ID subfield is the same as for the Network ID of the Global Call Reference parameter (see T1.673.3).

The Local BCU-ID subfield is an identifier that uniquely identifies a BCU entity within a network domain.

The format of the Bearer Control Unit Identifier is shown in Figure 22/T1.673.6.

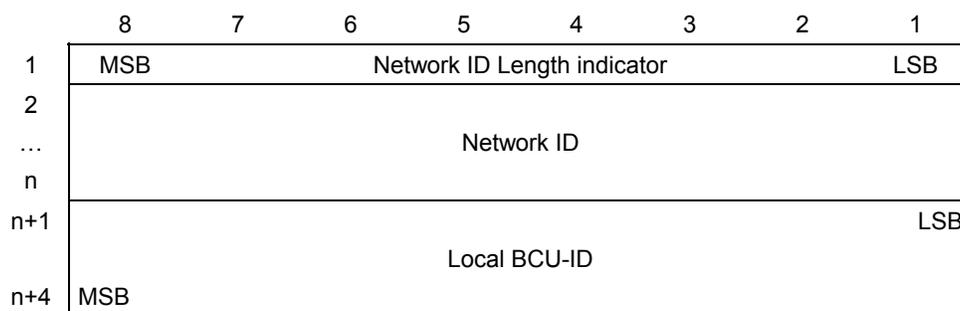


Figure 22/T1.673.6 - Bearer Control Unit Identifier

The following codes are used in the Bearer Control Unit Identifier:

- 1) *Network ID Length indicator*: The Network ID Length indicator specifies the length (i.e., integral number of octets in pure binary representation) of the Network ID subfield. The length does not include the Network ID Length indicator.
- 2) *Network ID*: The coding of the Network ID field is identical to the coding of the Network ID field in the Global Call Reference parameter as specified in T1.673.3.
 NOTE - When used inside a network domain, the Network ID may be omitted by setting the Network ID Length indicator to the value "0".
- 3) *Local BCU-ID*: A binary number that uniquely identifies the BCU within a network domain.

11.1.13 Signal

The format of the Signal is shown in Figure 23/T1.673.6.

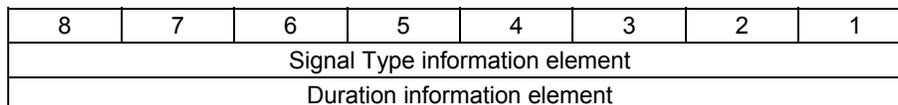


Figure 23/T1.673.6 - Signal

The Signal Type information element is specified in subclause 11.1.16, and the Duration information element is specified in subclause 11.1.17.

The Signal information element containing the Signal Type information element is mandatory if and only if the Action indicator is set to the value "start signal, notify" or "start signal, no notify." The purpose of the Signal Type information element is to convey a value for a single signal. Optionally the duration of the signal may be specified in the Duration information element (i.e., the Signal information element may contain the Signal Type information element only).

The duration of the signal can be controlled:

- Implicitly by a sequence of messages with the Action indicator set to "start signal, notify"/"start signal, no notify" and "stop signal, notify"/"stop signal, no notify";
- Implicitly by the signal itself; or
- Explicitly by a message with the Action indicator set to "start signal, notify"/"start signal, no notify" accompanied by a Signal information element containing the Signal Type information element and the Duration information element indicating the duration. In this case, no Action indicator with "stop signal, notify"/"stop signal, no notify" is sent by the originator. If a notification has been requested in the Action indicator, an Action indicator set to "start signal acknowledge" or "start signal reject" is sent back (i.e., there is no additional notification for the end of the signal).

11.1.14 Bearer Redirection Capability

The Bearer Redirection Capability information element contains information sent in the forward direction at call setup to indicate that the sending node supports Bearer Redirection, and to indicate support of options within the capability.

The format of the Bearer Redirection Capability is shown in Figure 24/T1.673.6.

MSB 8	7	6	5	4	3	2	1 LSB
Ext.	G	F	E	D	C	B	A

Figure 24/T1.673.6 - Bearer Redirection Capability

- Bit A: *Late Cut-through capability indicator*
 0 Late Cut-through not supported
 1 Late Cut-through supported
- Bits G-B: spare
- Bit H: *Extension indicator*
 0 Information continues through the next octet
 1 *Last octet*

11.1.15 Bearer Redirection Indicators

The Bearer Redirection Indicators information element contains information sent in the forwards or backwards direction relating to the bearer redirection procedure.

The format of the Bearer Redirection Indicators is shown in Figure 25/T1.673.6.

The format of the Bearer Redirection Indicators information element is not of type "constructor" but consists of a sequence of octets, each with the same format, allowing several indicator values to be included in a single information element, as follows:

	8	7	6	5	4	3	2	1
1	Bearer Redirection Indicator							
2	Bearer Redirection Indicator							
...								
N	Bearer Redirection Indicator							

Figure 25/T1.673.6 - Bearer Redirection Indicators

The number of the Bearer Redirection Indicator octets is derived from the length indication of the Bearer Redirection Indicators information element.

The following codes are used in the Bearer Redirection Indicator:

0000 0000		no indication
0000 0001		late cut-through request
0000 0010		redirect temporary reject
0000 0011		redirect backwards request
0000 0100		redirect forwards request
0000 0101		redirect bearer release request
0000 0110		redirect bearer release proceed
0000 0111		redirect bearer release complete
0000 1000		redirect cut-through request
0000 1001		redirect bearer connected indication
0000 1010		redirect failure
0000 1011		new connection identifier
0000 1100	}	
to	}	ITU-T spare
0111 1111	}	
1000 0000	}	
to	}	ANSI spare
1011 1111	}	
1100 0000	}	
to	}	reserved for network specific use (note)
1111 1111	}	

NOTE - Code points marked as "reserved for network specific use" should be assigned in descending order.

11.1.16 Signal Type

The format of the Signal Type is shown in Figure 26/T1.673.6.

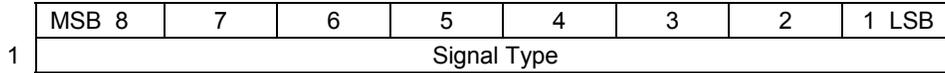


Figure 26/T1.673.6 - Signal Type

The following codes are used in the Signal Type:

0000 0000	DTMF 0
0000 0001	DTMF 1
0000 0010	DTMF 2
0000 0011	DTMF 3
0000 0100	DTMF 4
0000 0101	DTMF 5
0000 0110	DTMF 6
0000 0111	DTMF 7
0000 1000	DTMF 8
0000 1001	DTMF 9
0000 1010	DTMF *
0000 1011	DTMF #
0000 1100	DTMF A
0000 1101	DTMF B
0000 1110	DTMF C
0000 1111	DTMF D
0001 0000	} to }
0011 1111	} } ITU-T spare
0100 0000	dial tone
0100 0001	PABX internal dial tone
0100 0010	special dial tone
0100 0011	second dial tone
0100 0100	ringing tone
0100 0101	special ringing tone
0100 0110	busy tone
0100 0111	congestion tone
0100 1000	special information tone
0100 1001	warning tone
0100 1010	intrusion tone
0100 1011	call waiting tone
0100 1100	pay tone
0100 1101	payphone recognition tone
0100 1110	comfort tone
0100 1111	tone on hold
0101 0000	record tone
0101 0001	caller waiting tone
0101 0010	positive indication tone
0101 0011	negative indication tone
0101 0100	}

```

to      }      ITU-T spare
1101 1111 }
1110 0000 }
to      }      ANSI spare
1110 1111 }
1111 0000 }
to      }      reserved for network specific use (note 1)
1111 1111 }
    
```

NOTE 1 - Code points marked as “reserved for network specific use” should be assigned in descending order.

NOTE 2 - The signals 0100 0000 to 0101 0011 are defined in ITU-T Recommendation E.182.

NOTE 3 - The use of out-of-band transport of the value 0100 0100 “ringing tone” may cause speech clipping due to a race condition between out-of-band stop “ringing tone” and in-band speech.

11.1.17 Duration

The format of the Duration is shown in Figure 27/T1.673.6.

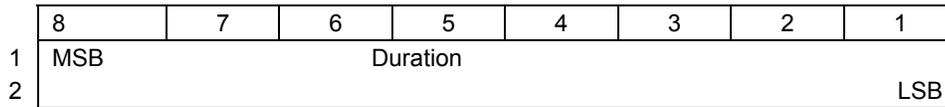


Figure 27/T1.673.6 - Duration

The Duration contains the duration of the signal (see subclause 11.1.16) in milliseconds.

11.2 Application Context Identifier

The Application Context Identifier field of the Application Transport parameter (see T1.113.7 and T1.673.4) shall be coded "BAT ASE."

Chapter T1.673.7

Bearer Independent Call Control Protocol -- Performance Objectives in the BICC Application

American National Standard
for Telecommunications –

Bearer Independent Call Control Protocol -- Performance Objectives in the BICC Application

T1.113.5-2000 applies, with the exception that the number of circuits in a user signaling relationship (T1.113.5, clause 5.1.2) is changed to refer to the number of call control associations in a signaling relationship, which is 2^{32} .