ATIS-1000672.2000(R2015)

Bearer Independent Call Control (BICC)

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ATIS-1000672.2000(R2015), *Bearer Independent Call Control (BICC)*

Is an American National Standard developed by the **Signaling, Architecture, and Control (SAC)** Subcommittee under the **ATIS Packet Technologies and Systems Committee (PTSC)**.

American National Standard for Telecommunications

Bearer Independent Call Control (BICC)

Foreword (This foreword is not part of American National Standard T1.672–2000)

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 signalling message transport technology used.

This standard is based on T1.113–2000, *Signalling System Number 7—Integrated Services Digital Network (ISDN) User Part.* This standard is written as a set of exceptions to the text of T1.113-2000 and is suitable for anticipated needs and applications within and between U. S. networks. These specifications are the result of extensive work by the members of the T1S1.3 working group on Common Channel Signalling.

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.

The overall and detailed organization of individual chapters of this standard parallels that used in T1.113-2000. This standard contains seven chapters. The first six chapters of this standard detail the exceptions for BICC to the corresponding chapters of T1.113-2000. Chapter 7 of this standard describes use of the Application Transport Mechanism (APM), specified in T1.113.7-2000, by BICC.

This standard is intended for use in conjunction with *American National Standard for Telecommunications—Signalling System No. 7 (SS7)—General Information*, ANSI T1.110–1999.

There are 9 annexes in this standard. Chapter 1 contains one informative annex. Chapter 4 contains five 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 1

Functional Description of the
Bearer Independent Call Control (BICC) Protocol

1   Scope

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 signalling message transport technology used.

This standard is written as a set of exceptions to T1.113-2000. In some cases these exceptions are displayed by quoting the original text of T1.113-2000 with revision marks. (Deleted text is shown using strikeouts, and added text is shown underlined.)

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.

Three types of Serving Node (SN) are defined:

- Interface Serving Node (ISN) –Provides an interface to circuit switched networks.

- Transit Serving Node (TSN) –Provides transit functionality, for call and bearer, within one network using the BICC protocol.

- Gateway Serving Node (GSN) –Provides inter-network gateway functionality, for call and bearer, using the BICC protocol.

The main body of this document defines the protocol at Transit Serving Nodes and Gateway Serving Nodes. The scope is thus as shown in Figure 1/T1.672.1.
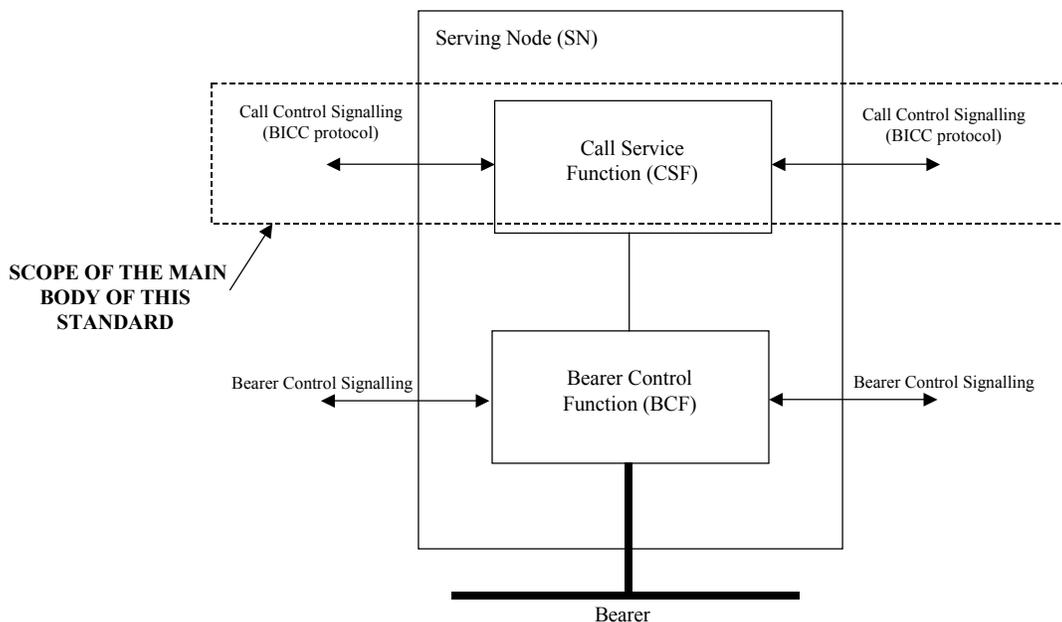
Figure 1/T1.672.1 - Scope of this Standard

In defining the procedures for BICC at an Interface Serving Node, this standard also defines how BICC interworks with other protocols. These descriptions are contained in Annex E/T1.672.4 to this standard.

This standard also contains Annex H/T1.672.4, of relevance to a Call Mediation Node, where call control functions may reside without any bearer control capability.

2   Normative References

The following standards, and other references contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards and other references are subject to revision; all users of this standard are therefore encouraged to investigate the possibility of applying the most recent edition of the standards and other references listed below.

T1.113-2000, *American National Standard for Telecommunications – Signaling System Number 7 (SS7) – Integrated Services Digital Network (ISDN) User Part*.[1]

ITU-T Recommendation Q.115 (1997) – *Logic for the Control of Echo Control Devices*.[2]

T1.111-2000, *American National Standard for Telecommunications – Signaling System Number 7 (SS7) – Message Transfer Part (MTP)*.[1]

T1.637-1999, *American National Standard for Telecommunications – B-ISDN ATM Adaptation Layer - Service Specific Connection Oriented Protocol (SSCOP)*.[1]

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[1] T1 standards are available from the Alliance for Telecommunications Industry Solutions < http://www.atis.org >.

[2] ITU-T recommendations are available from the ITU Telecommunication Standardization Sector < http://www.itu.int/ITU-T/publications/index.html >.

ITU-T Recommendation Q.2111 (12/99)– *Service Specific Connection Oriented Protocol in a Multi-link and Connectionless Environment (SSCOPMCE).*[2]

ITU-T Recommendation Q.1400 (1993) – *Architecture framework for the development of signaling and OA&M protocols using OSI concepts.*[2]

ITU-T Recommendation X.213 (11/1995) – *Information technology – Open system interconnection - Network service definition plus Amendment 1 (8/1997), Addition of the Internet protocol address format identifier.*[2]

3   Definitions

3.1   Bearer Control Function (BCF): Four types of BCF are defined; BCF-N, BCF-T, BCF-G and BCF-R.   The BCF-N, BCF-T and BCF-G provide the control of the bearer switching function, the communication capability with its associated Call Service Function (CSF), and the signalling capability necessary for the establishment and release of the bearer to its peer. The BCF-R provides the control of the bearer switching function and relays the bearer control signalling requests to next BCF in order to complete the end-to-end bearer control signalling action. The BCF is not within the scope of this standard.

3.2   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 (SN). A BIWF contains one BCF.

3.3   Call Mediation Node (CMN): A functional entity which provides CSF functionality without an associated BCF entity.

3.4   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 narrow-band service by inter-working with narrowband and bearer independent signalling, signalling to its peer CSF the characteristics of the call, and invoking the Bearer Control Nodal Functions (BCF-N) necessary to transport the narrow-band 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 2/T1.672.1), and its associated bearer by relaying signalling between CSF peers and invoking the Bearer Control Transit Functions (BCF-T) necessary to transport the narrow-band 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 signalling between CSF peers and invoking the Bearer Control Gateway Functions (BCF-G) necessary to transport the narrow-band 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 signalling between CSF peers. The CSF-C has no association with any BCF. It is only a call control function.

3.5 **Constructor:** An information element type, the contents of which consists of other information elements, as described in T1.672.7.

3.6 **Gateway Serving Node (GSN):** A functional entity which provides gateway functionality between two network domains. This functional entity contains the call service function (CSF-G), and one or more bearer inter-working functions (BIWF). GSNs interact with other GSNs, in other backbone network domains and other ISNs and TSNs within its own backbone network domain.

3.7 **Interface Serving Node (ISN):** A functional entity which provides the interface with SCNs. This functional entity contains the call service nodal function (CSF-N), and one or more bearer inter-working functions (BIWF) which interact with the Switched Circuit Network (SCN) and its peers within the backbone network.

3.8 **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.

3.9 **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.

3.10 **Signalling 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 standard.

3.11 **Serving Node (SN):** A functional entity that is either an ISN, a GSN, or a TSN.

3.12 **Signalling 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.

3.13 **Simple:** An information element type, as described in T1.672.7.

3.14 **Switching Node (SWN):** A functional entity which provides the switching functions within the backbone core network. This functional entity contains a BCF-R. SWNs interact with other SWNs and BIWFs, within their own backbone network domain.

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

3.16 **Transit Serving Node (TSN):** A functional entity which provides transit functionality between two ISNs. This functional entity contains the call service function (CSF-T), and supports one or more bearer inter-working functions (BIWF). TSNs interact with other TSNs, GSNs and ISNs within their own backbone network domain.

4   Abbreviations & Acronyms

AA	ATM Adaption
AAL	ATM Adaptation Layer
AAL1	ATM Adaptation Layer Type 1
AAL2	ATM Adaptation Layer Type 2
AAN	Application Addressed Node
AEI	Application Entity Invocation
AIN	Application Initiating Node
ALS	Application Layer Structure
AP	Application Process
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-N	Bearer Control Nodal Function
BCF-R	Bearer Control Function – Relay Function
BCF-T	Bearer Control Transit Function
BICC	Bearer Independent Call Control
B-ISUP	Broadban ISDN User PArt
BIWF	Bearer Inter-Working Function
BNC	Backbone Network Connection
BNC-ID	Backbone Network Connection Identifier
BR	Buffer Release
CIC	Circuit Identification Code (ISUP) or Call Instance Code (BICC)
CLLI	COMMON LANGUAGE Location Identification[3]
CMN	Call Mediation Node
CPCS	Common Part Convergence Sublayer
CSF	Call Service Function
CSF-C	Call Service Coordination Function
CSF-G	Call Service Gateway Function
CSF-N	Call Service Nodal Function

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[3] COMMON LANGUAGE is a registered tradmark and CLLI is a trademark of Telcordia Technologies, Inc.

CSF-T	Call Service Transit Function
CSI	Carrier Selection Information
DPC	Destination Point Code
DPC	Destination Point Code
DS0	Digital Signal, Level 0
DSS2	Digital Subscriber Signalling System Number 2
EH	Errors Handling
EXC	Exchange
GAP	Generic Address Parameter
GSN	Gateway Serving Node
ISDN	Integrated Services Digital Network
ISN	Interface Serving Node
ISUP	ISDN User Part
LSB	Least Significant Bit
M/O	Mandatory/Optional
MLPP	Multi-Level Precedence and Pre-emption
MSB	Most Significant Bit
MTP	Message Transfer Part
MTP	Message Transfer Part
MTP3	Message Transfer Part level 3 (Narrow-band)
MTP3b	Message Transfer Part level 3 (Broadband)
MU	Message Unit
NI	Network Indicator (in SIO), or Network Interface (in specification model)
NNI	Network-to-Network Interface
OA&M	Operations, Administration, & Maintenance
OID	Organization Identifier
OPC	Originating Point Code
OPC	Originating Point Code
OSI	Open Systems Interconnection
PDU	Protocol Data Unit
PLMN	Public Land Mobile Network
PSTN	Public Switched Telephone Network
SAAL	Signalling ATM Adaption Layer
SACF	Single Association Control Function
SAM	Subsequent Address Message
SAO	Single Association Object

SAP	Service Access Point
SCCP	Signalling Connection Control Part
SCN	Switched Circuit Network
SDU	Service Data Unit
SI	Service Indicator
SIO	Service Information Octet
SIO	Service Information Octet
SLS	Signalling Link Selection
SLS	Signalling Link Selection Code
SMH	Signalling Message Handling
SN	Serving Node
SS7	Signalling System Number 7
SSCOP	Service Specific Connection Oriented Protocol (T1.637-1999)
SSCOPMCE	Service Specific Connection Oriented Protocol in a multi-link or Connectionless Environment (Q.2111)
SSCOP-UU	SSCOP user-to-user information
SSCS	Service Specific Convergence Sublayer
STC	Signalling Transport Converter
STL	Signalling Transport Layers
SWN	Switching Node
TAR	Temporary Alternative Routing
TE	Terminal Equipment
TSN	Transit Serving Node
TTB	Temporary Trunk Blocking
UDI-TA	Unrestricted Digital Information with Tones & Announcement
USI	User Service Information

NOTE – Table 2/T1.113.2 lists acronyms for names of ISUP/BICC messages.

5   Conventions

1. The name of each element of the following classes of terms is capitalized:

    - Indicators;

    - Parameters;

    - Identifiers;

    - Information elements;

    - Messages; and

- Methods/functions.

Examples: Called Party Number parameter, Initial Address message, Backbone Network Connection Identifier information element.

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."

4. For the name and the type of a service primitive, the following applies:

- The name is capitalized; and

- The type is separated from the name by "."

Example: BICC_Data.request primitive.

NOTE - Where the text has been imported from other standards then the conventions of this standard do not automatically apply.

6 Architecture

6.1 Network model

Figure 2/T1.672.1 shows the complete functional model of a network using the BICC protocol for call control signalling.

Signalling Transport Network

Bearer Control Signalling

Call Control Signalling

Backbone Network Connections

Network Bearer Connection (end to end)

Backbone Network Connection Link

Bearer Interworking Function (BIWF)

TE

ISDN-B

ISN-B CSF-N BCF-N

SWN-4 BCF-R

CMN CSF-C

Note

SWN-3 BCF-R

GSN CSF-G BCF-G

GSN CSF-G BCF-G

SWN-2 BCF-R

TSN CSF-T BCF-T

SWN-1 BCF-R

ISN-A CSF-N BCF-N

ISDN-A

TE

Figure 2/T1.672.1 - Network Functional model

NOTE - The functionality of the CMN is described in informative Annex H/T1.672.4.

6.2   Protocol model

Figure 3/T1.672.1 shows the protocol model adopted for this standard.
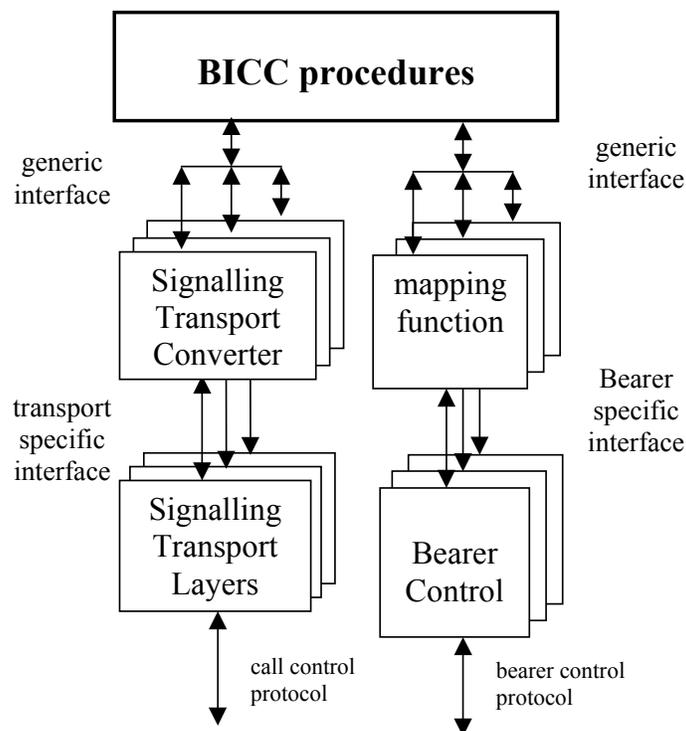
Figure 3/T1.672.1 - Protocol model

The protocol aspects of the functional model in Figure 2/T1.672.1 are provided by the elements of the protocol model in Figure 3/T1.672.1:

- 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 3/T1.672.1. The other functions included in the BCF element, e.g. control of switching functions, are not shown in Figure 3/T1.672.1.

- Where the BICC description refers to sending/receiving bearer signalling events to/from the BCF, this relates to use of the generic interface to the mapping function block in Figure 3/T1.672.1.

- Where the BICC description refers to sending/receiving BICC messages, this relates to the use of the generic interface to the Signalling Transport Converter, described in Annex B/T1.672.4.

6.3   Document structure

This standard describes procedures that are generally relevant to the BICC protocol, independent of the bearer technology employed. This is the block labelled BICC procedures in Figure 3/T1.672.1. It also uses the generic interface to the blocks labelled Mapping Functions and Signalling Transport Converter (STC).

The blocks in Figure 3/T1.672.3 labelled Mapping Function are defined in additional publications[4] that are to be provided for each bearer technology to describe specific adaptation for that technology.

The blocks in Figure 3/T1.672.3 labelled Signalling Transport Converter are defined in the Annexes of T1.672.4 which describe the general and transport specific issues relating to the STC.

The following clauses of this standard describe the BICC protocol as a series of exceptions to T1.113-2000.

7   Exceptions to T1.113.1-2000

7.1   General

The BICC protocol is an adaptation of the ISUP protocol definition, but it is not peer to peer compatible with ISUP.

The BICC protocol does include the compatibility mechanism of ISUP and a similar mechanism within the BICC Application Transport Mechanism (APM) user application. Thus:

1. Peer to peer compatibility of versions of BICC can be assured, as described for ISUP in T1.113.1-2000, clause 5.

2. The compatibility mechanism at a Serving Node (ISN/TSN/GSN) acts as at an ISUP exchange, and thus the introduction of BICC into a network using ISUP signalling does not degrade the ability to introduce new signalling versions into the network. e.g., an ISN receiving an unrecognised ISUP parameter will handle it according to T1.113.4-2000, clause 2.9.5 compatibility rules, passing it on to BICC if required.

7.2   Forward and Backward Compatibility for the BICC APM user application

BICC uses an APM user application to transfer signalling information. Thus, in order to provide forward and backward compatibility within BICC, a compatibility mechanism is introduced for the information elements transferred by this mechanism.

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 signalling information.

The compatibility method eases the network operation, for example:

- For the typical case of a BICC signalling protocol mismatch during a network upgrading;

- To interconnect two networks at different functional levels; and

- For networks using different subsets of the same BICC protocol, etc.

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[4] See Bibliography in Annex A/T1.672.1-2000.

NOTE - A node may be at a different functional level due to having implemented a different capability set or another subset of the protocol specified in this standard.

7.2.1 Backward compatibility rules

Compatible interworking between protocol capability sets should be optimised by adhering to the following rules when specifying a new capability set:

1. Existing protocol elements, i.e., procedures, information elements and subfield values, 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 an information element, or of a field and subfield within an information element should not be changed.

3. Established rules for formatting and encoding information elements should not be modified.

7.2.2 Forward compatibility mechanism

Compatibility between this and future capability sets will be guaranteed, in the sense that any two capability sets can be interconnected directly with each other, and the following requirements are fulfilled:

1. *Protocol compatibility*: Calls between any two BICC protocols do not fail for the reason of not satisfying protocol requirements.

2. *Service and functional compatibility*: This feature may be considered as compatibility typically between end nodes. Services and functions available at these nodes, but possibly not yet taken into account in the intermediate nodes, are supported, provided that information related to these services and functions can be passed transparently through intermediate nodes.

3. *Resource control and management compatibility*: For these functions, occurring only link-by-link, at least a backward notification may be needed, if correct handling is not possible.

7.3 Primitive interface to the signalling transport service

The BICC protocol uses the STC layer for message transport, and thus clause 3 of T1.113.1-2000 and Table 1/T1.113.1-2000 are replaced by the generic transport interface as described in Annex B/T1.672.4.

7.4 End-to-end signalling

BICC use of the end-to-end method using Signalling Connection Control Part (SCCP) is only applicable when an Message Transfer Part (MTP)-based STC is available.

Annex A/T1.672.1

(Informative)

Annex A/T1.672.1   Bibliography

T1.TR.69-2001, *Signalling Requirements for the support of Narrowband services via Broadband transport technologies.*[5]

T1.TR.63-2000, *Operation of the BICC protocol with Digital Subscriber Signalling System No. 2 (DSS2).*[5]

T1.TR.64-2000, *Operation of the BICC protocol with AAL Type 2 signalling protocol (CS1).*[5]

T1.TR.65-2000, *Operation of the BICC protocol with Broadband Integrated Services Digital Network User Part (B-ISUP) protocol for AAL1 Adaptation.*[5]

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[5] T1 Techincal Reports are available from the Alliance for Telecommunications Industry Solutions < http://www.atis.org >.

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Chapter 2
General Function of Messages and Signals

1   Scope, Purpose, and Application

This chapter describes the elements of signaling information used by the 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 T1.672.3 and T1.672.4. The BICC messages and signals are as described in T1.113.2-2000 with the exceptions listed in clause 2.

2   Exceptions to T1.113.2-2000

> NOTE – References within this clause are to T1.113.2-2000.

(*General*: in the descriptions of messages and parameters, replace "circuit" with "CIC value.")

1. Blocking message, clause 1.3, is not used.

2. Blocking Acknowledgement message, clause 1.4, is not used.

3. Circuit Reservation message, clause 1.11C, is not used.

4. Circuit Reservation Acknowledgement message, clause 1.11D, is not used.

5. Circuit Validation Response message, clause 1.11E, is not used.

6. Circuit Validation Test message, clause 1.11F, is not used.

7. Continuity message (COT), clause 1.14, BICC does not use COT to indicate the successful result of a continuity check on the current leg of the call, but it is used to indicate successful completion of the continuity check on a preceding ISUP circuit and/or successful setting up of the bearer on a preceding BICC leg of the call.

8. Continuity Check Request message, clause 1.15, is not used.

9. Loop Back Acknowledgement message, clause 1.25A, is not used.

10. Unblocking message, clause 1.37, is not used.

11. Unblocking Acknowledgement message, clause 1.38, is not used.

12. Circuit Assignment Map parameter, clause 2.27D, is not used.

13. Circuit Group Characteristics Indicator parameter, clause 2.27C, is not used.

14. Circuit Identification Name parameter, clause 2.30A, is not used.

15. Circuit Group Supervision Message Type Indicator parameter, clause 2.29, can only indicate "maintenance" blocking.

16. Circuit Validation Response Indicator parameter, clause 2.30C, is not used.

17. Common Language Location Identification (CLLI) Code parameter, clause 2.33B, is not used.

18. Continuity Indicators parameter, clause 2.36A, does not indicate successful completion of the continuity check on the current leg of the call, but indicates successful completion of the continuity check on a preceding ISUP circuit, and/or successful setting up of the bearer on a preceding BICC leg of the call.

19. Hop Counter parameter, clause 2.43E. Replace "ISUP interexchange circuits" by "call control associations."

20. Circuit Identification Code, clause 2.30, is used by BICC to indicate the instance of call control signaling, i.e., it is the "Call Instance Code."

21. Continuity Check indicator, clause 2.35, is not used to indicate that a continuity check will be performed on the current leg of the call but it is used to indicate that a Continuity message can be expected as a result of a continuity check on a preceding ISUP circuit, or establishment of a preceding BICC connection.

22. Routing Label, clause 2.66, is not passed from BICC to the MTP. If BICC is deployed on an MTP3 or MTP3b signalling transport service, the Routing Label is provided by the STC sublayer. See the description of the relevant STC in Annex C.

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Chapter 3
Formats and Codes

1   Scope, Purpose, and Application

The BICC formats and codes are as described in T1.113.3-2000 with the exceptions listed in clause 2.

2   Exceptions to T1.113.3-2000

2.1   Message format

The format of the message at the BICC to STC interface is according to T1.113.3-2000 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 Figure 2/T1.113.3 is modified as shown in Figure 1/T1.672.3. (CIC being the acronym for Call Instance Code, in the context of BICC)

	8	7	6	5	4	3	2	1
1				CIC				LSB
2				CIC				
3				CIC				
4	MSB			CIC				
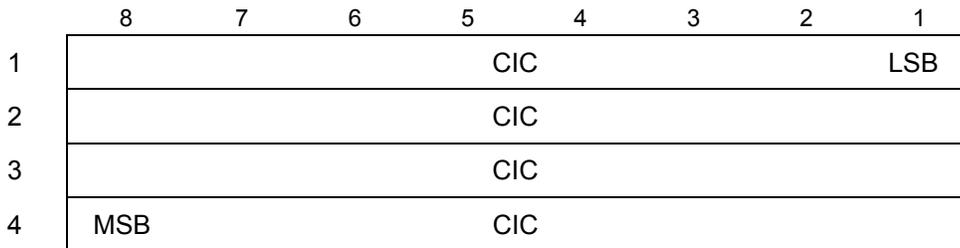
Figure 1/T1.672.3 – CIC field

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

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 Reservation message is not used.

4. Circuit Reservation Acknowledgement message is not used.

5. Circuit Validation Response message is not used.

6. Circuit Validation Test message is not used.

7. Continuity Check Request message is not used.

8. Loop Back Acknowledgement message is not used.

9. Unblocking message is not used

10. Unblocking Acknowledgement message is not used.

2.4   Parameters

NOTE – References within this clause are to T1.113.2-2000.

T1.113.3-2000 parameter definitions apply with the following exceptions:

1. The value "*block with immediate release"* of the Circuit Group Blocking Type indicator in the Circuit Group Supervision Message Type parameter, clause 3.11, is not used.

2. The value "*continuity check required on this circuit"* of the Continuity Check indicator in the Nature of Connection Indicators parameter, clause 3.24, is not used.

3. The Circuit Assignment Map parameter, clause 3.10B is not used.

4. Circuit Group Characteristics Indicator parameter, clause 3.10A, is not used.

5. Circuit Identification Name parameter, clause 3.11A, is not used.

6. Circuit Validation Response Indicator parameter, clause 3.11C, is not used.

7. CLLI Code parameter, clause 3.13A, is not used.

8. Outgoing Trunk Group Number Parameter, clause 3.26B. Generation of this parameter within a BICC network is for further study. However, this parameter may be mapped from ISUP to BICC, or generated in BICC, at an ISN with incoming BICC and outgoing ISUP interface.

9. Range and Status parameter, 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.

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Signalling Procedures for Bearer Independent Call Control (BICC)

1 Scope, Purpose, and Application

1.1 Relationship with other Signalling System 7 (SS7) specifications

This chapter describes the basic signaling procedures for set-up and clear-down of national and international connections. The messages and signals are defined in T1.672.2-2000 and their format and content are given in T1.672.3-2000. This chapter also includes generic procedures for supplementary services. Service-specific procedures for supplementary services are contained in separate American National Standards (see T1.672.1-2000)

The procedures for BICC are the same as those specified for ISUP in T1.113.4-2000 with the exception of additions, modifications, or deletions enumerated in this chapter. This chapter uses the same headings as T1.113.4-2000.

This chapter may contain requirements that reference other American National Standards. If so, when the American National Standards referenced in the requirements are superseded by revisions approved by the American National Standards Institute, Inc, the revisions shall apply. Unless otherwise noted, references within this chapter are to clauses of T1.113.4-2000.

1.2 Numbering

Clause 1.2 applies.

1.3 Address signalling

Clause 1.3 applies.

1.4 Basic procedures

Clause 1.4 applies with the following clarification/exception:

- References to ISDN terminals and access protocols are not applicable.

1.4A Signalling methods

Clause 1.4A applies.

1.5 Layout of chapter T1.672.4

The procedures specified in clause 2 of this chapter relate to basic calls (i.e., calls not involving supplementary services). Clause 3 of this chapter specifies the procedures relating to end-to-end

signalling connections. Generic procedures for supplementary services are specified in clause 4A of this chapter. The additional requirements to be met in the case of calls involving supplementary services and network utilities are specified in separate American National Standards.

1.6 Interworking with other signalling systems or user parts

Interworking between BICC and ISUP is documented in Annex E/T1.672.4-2000.

1.7 Exceptions to T1.113.4-2000

1.7.1   General

1.7.1.1 Use of CIC field

Unlike T1.113.4-2000 where the signalling procedures are applicable to call and/or circuit control, the signalling procedures in this American National Standard are applicable to call control and its co-ordination with bearer control. The services of the bearers, unlike the exchange-to-exchange physical "circuits" in the SCN, are invoked via bearer-specific control protocols.

The role of the mandatory signalling information ("Circuit Identification Code"), is central to the ISUP procedures. The following paragraphs clarify its role (as "Call Instance Code") in the BICC protocol.

The CIC in ISUP, in conjunction with the Originating Point Code (OPC)/Destination Point Code (DPC)/Network Indicator (NI) combination, serves the following purposes:

1. Identification of the physical circuits.

2. Identification of the signalling relation between the peer ISUP entities and association of all signalling messages to that relation.

The role of the CIC in the BICC protocol is the second purpose only. The size of the CIC field is increased to 4 octets to eliminate the size restriction resulting from the CIC defined in ISUP.

As the OPC/DPC/NI information is not seen in BICC (only in the STC for MTP), the CIC is significant per BICC signalling association (i.e., per STC instance).

For BICC, the number of CIC values being provisioned for any particular signalling association shall indicate the maximum number of per-call signalling relations between the BICC peer entities.

1.7.1.2 Use of Application Transport Mechanism

This clause describes how BICC uses the transport mechanism defined in T1.672.7-2000.

The BICC procedures require transfer of information between peer SNs. The Bearer Association Transport (BAT) Application Transport Mechanism Application Service Element (BAT APM 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/T1.672.4 - 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.

1.7.1.2.1   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 exchange.

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

1.7.1.2.2   Handling of Addressing Information

Implicit addressing shall be used (see T1.113.7-2000).

1.7.1.2.3   Exceptional procedures

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 *"unrecognised information,"* the Compatibility procedure in 1.7.1.2.4 applies.

1.7.1.2.4   Compatibility for the BICC APM user application

1.7.1.2.4.1   General requirements on receipt of unrecognised signalling information

It may happen that a node receives unrecognised signalling information, i.e., information element types or subfield values. This can typically be caused by the upgrading of the signalling system used by other nodes in the network. In these cases the following compatibility procedures are invoked to ensure predictable network behaviour.

All BAT information elements include a compatibility field as specified in T1.672.7.

The procedures to be used on receipt of unrecognised 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 unrecognised information element, discarded."*

For the above Report Reasons a Diagnostic field is included identifying the unrecognisedinformation elements.

The procedures are based on the following assumptions:

1. Since nodes can be both national and international nodes, the compatibility mechanism is applicable to the national and international network.

2. If a node receives a BAT Compatibility Report information element indicating an unrecognised information element received, it assumes interaction with a node supporting a different functional level.

When an unrecognised 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 unrecognised information elements and the other to indicate what to do when an unrecognised information element can not 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 unrecognised information.

d) If the instruction indicator is set to *"pass-on,"* the unrecognised information element is passed to the signalling association on the other side of the SN for this call. If the ability to *"pass-on"* is not possible at a SN, 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 unrecognised information element, it is possible for the instruction to require that either the unrecognised information element or all the information elements relating to the received Application Transport Parameter (APP) containing the information element is 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.

1.7.1.2.4.2   Procedures for the handling of unrecognised information elements

1.7.1.2.4.2.1   Unrecognised information elements

Unrecognised information elements are received via the BICC_Error indication primitive, indicating *"unrecognised information."*

Unexpected information element(s), received via the BICC_Data indication primitive are handled like unrecognised information elements.

Depending on the instructions received in the Information Element Compatibility Information field, a node receiving an unrecognised 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 unrecognised information element being referred to.

In case b), the BAT Compatibility Report information element shall include the Report Reason *"BICC data with unrecognised information element, discarded,"* followed by a Diagnostic field containing the Information Element Identifier (of the first detected unrecognised information element which caused the primitive to be discarded) and the Index subfield.

The Index subfield shall be coded to contain a pointer to the unrecognised Information Element Identifier octet. Thus:

1. For a "Simple" information element, see T1.672.7, 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 recognised, but is coded with an octet offset value, (see T1.672.7-2000), if the unrecognised 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 unrecognised 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 Pre-Release Information message) towards the node that sent the unrecognised information element; it shall include the Report Reason *"information element non-existent or not implemented"* followed by a Diagnostic field containing the Information Element Identifier (of the first detected unrecognised information element which caused the call to be released) and the Index subfield.

If a BICC_Error indication primitive indicating *"unrecognised information"* is received relating to a Pre-Release Information 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 unrecognised information elements relating to a Pre-Release Information 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 unrecognised information inside a Pre-Release Information message or for unrecognised information inside a BAT Compatibility Report information element inside a BICC_Data indication primitive.

1.7.1.2.4.2.2   Unrecognised fields

There exists no specific compatibility information for each field. For all fields contained in an information element, the compatibility information of the information element applies.

1.7.1.2.4.2.3   Procedures for the handling of a response indicating unrecognised information has been sent

Action taken on receipt of a BAT Compatibility Report information element will depend on whether the exchange has the functionality to generate the information element identified in the diagnostic field:

a) If the exchange does not have the functionality to generate the information element, the decision on what action should be taken is deferred to an exchange that does contain this functionality.

This is achieved by passing the BAT Compatibility Report information element transparently through the exchange.

b) If this exchange 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.

1.7.1.3 General Exceptions to T1.113.4-2000 Signalling procedures

The procedures described in T1.113.4-2000 are applicable with the clarifications/exceptions described in this clause.

As a general statement, which is not repeated at all possible occasions throughout this clause, the actions specific to originating and destination local exchanges are not applicable.

The numbering within this clause corresponds to the numbering within T1.113.4-2000, with additional lower level headings added for BICC specific text.

Three options are included for the handling of bearers:

1. A bearer connection is set-up and released for each call set-up and release. The bearer set-up is performed 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 performed 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 A).

An option is provided for support of Codec negotiation and modification.

1.7.1.4 Exchange types

T1.113.4-2000 defines the ISUP procedures related to three "exchange types":

1. Originating exchange;

2. Intermediate national exchange; and

3. Destination exchange.

The functional model for BICC refers to three SN types: ISN, TSN and GSN. Table 2 indicates which BICC SN types can exist at each of the exchange types.

Table 2/T1.672.4 - Relationship between exchange types and SN types

Exchange type	SN type
Originating exchange	Not applicable
Intermediate national exchange	ISN, TSN, GSN
Destination exchange	Not applicable

2   Basic call control and signalling procedures

2.1   Successful call set-up

Figures 1/T1.113.4-2000 to 8A/T1.113.4-2000 have not been included in this document.   Annex F includes figures representing successful basic call set-up.

2.1.1   Forward address signalling - En bloc operation

2.1.1.1 Actions required at originating exchange

Clause 2.1.1.1 does not apply.

2.1.1.2 Actions required at an intermediate exchange (Intermediate SN)

Clause 2.1.1.2 is modified as follows:

1) ~~Circuit~~ Outgoing selection: An intermediate exchange, on receipt of an IAM, shall analyze the called party number, the Protocol Control Indicator (see T1-113.4-2000 clause 2.1.1.1(3)), the ISDN User Part Preference Indicator, the bearer capability specified in the User Service Information parameter, and any other routing information (T1-113.4-2000 clause 2.1.1.1(1)) to determine the routing of the call.

When no echo control device or nature-of-circuit indication is received from a preceding exchange using a signalling system with fewer facilities, the indicators shall be considered as received "no" unless positive knowledge is available.

~~If the ISDN User Part Preference Indicator is set to~~

~~–   "ISDN User Part not required all the way", then the call is set up no matter what the outgoing signalling system is (ISDN User Part, Telephone User Part, MF, etc.);~~

~~–   "ISDN User Part preferred all the way" and it is not possible to find a circuit using the ISDN User Part, the call is still set up;~~

~~–   "ISDN User Part required all the way" and there is no available ISDN User Part circuit, the call is rejected and appropriate information is sent in the backward direction.~~

For the purpose of the ISDN User Part Preference Indicator, BICC should be considered equivalent to ISUP. If BICC is chosen, ~~the call is still permitted, the intermediate exchange~~ then a free CIC value is selected, and the IAM Sending Control procedure (2.1.1.2.3) is applied. The BICC incoming set-up procedures, (2.1.1.2.2), are started when the call can be routed. ~~seizes an idle inter-exchange circuit and sends an Initial Address Message to the succeeding exchange.~~

2) Parameters in the IAM: An intermediate exchange may modify signalling information received from the preceding exchange according to the capabilities used on the outgoing route. Signalling

information that may be changed are Nature of Connection Indicators and End-to-End Method Indicator; the most significant digits in the called party number may be amended or omitted (see T1-113.4-2000 clause 2.1.1.1(2)). A change of the end-to-end method used may also alter parameters (see clause 3). The satellite indicator in the Nature of Connection Indicators parameter should be incremented if the selected outgoing circuit is a satellite circuit[1]. Otherwise, the indicator is passed on unchanged. BAT ASE data is not necessarily passed on transparently. Other signalling information is passed on transparently (e.g., the Access Transport parameter, User Service Information, etc.)[2].

3) Completion of transmission path: For a speech, 3.1 kHz audio, or Unrestricted Digital Information with Tones & Announcement (UDI-TA) call, through connection of the transmission path in the backward direction shall be completed at an intermediate exchange no later than at receipt of an Address Complete Message (ACM) (see 2.1.4.2). Refer to 2.1.1.2.6 for procedures which specify when through connection may be initiated.

For any call, through connection in both directions shall be completed no later than at receipt of an ~~interworking or a~~Answer ~~indication~~ Message (see 2.1.4~~5~~.2).

4) Congestion: In the case of congestion at an intermediate exchange, the exchange may send a Release Message (including Automatic Congestion Level parameter) to the preceding exchange indicating congestion and initiating release of the call at that exchange. The Release Message shall include the cause indicators parameter with cause value 42 (switching equipment congestion). Refer to 2.11 for automatic congestion control procedures.

5) Number portability: The actions at an intermediate exchange acting as an initiating switch are the same as an originating exchange acting as an initiating switch. Otherwise, no action is required at an intermediate exchange. In particular, an intermediate exchange that receives an IAM with the Forward Call Indicators parameter set to "number translated" shall not act as the initiating switch.

6) Transport of dialed number: The intermediate exchange may, in addition to existing ISUP optional parameters, include in the IAM a Generic Address Parameter (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 intermediate exchange contains a "dialed number" GAP, the intermediate exchange shall not modify the "dialed number" GAP but shall pass the parameter as received.

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[1] Use of the satellite indicator to reflect use of satellite circuits in the bearer network is for further study.

[2] Other signalling information may be passed on to other networks based on bilateral agreements.

2.1.1.2.1   BICC outgoing set-up procedures

When the IAM Sending Control procedure determines that the IAM can be sent onwards from this SN the per-call bearer set-up in forward or backward direction procedure is started. The choice of procedure is provisioned at the SN, per originating BIWF.

Two variations of the forward set-up procedure are defined. The variant to be followed depends on the through connection characteristic of the bearer.

2.1.1.2.1.1   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. The BNC characteristics are determined, based on the selected BIWF.

2. An IAM is sent, including the Action indicator set to *"Connect forward"* and the BNC characteristics, in the BICC_Data request primitive.

3. The following subsequent indications can be received:

    3.1. A BICC_Data indication primitive (corresponding to an APM message):

        3.1.1. If the received Action indicator is *"Connect forward, plus notification"* the Connect Type[3] is set to *"notification required,"* else it is set to *"notification not required."*

        3.1.2. 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).

            •   Bearer Characteristics, i.e., User Service Information (as received in the IAM).

        3.1.3. When a Bearer Set-up Connect indication is received this indicates successful completion of the outgoing set-up procedure. 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."*

        3.1.4. If ACM or ANM are received, but Bearer Set-up Connect indication has not yet been received, the ACM/ANM shall be handled according to 2.1.4, and Bearer Set-up Connect or Bearer Set-up Failure indication is awaited.

2.1.1.2.1.2   Per-call bearer set-up in backward direction

In this procedure the bearer is set-up in the backwards 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 theSN that sends the IAM, and to allow the bearer set-up indication to be correlated with the call when it is received at the SN.

            1. The BNC-ID and BIWF Address are obtained from BCF.

            2. The BNC characteristics are determined, based on the selected BIWF.

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

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[3] 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.

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

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

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

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

   The outgoing set-up procedure is now successfully completed.

2.1.1.2.2   BICC incoming set-up procedures

When an IAM is received, a BIWF is selected and the relevant BICC incoming set-up procedure is started.

The BIWF selected shall be able to support the bearer set-up direction indicated by the Action indicator, and support the received BNC characteristics. Two variations of the forward bearer set-up procedure are defined. The variant to be followed depends on the through connection characteristic of the bearer.

2.1.1.2.2.1   Per-call bearer set-up in forward direction

In this procedure the bearer is set-up from the SN that sends the IAM. Addressing and bearer identification information is sent backwards to enable the preceding SN to initiate the bearer connection.

1. The IAM is further processed, in accordance with to T1-113.4-2000 procedures. The procedure to establish the bearer does not delay processing of the call. The progression of the call proceeds concurrently with the following procedures.

   If Codec negotiation (2.1.1.2.4) is applicable the following steps are delayed until indicated by that procedure.

2. The BNC-ID and BIWF Address are obtained from BCF.

3. The Connect Type[4] 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.

4. 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.
   - BIWF Address.

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

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

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[4] 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.

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

5.3   If the Connect Type is *"notification not required"* the incoming set-up procedure is now successfully completed.

5.4   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.

2.1.1.2.2.2   Per-call bearer set-up in backward direction

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 backwards to enable the preceding SN to identify that this bearer relates to this call.

1.   The IAM is further processed, according to T1-113.4-2000 procedures. The procedure to establish the bearer does not delay processing of the call. The progression of the call proceeds concurrently with the following procedures.

    If Codec negotiation (see 2.1.1.2.4) 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.

2.1.1.2.3   IAM sending control procedure

This procedure arbitrates between the incoming and outgoing set-up procedures to determine when the IAM and COT messages are to be sent forward, depending on events received by the incoming signalling.

In the TSN/GSN cases an IAM is sent before completion of the bearer set-up, and the continuity check protocol is used to withhold call completion until establishment of the bearer is complete.

The IAM is sent when determined by the outgoing selection procedures in 2.1.1.2 or 2.1.2.2. The Continuity check indicator in the Nature of connection indicators parameter is set to indicate *"continuity check performed on previous circuit"*. The sending of the IAM is done by invoking the BICC Outgoing set-up procedures in 2.1.1.2.1.

The Continuity message with the Continuity Indicators parameter set to *"continuity check successful"* is sent when the two following conditions are satisfied:

1.   If the incoming IAM indicated *"continuity check performed on previous circuit,"* a Continuity message with the Continuity Indicators parameter set to *"continuity check successful"* shall be received.

2. One of the following events -- which indicate successful completion of bearer set-up -- shall also be received by the incoming 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 case where the incoming Connect Type is *"notification required."*

2.3 Bearer Set-up Connect indication – for the backward bearer set-up case.

2.1.1.2.4 Codec negotiation

The support of the Codec negotiation procedure is optional. If supported it only applies to the cases of per-call forward or backward bearer set-up. Codec negotiation is not applicable in case of re-use of idle bearers (see Annex A).

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 clauses detail the procedures as a set of variations to the non-codec procedures, as defined in the preceding clauses.

2.1.1.2.4.1 SN initiating codec negotiation

At an SN generating an IAM the procedures in 2.1.1.2.1 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.

2. The Supported Codec List for the call is sent forwards 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.

Subsequent procedures are according to the relevant outgoing set-up procedure, as amended by the exceptions defined in 2.1.1.2.4.4.

2.1.1.2.4.2 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 T1-113.4-2000 procedures, but the incoming set-up procedure is suspended until backward codec information is received. Subsequently:

1. The BICC_Data request primitive associated with the IAM sent to the next SN 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 can not be used for the call.

2. When the outgoing set-up procedure (see 2.1.1.2.4.4) receives Selected Codec and Available Codecs List information, it is passed to the relevant incoming set-up procedure in 2.1.1.2.4.5.

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

- If the incoming side of the call is the network that supports codec negotiation, then the GSN shall perform the codec negotiation procedures described in 2.1.1.2.4.3 for SN terminating codec negotiation.

- If the incoming side of the call is the network that does not support codec negotiation, then the GSN shall perform the codec negotiation procedures described in 2.1.1.2.4.1 for an SN initiating codec negotiation.

2.1.1.2.4.3   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 procedures in 2.1.1.2.2 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 may be used for the call.

b) It constructs the Available Codec List for the call by deleting the entries that can not 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 set-up procedure, as amended by the exceptions in 2.1.1.2.4.5.

2.1.1.2.4.4   Outgoing set-up procedure

When the IAM Sending Control procedure determines that the IAM can be sent onwards from this SN, the forward or backward bearer set-up outgoing 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.

2.1.1.4.4.1   Per-call bearer set-up in forward direction

The procedures in 2.1.1.2.1.1 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 2.1.1.2.1.1 item 3.1:

- Action indicator set to "*Connect forward, no notification + Selected Codec*" or "*Connect forward, plus notification + Selected Codec*". (The handling of these Action indicators in 2.1.1.2.1.1 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 and the Available Codec List is stored for future use.

2.1.1.2.4.4.2   Per-call bearer set-up in backward direction

The procedures in 2.1.1.2.1.2 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.

- 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.

2.1.1.2.4.5   Incoming set-up procedure

2.1.1.2.4.5.1   Per-call bearer set-up in forward direction

The procedures in 2.1.1.2.2.1 apply with the following exceptions:

The incoming set-up procedure shall wait, at 2.1.1.2.2.1 item 1, until the Selected Codec and the Available Codecs List for the call become available[5], the procedure then continues. The Selected Codec and the Available Codecs List shall be included in the BICC_Data request primitive sent at 2.1.1.2.2.1 item 4:

- 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; and

- 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).

2.1.1.2.4.5.2   Per-call bearer set-up in backward direction

The procedures in 2.1.1.2.2.2 apply with the following exceptions:

The incoming set-up procedure shall wait, at 2.1.1.2.2.2 item 1, until the Selected Codec information and the Available Codecs List for the call become available[6], 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"*;

    - Selected Codec, coded as the Single Codec information element; and

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

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

- 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 continue at 2.1.1.2.2.2, item 2.

2.1.1.2.4.6   Abnormal cases

2.1.1.2.4.6.1   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 code #47 *"Resource unavailable, unspecified"* shall be initiated.

2.1.1.2.4.6.2   SN initiating codec negotiation

Whenever an SN 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 initiating SN shall then terminate its internal codec negotiation procedures and:

a)   For the forward bearer set-up case: proceed as described from item 3 in 2.1.1.2.1.1; and

b)   For the backward bearer set-up case: proceed as described from item 4 in 2.1.1.2.1.2.

2.1.1.2.4.6.3   Codec negotiation in a SN transiting codec negotiation

Whenever a SN transiting codec negotiation for a call, as described in 2.1.1.2.4.2, 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.

2.1.1.2.5   Codec modification

Networks supporting the codec negotiation procedure may also support the Codec modification procedure.

When the codec modification option is supported, the codec selected for a call can be modified in any direction and at anytime during the active phase of the call. Codec modification can only occur once a codec has been selected for the call and an Available Codec List for the call has been stored in all the SNs intervening in the codec negotiation procedures. The procedure to be followed for codec modification depends on whether the SN is to act as a SN initiating, transiting or terminating codec modification.

NOTE - The terms "preceding" and "succeeding" SN in the remaining clauses within this clause refer to the direction of the modification flow not of the direction of the call set-up flow.

2.1.1.2.5.1   SN initiating codec modification

In an SN, a codec modification procedure can be initiated in any direction and at anytime during the active phase of a call, after a codec has been selected for the call and an Available Codec List for the call is stored in the SN. 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. 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.

2. A BICC_Data indication primitive shall 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. The BCF is informed of the new codec, if modification of the selected codec was requested. 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 and the nodal functions are notified.

2.1.1.2.5.2   SN terminating codec modification

In an SN terminating codec modification, a codec modification request can be received at anytime during the active phase of a call, after a codec has been selected for this call and an Available Codec List has been stored for the call. The following 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 SN 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, then codec availability is checked against the owner of the codec resource (e.g., BIWF). If the new proposed codec is not available, the modification is rejected.

- Otherwise, the modification is accepted.

If the codec modification is rejected, then a BICC_Data request primitive with an Action indicator set to *"Codec modification failure"* is issued towards the preceding SN.

If the codec modification is accepted, then a BICC_Data request primitive with an Action indicator set to *"Successful codec modification"* is sent to the preceding SN. If the selected codec for the call has been modified, then a codec modification request is sent to the selected BCF. If the stored Available Codec List is modified, then the new Available Codec List is stored for future use.

2.1.1.2.5.3   SN transiting codec modification

The following procedures apply at a SN transiting codec modification:

Upon reception from the preceding SN 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 SN checks the received codec information:

1. If either the Single Codec or the Codec List are not valid (i.e., the Codec Information is not among the ones offered in the stored 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 SN issues a BICC_Data request primitive towards the preceding SN containing an Action indicator set to *"Codec modification failure"*.

2. If the modification is not rejected in item 1 above:

   2.1 The received information is forwarded in a BICC_Data request primitive towards the succeeding SN.

   2.2 Upon reception of a BICC_Data indication primitive from the succeeding SN 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. If the modification is successful and the stored Available Codec List is modified, then the new Available Codec List is stored for future use.

2.1.1.2.6   Through connection of the bearer path

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

- The Incoming set-up procedure is successfully completed; and

- The Outgoing set-up procedure is successfully completed.

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

- The Incoming set-up procedure has been successfully completed, and;

- The Bearer Set-up request has been sent by the Outgoing set-up procedure.

Clause 2.1.1.2, item 3, specifies when through connection shall be completed.

2.1.1.3 Actions required at the destination exchange

Clause 2.1.1.3 of T1-113.4-2000 does not apply.

2.1.2   Forward address signalling - Overlap operation

(No procedure specified for U.S. networks.)

2.1.3   Calling party number

Clause 2.1.3 of T1-113.4-2000 applies.

2.1.3A Exit Message

2.1.3A.1   Actions at a gateway exchange

Clause 2.1.3A.1 of T1-113.4-2000 applies[7].

2.1.3A.2   Actions at intermediate exchange

Clause 2.1.3A.2 of T1-113.4-2000 applies.

2.1.3A.3   Actions at an originating or gateway exchange

Clause 2.1.3A.3 of T1-113.4-2000 applies.

2.1.3B Circuit reservation

Clause 2.1.3B of T1-113.4-2000 does not apply and other references to Circuit Reservation in any other part of T1-113.4-2000 are not applicable.

2.1.4   Address Complete Message

2.1.4.1 Return of Address Complete Message from destination exchange

Clause 2.1.4.1 of T1-113.4-2000 does not apply.

2.1.4.2 Receipt of Address Complete Message at an intermediate exchange

Clause 2.1.4.2 of T1-113.4-2000 applies with the following clarification/exception:

- Conditions on the incoming circuit are to be interpreted as conditions related to the incoming bearer.

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[7] The use of Outgoing Trunk Group Number in the context of BICC is for further study.

2.1.4.3 Receipt of Address Complete Message at the originating exchange

Clause 2.1.4.3 of T1-113.4-2000 does not apply.

2.1.4.4 Through connection and awaiting answer indication at the destination exchange

Clause 2.1.4.4 of T1-113.4-2000 does not apply.

2.1.4.5 Address Complete Message with charging information

Clause 2.1.4.5 of T1-113.4-2000 applies.

2.1.4.6 Address Complete Message with other information

Clause 2.1.4.6 of T1-113.4-2000 applies.

2.1.4.7 Return of Address Complete Message in interworking situations

Clause 2.1.4.7 of T1-113.4-2000 does not apply.

2.1.4A Call Progress Message

Clause 2.1.4A of T1-113.4-2000 applies with the following clarification/exception:

- The phrase "while continuity-check is still in progress" shall be interpreted as "until the outgoing and/or incoming set-up procedures have completed."

2.1.4A.1   Return of Call Progress Message from the destination exchange

Clause 2.1.4A.1 of T1-113.4-2000 does not apply.

2.1.4A.2   Receipt of Call Progress Message at an intermediate exchange

Clause 2.1.4A.2 of T1-113.4-2000 applies with the following clarifications/exceptions:

a) Conditions on the incoming circuit are to be interpreted as conditions related to the incoming bearer.
b) The phrase "waiting for continuity reports" shall be interpreted as "waiting for the outgoing and/or incoming set-up procedures to complete."

2.1.4A.3   Receipt of Call Progress Message at the originating exchange

Clause 2.1.4A.3 of T1-113.4-2000 does not apply.

2.1.4B Information messages

2.1.4B.1   Requesting information

See 4A.1.1.

2.1.4B.2   Sending solicited information

See 4A.1.2.

2.1.4B.3   Sending unsolicited information

Clause 2.1.4B.3 of T1-113.4-2000 applies.

2.1.4B.4   Receiving a solicited Information Message

See 4A.1.3.

2.1.4B.5   Simple Segmentation

Clause 2.1.4B.5 of T1-113.4-2000 applies with the following clarifications/exceptions:

a) If the START-INFO.indication primitive received from the STC (see Annex B) indicates that the underlying message transport mechanism can transport greater than 272 octets, BICC shall not invoke Simple Segmentation.

b) ISNs may receive segmented ISUP messages and these shall be handled by SNs according to T1-113.4-2000 procedures.

c) References to the Blocking (Acknowledgement) and Unblocking (Acknowledgement) messages are not applicable.

2.1.5   Answer Message

2.1.5.1 Return of Answer Message from destination exchange

Clause 2.1.5.1 of T1-113.4-2000 does not apply.

2.1.5.2 Receipt of Answer Message at intermediate exchange

Clause 2.1.5.2 of T1-113.4-2000 applies with the following clarification/exception:

• Conditions on the incoming circuit are to be interpreted as conditions related to the incoming bearer.

2.1.5.3 Receipt of Answer Message at originating exchange

Clause 2.1.5.3 of T1-113.4-2000 does not apply.

2.1.5.4 Return of answer from automatic terminals

Clause 2.1.5.4 of T1-113.4-2000 does not apply.

2.1.5.5 Answer with charging information

Clause 2.1.5.5 of T1-113.4-2000 does not apply.

2.1.6   Continuity-check

Clause 2.1.6 of T1-113.4-2000 and its subsections apply with the following clarifications/exceptions:

    a) Initiation of a continuity check between SNs is not supported, therefore procedures for recheck are also not supported.

    b) The procedures are modified by the IAM sending control procedure (see 2.1.1.2.3).

2.1.7   Special procedures at an interworking point

2.1.7.1 Completion of transmission path at an interworking exchange

Clause 2.1.7.1 of T1-113.4-2000 does not apply.

2.1.7.2 Alerting of called party

Clause 2.1.7.2 of T1-113.4-2000 does not apply.

2.1.7.3 Number portability

Clause 2.1.7.3 of T1-113.4-2000 does not apply.

2.1.8   Cross office check

Clause 2.18 of T1-113.4-2000 does not apply.

2.1.9   Charging procedures

2.1.9.1 Basic call charging

Clause 2.1.9.1 of T1-113.4-2000 applies.

2.1.9.2 Network charging messages

Clause 2.1.9.2 of T1-113.4-2000 applies.

2.1.9.3 Charging for transfer of user-to-user data

Clause 2.1.9.3 of T1-113.4-2000 applies.

2.1.9.3A   Charge information

Clause 2.1.9.3A of T1-113.4-2000 applies.

2.1.10 Forward Transfer Message

Clause 2.1.10 of T1-113.4-2000 applies.

2.1.10A Transit network selection

Clause 2.1.10A of T1-113.4-2000 applies.

2.1.10B Carrier identification

Clause 2.1.10B of T1-113.4-2000 applies.

2.1.10C Jurisdiction information

Clause 2.1.10C of T1-113.4-2000 applies with the following clarifications/exceptions:

   a)   Interworking with inband signaling is not applicable.

   b)   The concept of an incoming trunk group is for further study.

2.1.10D Egress service

Clause 2.1.10D of T1-113.4-2000 applies.

2.1.11   Storage and release of IAM information

Clause 2.1.11 of T1-113.4-2000 applies.

2.2   Unsuccessful call set-up

Clause 2.2 of T1-113.4-2000 applies with the following additions:

   a)   If 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 BICC shall determine the cause value to be used, considering the cause provided by the BCF.

   b)   If a receiving SN cannot select a BIWF according to the criteria specified in 2.1.1.2.2, 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.

   c)   Destination exchanges are not supported.

   d)   Text on analog switch is not applicable.

2.2.1   Actions at exchange initiating a Release Message

Clause 2.2.1 of T1-113.4-2000 applies with the following exceptions/clarifications:

   a)   Where the text refers to "release of the switched path" this shall be interpreted to mean that the BCF is requested to disconnect the internal through connection of the bearer path.

   b)   Unsuccessful call set-up can occur when no bearer path has been established; in this case the release of the switched path is not applicable.

2.2.2 Actions at intermediate exchange

Forward/backward release at an intermediate SN is handled as in 2.3.1/2.3.2.

2.2.3 Actions at the controlling exchange

Clause 2.2.3 of T1-113.4-2000 applies with the following exceptions/clarifications:

a) Where the text refers to "release of the switched path" this shall be interpreted to mean that the BCF is requested to disconnect the internal through connection of the bearer path.

b) The Release Complete message is sent according to the procedures in 2.3.

2.2.4 Tones and announcements

Clause 2.2.4 of T1-113.4-2000 applies with the following exception/clarifications:

a) Call failure cases are possible where the bearer is not fully established due to failure during the BICC incoming set-up procedure; 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 SN shall release the call (without sending ACM), with the cause value most accurately describing the cause of failure.

b) 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 BICC incoming set-up procedure shall be performed prior to connecting the tone or announcement.

c) Procedures related to actions by a called party or user do not apply.

2.2.5 Actions at the number portability initiating exchange

Clause 2.2.5 of T1-113.4-2000 applies with the following exception/clarification:

- Interpretation of Cause value 26 at the originating User-Network interface is not applicable.

2.3 Normal call release

Clause 2.3 of T1-113.4-2000 is modified as follows:

The release procedures are based on a two message approach whereby the Release Message initiates release of the call ~~circuit switched connection~~. The same procedures are used in the network irrespective of whether they are initiated by the calling party, the called party, or the network.

NOTE - An indication of call release is issued to the BCF, but the subsequent decision to initiate release protocol is the responsibility of BCF logic and is not specified in this American National Standard (See Annex F and Annex G.)

2.3.1 Release initiated by a calling party

Clause 2.3.1 of T1-113.4-2000 is modified as follows:

1) Actions at originating exchange: ~~On receipt of a request to release the call from the calling party, the originating exchange immediately starts the release of the switched path and, at the same time, sends a Release Message to the succeeding exchange. Timers T_4 and T_5 are started~~

~~to ensure that a Release Complete Message is received from the succeeding exchange. (Expiration of these timers is covered in 2.9.6.)~~ Not Applicable to BICC.

2) Actions at an intermediate exchange: On receipt of the Release Message from the preceding exchange, an intermediate exchange shall:

a) ~~immediately start the release of the switched path. When the path has been fully disconnected~~, Request 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 side is indicated. When the BCF acknowledges successful disconnection of the bearer path a Release Complete Message is returned to the preceding exchange;

b) At the same time, send a Release Message to the succeeding exchange. Timers T_1 and T_5 are started to ensure that a Release Complete Message is received from the succeeding exchange. (Expiration of these timers is covered in 2.9.6.)

c) When the Release Complete message is received timers T_1 and T_5 are stopped and call release at the outgoing side is indicated to the BCF. The Cause parameter in the original Release message is passed to the BCF;

3) Actions at destination exchange: ~~On receipt of a Release Message from the preceding exchange, the destination exchange shall immediately start the release of the switched path. When the path has been fully disconnected, a Release Complete Message shall be returned to the preceding exchange.~~ Not Applicable to BICC.

4) Charging: Charging shall be stopped upon receipt of the Release Message at the charging exchange(s) ~~or on receipt of a request to release the call from the calling party when the charging exchange is the originating exchange~~.

5) Collision of Release Messages: In the case when two points in the connection both initiate the release of a call, a Release Message may be received at an exchange from a succeeding or preceding exchange after the release of the switched path is initiated and after sending a Release Message to the adjacent exchange. In this case, the exchange shall return a Release Complete Message to the exchange from which the concerned Release Message was received after the BCF has acknowledged the Bearer Release request. The exchange shall make the CIC value ~~path~~ available for new calls after both a Release Complete Message response is received (for any previously sent Release Message) and a Release Complete Message is sent (for any previously received Release Message).

2.3.2   Release initiated by a called party

The procedures in 2.3.1 apply, except that the designation of succeeding and preceding exchanges are transposed. (The procedures for originating and destination exchanges do not apply).

2.3.3   Release initiated by the network

Release can be initiated at any SN. Releases in the forward direction are treated as in 2.3.1, and releases in the backward direction are treated as in 2.3.2. The network initiated release can be initiated as a result of receiving a Bearer Release indication from the BCF (e.g., as a result of a failure in the bearer network during the active phase of a call).

2.3.4   Release of address and routing information

See 2.1.11.

2.4   Transfer of user-to-user information

Clause 2.4 of T1-113.4-2000 applies.

2.4A   Transfer of access signalling information

Clause 2.4A of T1-113.4-2000 does not apply. However, any Access Transport information received shall be passed on without interpretation.

2.4B   Transfer of network signalling information

2.4B.1 Actions at the exchange which initiates message with network transport parameter

Clause 2.4B.1 of T1-113.4-2000 does not apply.

2.4B.2 Actions at an intermediate exchange

Clause 2.4B.2 of T1-113.4-2000 applies.

2.4B.3 Actions at the exchange which terminates message with network transport parameter

Clause 2.4B.3 of T1-113.4-2000 applies for cases where an intermediate exchange terminates the network transport parameter.

2.5   Suspend, resume

2.5.1   Suspend

Clause 2.5.1 of T1-113.4-2000 applies.

2.5.1.1 Suspend initiated by a calling party

Clause 2.5.1.1 of T1-113.4-2000 applies.

2.5.1.2 Suspend initiated by a called party

Clause 2.5.1.2 of T1-113.4-2000 applies.

2.5.1.3 Suspend initiated by the network

Clause 2.1.5.3 of T1-113.4-2000 is modified as follows:

> A Suspend (network) Message may 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.

> > **1)   Action at destination exchange or interworking exchange:** ~~On receipt of an on-hook condition at the destination exchange or a clearback signal at the interworking exchange, the exchange shall send a Suspend (network) Message to the preceding exchange;~~ Not Applicable to BICC.

2) **Action at an intermediate exchange:** On receipt of the Suspend (network) Message, the exchange shall send a Suspend (network) Message to the preceding exchange.

3) **Action at the controlling exchange:** On receipt of the ~~on-hook condition, clearback indication, or~~ Suspend (network) Message, the controlling exchange starts a timer[8] (T_6) to ensure that ~~an off-hook condition, a re-answer indication, a~~ Resume (network) Message or a Release Message is received. If the timer expires, the procedures in 2.5.3 apply.

2.5.2   Resume

Clause 2.5.2 of T1-113.4-2000 applies.

2.5.2.1 Resume initiated by a calling party

Clause 2.5.2.1 of T1-113.4-2000 applies.

2.5.2.2 Resume initiated by a called party

Clause 2.5.2.2 of T1-113.4-2000 applies.

2.5.2.3 Resume initiated by the network

Clause 2.5.2.3 of T1-113.4-2000 is modified as follows:

A Resume (network) Message is initiated by the network, if a Suspend (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.

1) **Action at destination exchange or interworking exchange:** ~~On receipt of a re-answer indication at the interworking exchange or off-hook condition in the destination exchange, the exchange shall send a Resume (network) Message to the preceding exchange if a Suspend (network) Message had previously been sent;~~ Not Applicable to BICC.

2) **Actions at an intermediate exchange:** On receipt of a Resume (network) Message, the exchange shall send a Resume (network) Message to the preceding exchange.

3) **Action at the controlling exchange:** On receipt of the ~~off-hook condition, re-answer signal, Release Message or~~ Resume (network) Message, the controlling exchange stops timer (T_6).

2.5.3   Expiration of timer T_6

Clause 2.5.3 of T1-113.4-2000 applies.

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[8] The value of this timer is taken from CCITT Recommendation Q.118.

2.6   Delayed release

Clause 2.6 of T1-113.4-2000 applies.

2.7   In call modification

Clause 2.7 of T1-113.4-2000 applies.

2.7A   Echo control procedure

Clause 2.7A of T1-113.4-2000 and its subsections related to intermediate exchanges apply, except that echo control devices shall not be used when codec negotiation is employed and the resultant codec is not G.711.

> NOTE 1 - 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 BIWF 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 Q.115).

> NOTE 2 - 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 Q.115.

2.8   Network features

2.8.1   Automatic repeat attempt

Clause 2.8.1 of T1-113.4-2000 applies with the following exceptions/clarifications:

a) References to a single CIC Blocking message are not applicable.

b) Text which refers Circuit Reservation Messages or Circuit Reservation Acknowledgement Messages does not apply.

c) The fourth bullet referring to a continuity check is not applicable to BICC.

2.8.2   Blocking and unblocking of circuits and circuit groups

Clause 2.8.2 of T1-113.4-2000 is modified as follows:

> The ~~Blocking (Unblocking) Message and the~~ Circuit Group Blocking (Unblocking) Message<u>s</u> are provided to permit the switching equipment or maintenance system to remove from (and return to) traffic <u>CIC values, thus providing a means to control the amount of traffic that can be presented to the SN</u> ~~the distant terminal(s) of a circuit or group of circuits because of a fault or to permit testing~~.

> ~~Since the circuits served by ISDN User Part have both way capability, t~~<u>T</u>he ~~Blocking Message or~~ Circuit Group Blocking Message can be originated by either exchange. The <u>CIC's</u> ~~circuit(s)~~ shall be removed from service (blocked) on transmission of the ~~Blocking Message or~~ Circuit Group Blocking Message at one exchange and on receipt of the ~~Blocking Message or~~ Circuit Group Blocking Message at the other exchange. The receipt of a ~~Blocking Message or~~ Circuit Group Blocking Message shall have the effect of prohibiting non-test calls on the relevant <u>CIC's</u> ~~circuit(s)~~ outgoing from the exchange until ~~an Unblocking Message, an~~ appropriate Circuit Group Unblocking Message, or a non-test Initial Address Message (see 2.8.2.3(14)) is received, but shall not prohibit test calls incoming to that exchange. Test calls generated in the outgoing

direction from the exchange that sent the ~~Blocking Message or~~ Circuit Group Blocking Message shall not be prohibited.

An acknowledgment sequence is always required for ~~the Blocking and Unblocking Messages as well as for~~ the Circuit Group Blocking and Circuit Group Unblocking Messages using ~~the Blocking Acknowledgment Message, the Unblocking Acknowledgment Message,~~ the appropriate Circuit Group Blocking Acknowledgment Message, and the appropriate Circuit Group Unblocking Acknowledgment Message, respectively. The acknowledgment is not sent until the appropriate action, either blocking or unblocking has been taken.

The Release Message should not override the blocked condition and return CIC's ~~circuits~~ to service ~~which might be faulty~~. The blocked CIC(s) ~~circuit(s)~~ shall be returned to service (unblocked) on transmission of ~~the Unblocking Acknowledgment Message or~~ the appropriate Circuit Group Unblocking Acknowledgment Message at one exchange and on receipt of ~~the Unblocking Acknowledgment Message or~~ the appropriate Circuit Group Unblocking Acknowledgment Message at the other exchange.

The exchange that has sent ~~Blocking and~~ Circuit Group Blocking Messages must not send the corresponding ~~Unblocking and~~ Circuit Group Unblocking Messages for the circuit until all the blocking reasons for the ~~circuit~~ CIC(s) are cleared.

Notification should be provided to maintenance personnel when CIC's ~~circuits~~ are blocked or unblocked. The procedures for such notification are implementation-specific.

2.8.2.1 Blocking and Unblocking Messages

Clause 2.8.2.1 of T1-113.4-2000 does not apply.

2.8.2.2 Circuit Group Blocking and Unblocking Messages

Clause 2.8.2.2 of T1-113.4-2000 applies with the following clarifications/exceptions:

a) Where the text refers to circuits, this shall be interpreted to mean CIC values.

b) The 6th paragraph, which starts with "A circuit is controlled by the ISDN User Part if....", is not applicable.

c) Circuit group blocking with immediate release of all circuits and related calls procedures are not applicable to BICC.

d) References to automatic continuity test procedures are not applicable

e) Group Blocking Messages shall only be transmitted once. Therefore, when the Group Blocking Message is received, the SN shall act on the message immediately, and timer T_{CGB} is not applicable.

f) The maximum number of CICs to be blocked (unblocked) with one Circuit Group Blocking (Unblocking) Message is extended to 256.

g) The 8th paragraph, which starts with "If a Circuit Group Blocking Message is sent….", is replaced with the following text:

> If a Circuit Group Blocking Message is sent and subsequently an Initial Address Message is received in the opposite direction, 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, a Circuit Group Blocking Message including the relevant status bit for this CIC set to "1" shall be returned;

- • − For calls other than test calls, a Circuit Group Blocking Message including the relevant status bit for this CIC set to "1" shall be returned and the Initial Address Message shall be discarded.

h) The 13th paragraph, which starts with "In addition, in the case of ….", is replaced with the following   text:

In addition, in the case of blocking without immediate release, if the Circuit Group Blocking Message is received after sending or receiving an Initial Address Message for any of the indicated CIC(s), the following conditions and actions apply.

On receipt of a Circuit Group Blocking Message, the indicated CIC(s) is removed from service (blocked), and a Circuit Group Blocking Acknowledgment Message is returned. The fact that the CIC is engaged on a call shall not delay transmission of the Circuit Group Blocking Acknowledgment Message.

In the event of a Circuit Group Blocking Message being received:
- • After an Initial Address Message has been sent for the CIC in the opposite direction; and
- • Before an Address Complete/Answer, relating to that call has been received; an automatic repeat attempt shall be using another CIC. The exchange receiving the Circuit Group Blocking Message should release the original attempt in the normal manner (see 2.3.3) after sending the Circuit Group Blocking Acknowledgment Message and shall not seize the CIC for subsequent calls.

If the Circuit Group Blocking Message is received:
- • After an Initial Address Message has been sent for the CIC in the opposite direction, and after an Address Complete/Answer, relating to that call has been received; or
- • After an Initial Address Message has been received for that CIC beforehand; the exchange shall proceed with the existing call but shall not seize that CIC for subsequent calls

i) The next to last paragraph, which starts with "Circuits which have been blocked….", is not applicable.

2.8.2.2A   Receipt of an Initial Address Message on a remotely blocked circuit

See 2.8.2.3.

2.8.2.3 Abnormal blocking and circuit group blocking procedures

Clause 2.8.2.3 of T1-113.4-2000 applies with the following clarifications/exceptions:

a) Where the text refers to circuits, this shall be interpreted to mean CIC values.

b) References to Circuit Reservation Messages are not applicable.

c) The maximum number of CICs to be blocked (unblocked) with one Circuit Group Blocking (Unblocking) Message is extended to 256.

d) Items 10), 11), 11A), 12), 13) are not applicable.

e) The text for item 14) is replaced with the following:

If a non-test Initial Address Message is received on a remotely blocked CIC, the remotely blocked state of the CIC is removed and the Initial Address Message is processed normally, unless the CIC is also locally blocked. In that case, a Circuit Group Blocking Message including the relevant status bit for this CIC set to "1", is returned and the Initial Address Message is discarded. This applies to any blocking states; however, it should not be the preferred method of unblocking a CIC.

2.8.2A Circuit query

Clause 2.8.2A and its subsections apply with the following clarifications:

   a) Where the text refers to circuit(s), this shall be interpreted to mean CIC value(s).

   b) In the 3rd paragraph of Clause 2.8.2A.2 of T1-113.4-2000, the text "not an ISDN User Part circuit" shall be interpreted to mean a non-BICC CIC."

   c) References to the Blocking (Acknowledgement) and Unblocking (Acknowledgement) messages are not applicable.

2.9   Abnormal conditions

2.9.1   Dual seizure

Clause 2.9.1 of T1-113.4-2000 and its subsections apply with the following clarifications/exceptions:

   a) Where the text refers to circuits this shall be interpreted to mean CIC values.

   b) For the determination of control exchange, the first method in Clause 2.9.1.4 of T1-113.4-2000 is applicable. However, the method of determining whether the SN is the controlling exchange for even or odd numbered CICs is replaced by examination of the CIC_control parameter in the START-INFO.indication primitive (see Annex B). This primitive is received per STC instance, i.e., per signaling route. The second method of determining control is accomplished by provisioning whether an SN has control over all CIC's in a signaling route.

   c) References to Circuit Reservation Messages and Circuit Reservation Acknowledgement Messages are not applicable.

2.9.2   Transmission alarm handling on digital interexchange circuits

Not applicable to BICC.

2.9.3   Reset of circuits and circuit groups

Clause 2.9.3 of T1-113.4-2000 and its subsections apply with the following clarifications/exceptions:

   a) Where the text refers to the circuit(s) being made idle, this shall be interpreted to mean that the CIC value(s) shall be made available for re-use.

   b) When a Reset or Circuit Group Reset message is received a request to reset associated bearer connections shall be sent to the BCF. This will force release of the bearer connections.

   c) Where the text refers to a circuit being idle, this shall be interpreted to mean that the CIC value is currently not in use for a call.

   d) Where the text refers to the circuit(s) being made "idle blocked", this shall be interpreted to mean that the CIC value(s) shall not be made available for re-use.

e) Where the text refers to "circuit(s) whose control is allocated to the ISDN User Part", this shall be interpreted as "CIC value(s) under the control of the BICC protocol".

f) Group Reset messages shall only be transmitted once. Therefore, when the Group Reset Message is received, the SN shall act on the message immediately and timer T_{GRS} is not applicable.

g) The maximum number of CICs to be reset with one Circuit Group Reset Message is extended to 256.

h) References to Circuit Reservation Messages and Circuit Reservation Acknowlegement messages are not applicable.

i) Where the text refers to circuit(s), this shall be interpreted to mean CIC value(s).

j) Where the text refers to use of the Blocking message this shall be interpreted to mean use of the Circuit Group Blocking message.

k) References to continuity recheck procedures are not applicable.

2.9.4 Failure in the blocking/unblocking sequence

Clause 2.9.4 of T1-113.4-2000 applies with the following clarifications:

- Where the text refers to removal of the circuit(s) from service, this shall be interpreted to mean that the CIC value(s) shall not be used for subsequent signalling until maintenance action corrects the situation.

- References to the Blocking (Acknowledgement) and Unblocking (Acknowledgement) messages are not applicable.

2.9.5 Receipt of unreasonable signalling information

Clause 2.9.5 of T1-113.4-2000 and its subsections apply, with the following exceptions/clarifications:

a) References to the MTP are not applicable to BICC (see the relevant Signalling Transport Converter Annex).

b) Messages and parameters that are indicated as "not used" for BICC[9] shall be treated as unrecognised.

c) Where the text refers to circuits, this shall be interpreted to mean CIC values.

d) 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, 2.9.3, 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 primitive is discarded.

e) The maximum message length to be used in determining format errors is determined by the STARTINFO.indication primitive received from the STC.

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[9] As indicated in T1.672.3-2001.

2.9.5A Receipt of unrecognised signalling information

(Refer to 2.9.5.)

2.9.6   Failure to receive a Release Complete Message - Timer T_1 and T_5

Clause 2.9.6 of T1-113.4-2000 applies with the following clarification:

- When timer T_1 expires, the BCF is requested to release the bearer, as in 2.3.1.

2.9.7   Failure to receive a response to a Information Request Message

Clause 2.9.7 of T1-113.4-2000 applies.

2.9.8   Other failure conditions

2.9.8.1 Inability to release in response to a Release Message

Not applicable to BICC.

> NOTE - The successful returning of bearer resources to the idle condition is the responsibility of the relevant bearer control functions.

2.9.8.2 Call failure

Clause 2.9.8.2 of T1-113.4-2000 applies.

2.9.8.3 Abnormal release conditions

Clause 2.9.8.3 of T1-113.4-2000 applies.

2.9.8.3A   Unequipped Circuit Identification Code Message

Clause 2.9.8.3A of T1-113.4-2000 applies with the following exceptions/clarifications:

a) Where the text refers to circuits this shall be interpreted to mean CIC values.

b) Where the text refers to removal of the circuit(s) from service, this shall be interpreted to mean that the CIC value(s) shall not be used for subsequent signalling until maintenance action corrects the situation.

c) An unequipped CIC in the context of BICC is a CIC that has not been provisioned for use by BICC.

d) References to messages that are indicated as "not used" for BICC (see T1.672.3-2000) are not applicable.

e) References to in-band signaling are not applicable.

2.9.8.4 Loss of messages during end-to-end transfer

Clause 2.9.8.4 of T1-113.4-2000 applies.

2.9.8.5 Expiration of the call supervision timer

Clause 2.9.8.5 of T1-113.4-2000 applies.

2.9.9 Temporary trunk blocking (TTB)

Clause 2.9.9 a of T1-113.4-2000 applies.

2.9A Multilevel precedence and preemption

Clause 2.9A of T1-113.4-2000 applies.

2.9B NxDS0 multi-rate connection type (N x 64 kbit/s Connections)

Procedures for multirate or $N \times 64$ kbit/s connection types shall be as for a 64 kbit/s connection type call with the following exceptions/clarifications:

a) Only one CIC shall be used for a multirate or $N \times 64$ kbit/s connection type call between SNs. The selection method of the CIC is the same as that of non-multirate connections.

b) The User Service Information (USI) parameter in the BICC IAM shall indicate the multirate or $N \times 64$ kbit/s connection type as received from the SCN.

c) Contiguous and non-contiguous circuit selection procedures specified in Clause 2.9B of T1.113.4-2000 are not applicable.

d) Procedures for blocking and reset are the same as those for non-multirate connections, since only one CIC is used per call.

e) Dual seizure is resolved using the same procedures as for non-multirate connection.

f) Procedures concerning non-controlling circuits are not applicable.

2.9C Connection type allowing fallback

Clause 2.9C of T1-113.4-2000 and its subsections apply with the following clarifications/exceptions:

a) The actions at the originating and destination exchanges are not applicable.

b) Some fallback actions may not apply at all SNs. (This topic is for further study).

c) Text which refers to circuits shall be interpreted as CIC values.

2.10 ISDN User Part signalling congestion control

Clause 2.10 of T1-113.4-2000 applies.

2.10A ISDN User Part flow control

Clause 2.10A of T1-113.4-2000 is not applicable.

> NOTE - Flow control for BICC is performed by the STC. Its interface to BICC is provided by the IN-SERVICE.indication primitive and the OUT-OF-SERVICE.indication primitive.

2.10B Hop counter procedure

Clause 2.10B of T1-113.4-2000 applies with the following exceptions/clarifications:

    a) The hop counter is incremented per CSF, i.e., per call control association.

    b) When the text refers to trunk(s), this should be interpreted to mean CIC value(s).

    c) As BICC is not necessarily using MTP for signalling transport, the identification of succeeding/preceding exchanges is for further study.

    d) Only applicable to intermediate exchanges.

    e) The concept of an incoming trunk group is for further study.

2.10C Support for Temporary Alternative Routing (TAR)

Clause 2.10C of T1-113.4-2000 applies. However, the TAR procedure relates to call routing only.

2.10D Calling geodetic location procedure

Clause 2.10D of T1-113.4-2000 applies.

2.11   Automatic congestion control

Clause 2.11 of T1-113.4-2000 applies.

2.11A Examples of call set-up sequences

The examples of ISDN call set-up sequences found in Figures 1/T1-113.4-2000 through 13/T1-113.4-2000 have not been included in this document. Examples of successful call set-up can be found in Annex F.

2.11B State transition diagrams

No state transition diagrams are documented for BICC.

3   End-to-end signalling

Clause 3 of T1.113.4-2000 applies for intermediate exchanges.

        NOTE - The use of SCCP method is only applicable when an MTP-based STC is available.

4   User facilities

Clause 4 of T1.113.4-2000 applies.

4A   Generic supplementary services procedures

Clause 4A of T1.113.4-2000 applies for intermediate exchanges with the following clarifications/exceptions:

a) In 4A.4, conditions on the incoming circuit shall be interpreted as conditions related to the incoming bearer.

b) The through connection timing with the User Network Interaction procedures in 4A.6 is affected by 2.1.1.2.6.

c) References to continuity check in 4A.6.1 are not applicable.

5   Table 1/T1.113.4-2000 -- Switch-through when interworking

Table 1/T1.113.4 is not applicable to T1.672-2000. Through connection is discussed in 2.1.1.2.6.

6   Table 2/T1.113.4-2000 -- Circuit Query State Actions

Table 2/T1.113.4-2000 applies with the following exceptions/clarifications:

- States "Incoming Trunk BUSY" and "Outgoing Trunk BUSY" should be interpreted respectively as "CIC is use – Incoming Call" and "CIC in use – Outgoing Call."

7   Table 3/T1.113.4-2000 -- Timers in chapter T1.113.4

Table 3/T1.113.4-2000 applies with the following exceptions/clarifications:

a)   Timers T_{12}, T_{13}, T_{14}, and T_{15} are not used.

b)   Timers T_{24}, T_{25}, T_{26}, T_{27}, and T_{34} are not used.

c)   Timers T_{CGB} and T_{GRS} are not used.

d)   Timer T_{37} is not used.

e)   Timers T_{CCR} and $T_{CCR,r}$ are not used.

f)   Timers T_{CRM} and T_{CRA} are not used.

g)   Timer T_{CVT} is not used.

h)   Timers T_{HGA}, T_{SCGA}, and $T_{SCGA,\,d}$ are not used.

8   Figures in T1.113.4-2000

- Figure 1/T1.113.4-2000 to Figure 13/T1.113.4-2000 are not applicable. Figures for basic call setup are documented in Annex F/T1.672.4-2000.

- Figure 13A/T1.113.4-2000 and Figure 13B/T1.113.4-2000 apply only when an MTP-based STC is available.

- Figure 14/T1.113.4-2000 does not apply.

- Figure 15/T1.113.4-2000 to Figure 22/T1.113.4-2000 apply only when an MTP-based STC is available.

9   Annex A/T1.113.4-2000 -- Contents of interface elements between the ISDN User Part and the SCCP

Annex A/T1.113.4-2000 applies only when an MTP-based STC is used.

10 Annex B/T1.113.4-2000 -- Continuity check sections

Annex B/T1.113.4-2000 does not apply.

11 Annex C/T1.113.4-2000 -- Circuit and circuit group maintenance requirements

11.1 Circuit Test Calls

Not Applicable to BICC.

11.2 Semi-automatic Circuit Turn-up Procedure (CICs)[10]

The start up procedure for BICC CICs is a manually controlled procedure.

During the process of placing CICs into service, unacknowledged circuit supervision messages will most likely be reported to maintenance systems. In order to minimize this impact, it is recommended that coordination takes place between SNs and established procedures for placing CICs into service be followed. Lack of coordination may result in inefficient use of SN and maintenance resources.

The CIC Turn-up procedure is executed between two SNs and consists of sending (Group) Reset messages in both directions. As an operational option, a conversation test 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 acknowledgement
GRS	Group Reset
IAM	Initial Address
RLC	Release Complete

11.2.1 Initial procedure for putting CICs into service

SN X ←-----→ SN Y

        -----GRS---> and <----GRS-----

        <----GRA-----   -----GRA---->

        or

        <----GRS---- and -----GRS---->

---

[10] Start up and testing of the bearer is outside the scope of this document.

```
-----GRA---->    <----GRA-----
```

> NOTE – It is also possible to have individual reset circuit messages. The diagrams do not intend to cover all possible exchange of messages (see 2.9.3).

11.2.2 Test procedures

This clause describes test procedures for the initial testing of CICs. As a minimum, it is required that an SN can actively perform the test procedure.

Procedure using a conversation test

```
-----IAM (test)---->
<-------ACM--------
<-------ANM--------
Conversation test
--------REL------->
<-------RLC--------
```

11.3   Circuit Validation Test

Not Applicable to BICC.

11.4   Software Carrier Group Alarm

Not Applicable to BICC.

11.5   Hardware Carrier Group Alarm

Not Applicable to BICC.

11.6   Maintenance Processing Control State Transition Diagrams

No state transition diagrams are documented for BICC.

12 Annex D/T1.113.4-2000 – Automatic Congestion Control System

Annex D/T1.113.4-2000 applies.

13 Annex E/T1.113.4-2000 – Hop Counter Procedure Logic Diagram

Annex E/T1.113.4-2000 applies with the following clarification:

- The use of circuit groups in BICC is for further study.

14 Exceptions to T1.113.7-2000

T1.113.7-2000 applies with the following exceptions:

- The reference to SS7 in the title is not relevant. Where the text refers to ISUP, this shall be interpreted to mean BICC.

- The subsequent clause numbers within clause 14 correspond to the numbering within T1.113.7-2000, and show exceptions or clarifications to those clauses.

14.6.2.2.1   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/T1.113.7-2000.

In this model the application logic for the APM users are considered to be within the Nodal functions (Application Process).

ISUP basic call Standard (T1.113.4-2000) includes specification of ISUP signalling 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. T1.113.7-2000 also does not define the functionality split for ISUP basic call.

The model from Figure 2/T1.113.7-2000 applied on the BICC basic call is shown in Figure 1/T1.672.4.
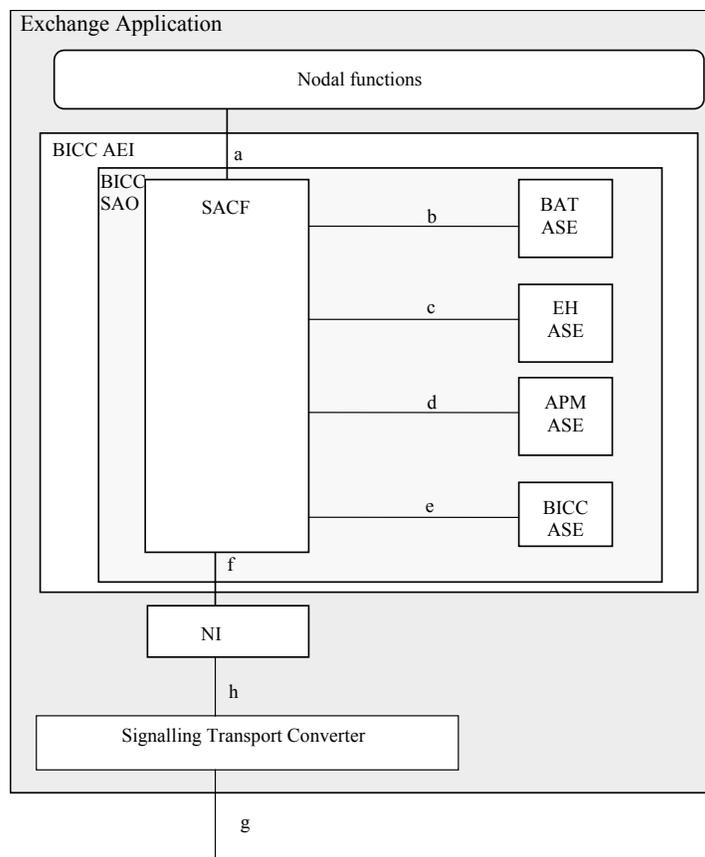
Figure 1/T1.672.4 - BICC specification model

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 signalling is not the same as ISUP signalling. 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 T1.113.7-2000). 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 3/T1.672.1, and described by the procedure text in clause 10, 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 modelling entities.

The interface (h) is the BICC Signalling Transport Service primitive interface as specified in Annex B/T1.672.4-2000 of this American National Standard while interface (g) is the specific signalling transport service, and, in case of MTP-3 signalling transport, is the same as described in T1.113.7-2000.

14.10.2.1   Normal procedures - Sending

Clause 10.2.1 of T1.113.7-2000 states that the 272 octet limit of the MTP is the reason that would cause APM segmentation to be invoked. This statement is applicable for BICC if the START-INFO.indication primitive received from the STC (see Annex B/T1.672.4-2000), 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 T1.113.3-2000.

14.12   Network Interface function

Clause 12 of T1.113.7-2000 applies with the following exceptions:

1. When the text refers to MTP, it shall be interpreted to mean the actual signalling transport.

2. When the text refers to CIC, it shall be interpreted to mean Call Instance Code.

3. When the text refers to T1.113.3-2000, it shall be interpreted to be a reference to T1.672.3-2000.

4. When the text refers to T1.113.4-2000, it shall be interpreted to be a reference toT1.672.4-2000.

5. There is one instance of signalling transport converter per signalling route, and thus the distribution function performed by the NI acts only upon the CIC value. When the signalling transport is MTP the OPC, DPC, SIO and SLS are handled within the signalling transport converter as described in Annex C.

6. Primitive interface (g) shall be replaced by the primitive interface as described in the relevant Annex to this American National Standard.

Annex A/T1.672.4-2000

(normative)

Annex A/T1.672.4-2000   Procedures for re-use of idle bearers (network option)

A.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 ISN 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 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.

A.2   Procedures

The following procedures are applied, as increments to the BICC protocol, as described in clause 2.

A.2.1   Outgoing set-up procedures

A.2.1.1 Re-use of forward idle bearer

During the forward set-up procedure (see 2.1.1.2.1.1), in response to the Bearer Set-up request (item 3.1.2), 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 set-up procedure awaits a BICC_Data indication primitive (corresponding to an APM message), with Action indicator set to *"Switched."*

The outgoing set-up procedure is now successfully completed.

A.2.1.2 Re-use of backward idle bearer

During the backward set-up procedure (see 2.1.1.2.1.2), while awaiting a Bearer Set-up indication from the BCF (item 4), 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 set-up procedure.

2. If the BCF fails to accept this request, the call instance is reset according to 2.9.3 (use of reset causes the re-alignment of system resources).

A.2.2   Incoming set-up procedures

A.2.2.1 Re-use of forward idle bearer

During the forward set-up procedure (see 2.1.1.2.2.1), while awaiting a Bearer Set-up indication from the BCF (item 5), 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 set-up procedure is now successfully completed.

2. If the BCF fails to accept this request the call instance is reset according to 2.9.3 (use of reset causes the re-alignment of system resources).

A.2.2.2 Re-use of backward idle bearer

During the backward set-up procedure (see 2.1.1.2.2.2), 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 set-up procedure is now successfully completed.

A.2.3   IAM sending control procedure

The procedure in 2.1.1.2.3 applies, except that the completion of set-up of the bearer path is indicated by completion of the incoming set-up procedure described in this Annex, instead of the various bearer events listed in that clause.

A.2.4   Codec negotiation

Codec negotiation is not applicable when re-using idle bearers.

A.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.

(normative)

Annex B/T1.672.4-2000   The BICC Signalling Transport Service

B.1   Architecture

The BICC signalling protocol can be deployed over a range of signalling transport protocol stacks (see Figure B.1/T1.672.4-2000). Two peer CSF entities rely on the BICC Signalling Transport service to provide assured data transfer between them and service availability indications; i.e., BICC messages are exchanged between peer protocol entities using the BICC signalling transport service.
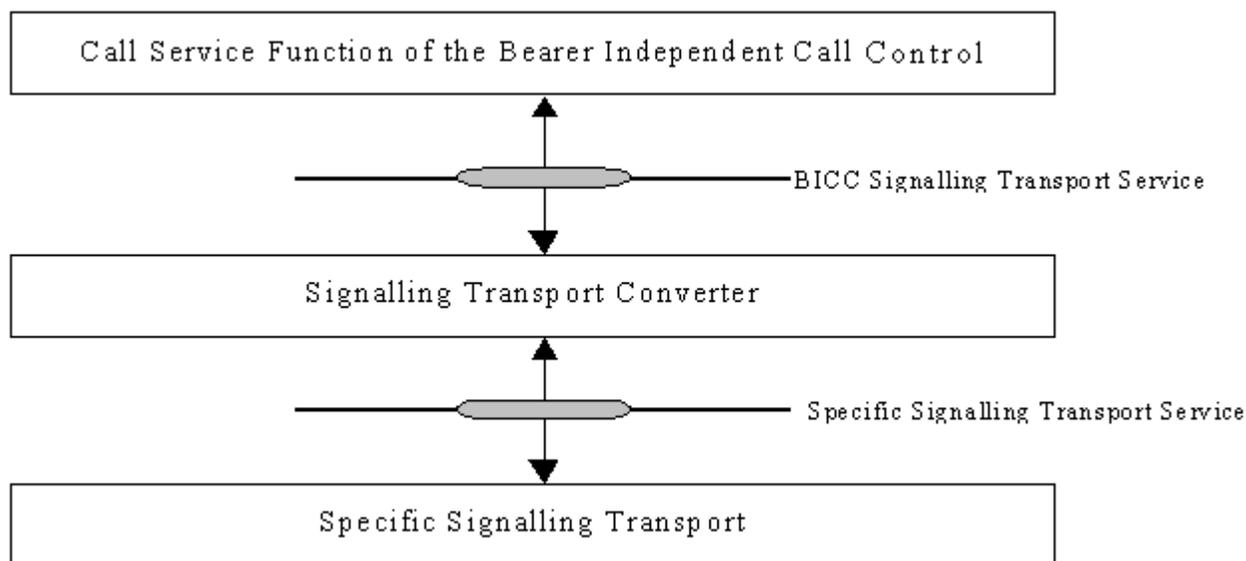
Figure B.1/T1.672.4 - Functional architecture of the CSF signalling

NOTE - In every Call Service Function (CSF), a signalling transport converter instance is associated with each BICC signalling transport, i.e., a separate signalling transport converter instance is associated with each adjacent CSF.

B.2   Definitions

For the purpose of this Annex and the Annexes defining specific Signalling Transport Converters, the following definitions apply:

B.2.1   BICC Signalling Endpoint: The termination point of an BICC signalling transport.

B.2.2   BICC Signalling Transport: The function that enables an BICC signalling entity to communicate with a peer BICC signalling entity independently of the underlying signalling transport.

B.2.3   Signalling Transport: A signalling link or network that connects two BICC nodes.

B.2.4   Signalling Transport Converter: A function that converts the services provided by a particular Signalling Transport to the services required by the Generic Signalling Transport.

B.3   The BICC Signalling Transport Service

B.3.1   Conventions

This subclause specifies the information flow across the signalling transport converter - BICC boundary. Conceptually, there exists one STC entity per signalling association. BICC transfers or receives signalling messages on a particular signalling association by utilizing a particular Service Access Point (SAP).

B.3.2   Primitive definition

The services are summarized in Table B.1/T1.672.4, and are defined as follows.

   a) **IN-SERVICE.indication**: This primitive indicates that the signalling transport is able to exchange signalling messages with the peer entity. This indication shall be provided without the BICC signalling protocol requesting any service across the SAP.

   b) **OUT-OF-SERVICE.indication**: This primitive indicates that the signalling transport is unable to exchange signalling messages with the peer entity. This indication shall be provided without the BICC signalling protocol requesting any service across the SAP.

   c) **TRANSFER.request**: This primitive is used by the BICC signalling protocol to convey a signalling message to its peer entity.

   d) **TRANSFER.indication**: This primitive provides a signalling message from the peer entity to the BICC signalling protocol.

   e) **CONGESTION.indication**: A primitive used to convey information concerning signalling network congestion.

   f) **START-INFO.indication**: This primitive indicates to BICC the maximum length of an SDU that the STC can transfer and whether this BICC is the controlling node of the call association at start-up.

Table B.1/T1.672.4 - Primitives and parameters of the BICC Signalling Transport Sublayer

| Primitive | Type | | | |
Generic Name	Request	Indication	Response	Confirm
START-INFO	-	Max_Length CIC_Control	-	-
IN-SERVICE	-	Level	-	-
OUT-OF-SERVICE	-	(Note 1)	-	-
CONGESTION	-	Level	-	-
TRANSFER	Sequence Control BICC Data Priority	BICC Data Priority	-	-
- : This primitive is not defined NOTES 1 This primitive has no parameters				

B.3.3   Parameters

a) **BICC Data**: This parameter contains a complete BICC signalling message; it represents the STC SDU.

b) **Level**: This parameter indicates the level of congestion.

c) **Sequence Control**: This parameter indicates to the STC a value that can be used by the underlying signalling transport STC for load sharing and/or in-sequence delivery.

d) **Max_Length**: This parameter indicates the maximum length of signalling messages that can be transported on this signalling association.

e) **CIC_Control**: This parameter indicates to BICC whether it serves as the controlling entity for either the odd or even CIC values on this call association.

f) **Priority**: This parameter indicates the priority of the BICC signalling message.

B.3.4   Establishment

On the establishment of an signalling transport converter entity and the associated signalling transport converter user entity (for example, at power up), the initial conditions are the same as if an OUT-OF-SERVICE.indication had been conveyed across this SAP. Also at this time, the START-INFO.indication is sent to BICC.

Annex C/T1.672.4-2000

(normative)

Annex C/T1.672.4-2000   Additional Specification for the deployment of BICC on MTP3

C.1   Scope

This Annex specifies the signalling transport converter sublayer on top of the Message Transfer Part (MTP) specified in T1.111.4-2000, "MTP3." T1.111.4-2000 specifies the peer-to-peer protocol for the transfer of information and control between any pair of MTP level 3 entities. This Annex allows for both MTP2 and SAAL as the underlying link layer below MTP3. This Annex covers the specification of the sublayer structure, the additional Protocol Data Unit (PDU) structures of the signalling transport converter sublayer, and the procedures for the provision of the signalling transport service that is specified in Annex B/T1.672.4-2000.

This Annex describes the interactions between the Signalling Transport Converter (STC) and the next higher layer, i.e., the BICC signalling protocol entity, between the STC and the Message Transfer Part, and between the STC and layer management operations.

C.2   Additional Abbreviations

DPC   Destination Point Code

MTP   Message Transfer Part

OPC   Originating Point Code

PDU   Protocol Data Unit

SDU   Service Data Unit

SIO   Service Information Octet

SLS   Signalling Link Selection Code

C.3   Structure of the signalling transport converter on MTP sublayer

The sublayer providing the STC resides on top of the Message Transfer Part. It deploys the services provided by level 3 of the Message Transfer Part defined in T1.111-2000.

The STC provides for the service that is requested by the Signalling Transport Service defined in Annex B/T1.672.4-2000, where the BICC signalling protocol makes use of this service.

This Annex specifies:

- The interactions between the STC and the BICC;

- The interactions between the STC and the MTP level 3 sublayer; and

- The interactions between the STC and layer management.

C.4   Services provided by the STC

The STC provides for the transparent transfer of data, i.e., BICC data between peer BICC entities. The supporting communication resources to achieve this transfer stay invisible to the BICC entities.

In particular, the STC service provides for:

a)   *Independence from the underlying transmission media:* The STC service relieves its users from all concerns of the manner in which the STC service is provided. Except for possible influences of the quality of service, the transfer of data over different underlying networks is thus invisible.

b)   *Transparency of the information transferred*: The STC service provides for the transparent transfer of octet-aligned BICC data. It does not restrict the content, format, or coding of the information, nor is there ever a need to interpret its structure or meaning.

c)   *Service Availability Reporting*: As the underlying service (MTP) reports about availability/unavailability of the data transfer service, after the necessary translation, these notifications are forwarded to the BICC.

C.5   Functions of the STC

The STC performs the following functions:

a)   *Data transfer service availability reporting to BICC*: This function reports the availability or unavailability of the MTP message transfer service to the BICC.

b)   *Congestion reporting to BICC*: This function translates and forwards the congestion indications provided by the MTP to the BICC.

c)   *Maximum length indication to BICC*: This function indicates to BICC the maximum length of the PDU that the STC can transfer; it is indicated at creation of the STC entity.

d)   *CIC control indication to BICC*: This function indicates to BICC, at creation of the STC entity, whether it serves as the controlling node for either the odd or even CIC values of the call association.

C.6   Elements for layer-to-layer communication

C.6.1   The BICC Signalling Transport Service

The BICC Signalling Transport Service is specified in Annex B/T1.672.4-2000.

C.6.2   The Service provided by MTP

The primitives and parameters are shown in Table C.1/T1.672.4.

NOTE - This service corresponds to the "Specific Signalling Transport Service" in Figure B.1/T1.672.4.

Table C.1/T1.672.4 - Message Transfer Part service primitives

Primitive Generic Name	Type			
	Request	Indication	Response	Confirm
MTP-TRANSFER	OPC (see 2.2/T1.111.4) DPC (see 2.2/T1.111.4) SLS (see 2.2/T1.111.4) (Note 1) SIO (see 14.2/T1.111.4) User Data (see 2.3.8/T1.111.3)	OPC (see 2.2/T1.111.4) DPC (see 2.2/T1.111.4) SLS (see 2.2/T1.111.4) (Note 1) SIO (see 14.2/T1.111.4) User Data (see 2.3.8/T1.111.3)	-	-
MTP-PAUSE (Stop)	-	Affected DPC[a)]	-	-
MTP-RESUME (Start)	-	Affected DPC[a)]	-	-
MTP-STATUS	-	Affected DPC Cause (Note 2)	-	-

- :   This primitive is not defined
a)   See 7.2.6/T1.111.1.

NOTES

1   The MTP users should take into account that this parameter is used for load sharing by the MTP, therefore, the SLS values should be distributed as equally as possible. The MTP guarantees (to a high degree of probability) an in-sequence delivery of messages that contain the same SLS code.

2   The Cause parameter has, at present, four values:

    i)   Signalling network congested (plus congestion level).

    ii)   User Part Unavailability: unknown.

    iii)   User Part Unavailability: unequipped remote user.

    iv)   User Part Unavailability: inaccessible remote user.

C.6.2.1 Primitive definition

a) **MTP-TRANSFER**: The primitive "MTP-TRANSFER" is used between level 4 and level 3 (SMH) to provide the MTP message transfer service.

b) **MTP-PAUSE**: The primitive "MTP-PAUSE" indicates to the "Users" the total inability of providing the MTP service to the specified destination.

The signalling point is inaccessible via the MTP. The MTP will determine when the signalling point is again accessible and send MTP-RESUME indication. The user should wait for such an indication and, meanwhile should not send normal messages to that signalling point. If the remote peer user is thought to be unavailable, that condition may be maintained or cancelled at the local user's discretion.

c) **MTP-RESUME**: The primitive "MTP-RESUME indicates to the "User" the ability of providing the MTP service to the specified destination

This primitive corresponds to the destination accessible state as defined in T1.111.4-2000.

When the MTP-RESUME indication is given to each user, the MTP does not know whether the remote peer user is available. This is the responsibility of each user.

d) **MTP-STATUS**: The primitive "MTP-STATUS" indicates to the "Users" the partial inability of providing the MTP service to the specified destination.

In the case of signalling link congestion with multiple priorities, the "MTP-STATUS" primitive is used to indicate a change of congestion level.

In the case of remote user unavailability, the user is responsible for determining the availability of this peer user. The user is cautioned not to send normal traffic to the peer user, because while such peer is unavailable, each message will be delivered but will result in a repeated MTP-STATUS indication. The MTP will not send any further indications about the unavailability or availability of this peer user unless interrupted by an MTP-PAUSE indication, or unless the local user continues to send messages to the peer user.

C.6.2.2 Restart

When the MTP restart procedure is terminated, the MTP indicates the end of MTP restart to all local MTP Users by sending MTP-RESUME primitives for all accessible destinations (see T1.111.4-2000, clause 9).

C.6.3 Primitives between the STC and layer management

This subclause specifies the information flow across the STC - Layer Management boundary.

The repertoire of primitives between STC and layer management is listed in Table C.2.

Table C.2/T1.672.4 - Primitives and parameters between the STC and layer management

Primitive	Type			
Generic Name	Request	Indication	Response	Confirm
MSTC-ERROR	-	Cause	-	-
- : This primitive is not defined				

C.6.3.1 Primitive definition

- **MSTC-ERROR:** MSTC-ERROR primitives are used to inform layer management about errors.

C.6.3.2 Parameters

- **Cause:** The cause parameter can indicate the following errors:
    - a) User part unavailable (unknown);
    - b) User part unavailable (inaccessible); and
    - c) User part unequipped.

C.7 Protocol Elements for Peer-to-Peer Communication

C.7.1 STC messages (STC-PDUs)

The following STC messages (PDUs) are used for exchanging information between peer STC entities:

- **BICC Signalling Message:** This PDU is used for carrying BICC signalling messages to a peer STC entity via the MTP network. The length of such a signalling message may not exceed the maximum length indicated in the Max_Length parameter. The STC is not adding any Protocol Control Information to the message.

C.7.2   STC timers

(Not specified for U. S. networks.)

C.7.3   Provisioned STC parameters

STC parameters are specified at creation of a new STC entity and remain unchanged during the lifetime of the STC entity. The following parameters are defined:

a)   **STC_DPC**: Point Code corresponding to the destination point served by the STC entity.

b)   **STC_OPC**: Point Code corresponding to the originating point served by the STC entity.

c)   **STC_SIO**: The service information octet contains the service indicator and the subservice field. The subservice field carries the network indicator bits and spare bits; the spare bits are used to indicate message priority. The network indicator must indicate to which network the signalling relation belongs. The service indicator must indicate "BICC signalling".

   NOTE - The value of the Service Indicator for the Bearer Independent Call Control is decimal "13" (see T1.111.4 Clause 14.2).

d)   **Value of Timer_Long**: (Not applicable for US networks.)

e)   **Value of Timer_Short**: (Not applicable for US networks.)

f)   **Value of Max_Length**: The value of Max_Length can be set to either "272" or "4096".

   NOTE — The Max_Length parameter is set as follows:

   •   If BICC is deployed in an MTP3 signalling relation using MTP2 links, the Max_Length parameter is set to "272".

   •   If BICC is deployed in an MTP3 signalling relation using SAAL links, the Max_Length parameter is set to "272"or "4096". The value to be provisioned is chosen by network operators.

C.8   Procedures of the STC

C.8.1   Initial Conditions

This clause specifies how the STC operates at power up.

When the STC is initialized, it determines the CIC_Control parameter and indicates it together with the maximum permitted length of a BICC signalling message to BICC in the START-INFO.indication primitive.

The CIC_Control parameter is computed the following way:

   •   If the value of the STC_OPC parameter is greater than the value of the STC_DPC parameter, then the CIC_Control will indicate to the BICC that it is the controlling node for **EVEN** CIC values of the call association.

   •   If the value of the STC_DPC parameter is greater than the value of the STC_OPC parameter, then the CIC_Control will indicate to the BICC that it is the controlling node for **ODD** CIC values of the call association.

If an MTP-RESUME.indication primitive is received by the STC, the MTP service is successfully initialized towards its peer MTP. STC then sends an IN-SERVICE.indication primitive to BICC signalling. The IN-SERVICE.indication primitive carries a Level parameter; the value of the Level parameter is mapped to

the congestion level in the MTP network. If the Level indicates congestion then the congestion indication procedure (specified in clause C.8.4) is started.

C.8.2 BICC signalling message transfer procedure

C.8.2.1 Sending a signalling message

Upon receipt of a TRANSFER.request primitive from BICC, the STC shall place the signalling message unaltered into a BICC Signalling Message PDU and derive the Signalling Link Selection Value (SLS) from the received Sequence Control parameter. It shall then transfer the PDU to the MTP using the MTP-TRANSFER.request primitive. The primitive carries the parameters shown in Table C.3/T1.672.4.

Table C.3/T1.672.4 - Parameters in the MTP-TRANSFER.request primitive

Parameter	Content
MTP User Data	unaltered BICC Signalling Message as received in the BICC Data parameter
Point code of the originating exchange	value of STC_OPC provisioned parameter
Point code of the destination exchange	value of STC_DPC provisioned parameter
Service Information Octet	value of STC_SIO provisioned parameter (Note)
Signalling Link Selection Value (SLS)	derived from received Sequence Control parameter
NOTE — The SIO is augmented, with message priority based on the value received in the Priority parameter for each message.	

C.8.2.2 Receiving a signalling message

Upon receipt of an MTP-TRANSFER.indication primitive containing a BICC Signalling Message PDU, the STC shall pass the MTP User Data unaltered to BICC in a TRANSFER.indication primitive. The TRANSFER.indication primitive conveys priority information extracted from the Service Information Octet.

C.8.3 Destination availability procedure

On the reception of a MTP-PAUSE.indication primitive, the STC takes the following action:

- If the affected destination is not a destination (Signalling Point) known by the STC, no action takes place.

- If the affected destination is a destination (Signalling Point) known by the STC, an OUT-OF-SERVICE.indication primitive is transmitted to BICC.

On the reception of a MTP-RESUME.indication primitive, the STC takes the following action:

- If the affected destination is not a destination (Signalling Point) known by the STC, no action takes place.

- If the affected destination is a destination (Signalling Point) known by the STC, an IN-SERVICE.indication primitive is transmitted to BICC. The IN-SERVICE.indication primitive carries a Level parameter; the value of the Level parameter is mapped to the congestion level in the

MTP network. If the Level indicates congestion then the congestion indication procedure (specified in clause C.8.4) is started.

C.8.4   Congestion Indication procedure

On receipt of a MTP-STATUS.indication primitive with the cause set to "signalling network congestion", the STC acts as follows:

- A CONGESTION.indication primitive with the parameter Level indicating congestion shall be issued towards BICC. The value of the Level parameter shall be mapped to the congestion level in the MTP network.

C.8.5   User Part availability

On receipt of an MTP-STATUS.indication primitive with the cause parameter set to "user part unavailability – unknown," "user part unavailability - inaccessible remote user," or "user part unavailability - unequipped remote user," BICC shall be informed via an OUT-OF-SERVICE.indication primitive, and an MSTC-ERROR.indication primitive with the cause parameter set to the value indicated in Table C.4/T1.672.4 shall be issued. If the STC receives an MTP-TRANSFER.indication primitive, it will issue an IN-SERVICE.indication primitive prior to performing the procedure specified in C.8.2.2. The IN-SERVICE.indication primitive carries a Level parameter; the value of the parameter is mapped to the congestion level in the MTP network dependent. If the Level indicates congestion then the congestion indication procedure (specified in clause C.8.3) is started.

Table C.4/T1.672.4 - Cause parameter mapping

Cause parameter in MTP-STATUS.indication	Cause parameter in MSTC-ERROR.indication
user part unavailability - unknown	user part unavailable (unknown)
user part unavailability - inaccessible remote user	user part unavailable (inaccessible)
user part unavailability - unequipped remote user	user part unequipped

Annex D/T1.672.4-2000

(Normative)

Annex D/T1.672.4-2000 Additional Specification for the deployment of BICC on SSCOP and on SSCOPMCE

D.1 Scope

This Annex specifies the signalling transport converter sublayer directly on top of the Service Specific Connection Oriented Protocol (SSCOP) -- which specifies the peer-to-peer protocol for the transfer of information and control between any pair of SSCOP entities. Operation of SSCOP in a point-to-point environment is specified in T1.637-1999. In a multi-link or connectionless environment, its operation (SSCOPMCE) is specified in ITU-T Recommendation Q.2111. Since the service provided by either of these Recommendations is the same, this Annex only describes the actions in terms of T1.637-1999 for clarity of expression. This BICC signalling transport converter on SSCOP can be deployed on any protocol stack that supports SSCOP. This Annex covers the specification of the sublayer structure, the PDU structures of the signalling transport converter sublayer, and the mechanisms for the provision of the signalling transport service that is specified in Annex B/T1.672.4-2000.

This Annex describes the interactions between the STC and the next higher layer, i.e., the BICC signalling protocol entity, between the STC and the SSCOP, and between the STC and layer management.

D.2 Definitions

This Annex is based upon the concepts developed in T1.637-1999, and makes use of the following terms defined in that Recommendation:

a) Service Specific Coordination Function;

b) Service Specific Connection Oriented Protocol.

D.3   Additional Abbreviations

ATM	Asynchronous Transfer Mode
BR	Buffer Release
CPCS	Common Part Convergence Sublayer
MU	Message Unit
PDU	Protocol Data Unit
SAP	Service Access Point
SDU	Service Data Unit
SSCOP	Service Specific Connection Oriented Protocol (T1.637-1999)
SSCOPMCE	Service Specific Connection Oriented Protocol in a multi-link or Connectionless Environment (Q.2111)
SSCOP-UU	SSCOP user-to-user information
SSCS	Service Specific Convergence Sublayer

D.4   Structure of the signalling transport converter on SSCOP sublayer

The sublayer providing the STC resides on top of the Service Specific Convergence Sublayer (SSCS) of the ATM Adaptation Layer (AAL). It deploys the services provided by the SSCOP defined in T1.637-1999. SSCOP also resides in the SSCS.

In the SSCS, the Service Specific Coordination Function is "Null" in the sense that the primitives for the AAL are equivalent to the SSCOP primitives (see clause D.7.2) but identified as AAL-primitives instead of AA-signals consistent with the primitive naming convention at a SAP (see clause 6.1/T1.637[13]).

The STC provides for the service that is requested by the Signalling Transport Service defined in Annex B/T1.672.4-2000, where the BICC signalling protocol makes use of this service. The STC is relying on the assured data transfer service of SSCOP.

This Annex specifies:

- The interactions between the STC and the BICC signalling protocol;
- The interactions between the STC and the SSCOP sublayer; and
- The interactions between the STC and layer management.

D.5   Services provided by the STC

The STC provides for the transparent transfer of data, i.e., BICC data between peer BICC entities. The supporting communication resources to achieve this transfer stay invisible to the BICC.

In particular, the STC service provides for:

a) *Independence from the underlying transmission media*: The STC service relieves its users from all concerns of the manner in which the STC service is provided. Except for possible influences of the quality of service, the transfer of data over different underlying networks is thus invisible.

b) *Transparency of the information transferred*: The STC service provides for the transparent transfer of octet-aligned BICC data. It does not restrict the content, format, or coding of the information, nor is there ever a need to interpret its structure or meaning.

c) *Connection establishment and release*: The STC service provides for a permanent connection service. As the underlying service (SSCOP) needs to have a connection established, the STC establishes and maintains this connection on behalf of its user; the user is informed about the availability of the assured data transfer service.

NOTE - The establishment of any connection below the SSCOP is outside the scope of this Recommendation.

D.6 Functions of the STC

The STC performs the following functions:

a) *Connection establishment and maintenance*: This function provides for the establishment and maintenance of an SSCOP-connection. Upon a connection release by SSCOP, a connection re-establishment is attempted.

NOTE - The connection below the sublayer specified in T1.637-1999 may be established either on demand or permanently.

b) *Connection availability reporting to the BICC*: This function reports the availability or unavailability of the SSCOP-connection to the user of the STC.

c) *Maximum length indication to BICC*: This function indicates to BICC the maximum length of the PDU that the STC can transfer; it is indicated at creation of the STC entity.

d) *CIC control indication to BICC*: This function indicates to BICC, at creation of the STC entity, whether it serves as the controlling node for either the odd or even CIC values of the call association.

In addition, the following SSCOP services are utilized (see T1.637-1999):

e) Sequence Integrity of STC-SDUs.

f) Error Correction of STC-SDUs.

g) Flow Control of STC-SDUs.

h) Keep alive.

D.7 Elements for layer-to-layer communication

D.7.1 The BICC signalling transport service

The BICC Signalling Transport Service is specified in Annex B/T1.672.4-2000.

D.7.2 The Service provided by SSCOP

This clause specifies the information flow across the BICC signalling transport converter - AAL SSCOP boundary. This boundary is defined in T1.637-1999 clause 6.1, and summarized below. In the event of

any difference between the following summary and the definitions in T1.637-1999, the definitions in T1.637-1999 take precedence.

> NOTE — This service corresponds to the "Specific Signalling Transport Service" in Figure B.1/T1.672.4.

The repertoire of AAL-primitives between STC and SSCOP is defined in Table D.1/T1.672.4.

D.7.2.1 Primitive definition

The definition of these primitives is as follows:

a) **AAL-ESTABLISH**: The AAL-ESTABLISH primitives are used to establish a point-to-point connection for assured information transfer between peer user entities.

b) **AAL-RELEASE**: The AAL-RELEASE primitives are used to terminate a point-to-point connection for assured information transfer between peer user entities.

c) **AAL-DATA**: The AAL-DATA primitives are used for the assured point-to-point transfer of SDUs between peer user entities.

d) **AAL-RESYNC**: The AAL-RESYNC primitives are used to resynchronize the SSCOP connection.

> NOTE 1 - The AAL-RESYNC primitives are not used actively by the protocol specified in this standard; however, to provide robustness the indication and response primitives are specified nevertheless.

e) **AAL-RECOVER**: The AAL-RECOVER primitives are used during recovery from protocol errors.

> NOTE 2 - In the absence of protocol errors, the AAL-RECOVER primitives will not be used; however, to provide robustness the indication and response primitives are specified nevertheless.

> NOTE 3 - The AAL-UNITDATA, AAL-RETRIEVE, and AAL-RETRIEVE-COMPLETE primitives are not used by the STC entity specified in this Annex.

Table D.1/T1.672.4 - SSCOP primitives and parameters

Primitive	Type			
Generic Name	**Request**	**Indication**	**Response**	**Confirm**
AAL-ESTABLISH	SSCOP-UU BR	SSCOP-UU	SSCOP-UU BR	SSCOP-UU
AAL-RELEASE	SSCOP-UU (Note 2)	SSCOP-UU Source	-	(Note 1) (Note 2)
AAL-DATA	MU	MU SN	-	-
AAL-RESYNC	SSCOP-UU (Note 2)	SSCOP-UU	(Note 1)	(Note 1) (Note 2)
AAL-RECOVER	-	(Note 1)	(Note 1)	-
AAL-UNITDATA	MU (Note 2)	MU (Note 2)	-	-
AAL-RETRIEVE	RN (Note 2)	MU (Note 2)	-	-
AAL-RETRIEVE COMPLETE	-	(Note 1) (Note 2)	-	-
- : This primitive is not defined				
NOTES				
1 This primitive has no parameters.				
2 This primitive is not used by the STC.				

D.7.2.2 Parameter definition

Table D.1/T1.672.4-2000 lists the parameters associated with each SSCOP primitive. The definition of the parameters is as follows:

a)   **MU** (Message Unit): The Message Unit parameter is used during information transfer to convey a variable-length message. In AAL-DATA.request primitives, this parameter is mapped transparently into the Information field of an SSCOP PDU. For AAL-DATA.indication primitives, this parameter contains the contents of the information field of the received SSCOP PDU.

b)   **SSCOP-UU** (SSCOP user-to-user information): The STC does not make use of this parameter. When issuing "request" or "response" primitives, this parameter has length zero; on receiving it in "indication" or "confirm" primitives, this parameter is ignored.

c)   **SN** (sequence number): The STC does not make use of this parameter. When receiving it in the DATA.indication primitive, this parameter is ignored.

d)   **BR** (buffer release): The STC does not make use of the functionality of this parameter. In both, the AAL-ESTABLISH.request and AAL-ESTABLISH.response primitives, this parameter is set to "Yes".

e)   **Source**: The source parameter indicates to the SSCOP user whether the SSCOP layer or the peer SSCOP user originated the connection release. This parameter assumes one of two values: "SSCOP" or "User". If "SSCOP" is indicated, the user should disregard the SSCOP-UU parameter, if present.

Any other parameters are ignored.

D.7.3   Primitives between the STC and layer management

Error indications to layer management are performed by the lower layers and no additional error indications are required from the STC. No primitives between the STC and layer management need to be defined.

D.8   Protocol Elements for STC Communication

The STC utilizes the mechanisms provided by the underlying sublayer (SSCOP, T1.637-1999). In particular:

- In order to provide the assured data transfer service and report the availability of this transport to its user, the STC uses the connection establishment and release service of SSCOP, i.e., the primitives AAL-ESTABLISH and AAL-RELEASE. No additional information is conveyed via the SSCOP-UU parameter.

- Data transfer utilizes SSCOP's assured data transfer service including the imbedded flow control mechanism.

- The use of SSCOP's resynchronization service by the peer STC entity is an error and is ignored, i.e., the Data Transfer Ready state is re-entered immediately.

- SSCOP's error recovery service is ignored, i.e., the Data Transfer Ready state is re-entered immediately.

- SSCOP's unassured data transfer service is not used, i.e., the STC never issues the primitives AAL-UNITDATA.request and ignores received AAL-UNITDATA.indication primitives.

- SSCOP's data retrieval service is not used, i.e., the STC never issues the primitives AAL-RETRIEVE-request and, hence, never receives the primitives AAL-RETRIEVE.indication and AAL-RETRIEVE-COMPLETE.indication.

D.8.1   STC PDUs

The STC has no need of its own special PDUs; the SDUs received from the STC user are transmitted via the AAL-DATA primitives without any additional protocol control information. The PDU parameter of the TRANSFER primitives at the upper boundary of the STC are mapped unchanged to the MU parameter of the DATA primitives at the lower boundary and vice versa.

D.8.2   STC state variables

The STC maintains no state variables.

D.8.3   STC timers

The STC entity requires the following timer:

- **Timer_DELAY**: If the STC procedure is in state "1.1" (Idle), the Timer_DELAY is running. It protects the unnecessary consumption of resources if an SSCOP connection could not be established or has been released. During the time when Timer_DELAY is running, the STC

service is unavailable. Expiry of this timer leads to a re-establishment attempt of the SSCOP connection.

D.8.4   Provisioned STC parameters

STC parameters are specified at the creation of a new STC entity and remain unchanged during the lifetime of the STC entity. The following parameters are defined:

    a) a) **Value of Max_Length :** The value of Max_Length can be set to either "272", "4096", or "65,328". The value to be provisioned is chosen by network operators.

    b) **CIC_Control:** This value is used in the CIC_Control parameter of the START-INFO primitive; it indicates to BICC whether BICC controls the **EVEN** or **ODD** CIC values of the call association.

> NOTE - One STC of the signalling association must control the odd CIC values; the other must control the even CIC values. Inconsistent provisioning will result in faulty operation of the BICC dual seizure procedure.

    c) **Value of Timer_DELAY:** The value of Timer_DELAY can be in the range of 800 to 1500 ms.

D.9   Specification of the STC

D.9.1   Initial Conditions

This clause specifies how the STC operates at power up.

When the STC is initialised, it indicates the value of the CIC_Control and the Max_Length parameter to BICC using the START-INFO.indication primitive. After issuing the START-INFO primitive, it executes the actions, which are due after the expiry of Timer_DELAY in state Idle (see Table D.2/T1.637-1999).

D.9.2   State Transition Table

The following states are used in this specification. The states are conceptual and reflect general conditions of the STC entity in the sequences of primitives and PDU exchanges with its user, underlying sublayer.

State 1   Idle
    In this state, no service is available. No data is received, if the STC user submits data for transfer with the TRANSFER.request primitive, the primitive is ignored.

State 2   Outgoing Connection Pending
    In this state, no service is available. The STC instructed SSCOP to establish a new connection with its peer and awaits the peer's response. No data is received, if the STC user submits data for transfer with the TRANSFER.request primitive, the primitive is ignored.

State 3   Data Transfer Ready
    In this state, service is available and data transfer takes place.

D.9.3　State Transition Table

The State Transition Table (Table D.2/T1.672.4-2000) for STC describes the primitives and primitives that lead to state transitions.

Table D.2/T1.672.4 - State transition table

| Event | State | | |
	1 Idle	2 Outgoing Connection Pending	3 Data Transfer Ready
AAL-ESTABLISH.indication	reset Timer_DELAY AAL-ESTABLISH. response IN-SERVICE. indication (Level := 0) → 2.10	—	—
AAL-ESTABLISH.confirm	—	IN-SERVICE. indication (Level := 0) → 2.10	—
AAL-RELEASE.indication	—	set Timer_DELAY → 1.1	OUT-OF-SERVICE. indication set Timer_DELAY → 1.1
AAL-DATA.indication	—	—	TRANSFER.indication → 2.10
AAL-RECOVER.indication	—	—	AAL-RECOVER. response → 2.10
TRANSFER.request	—	—	AAL-DATA.request → 2.10
Timer_DELAY expiry	AAL-ESTABLISH. request → 1.2	—	—

Annex E/T1.672.4-2000

(Normative)

Annex E/T1.672.4-2000   Interworking with ISUP at an ISN

E.1   Scope

This Annex defines the procedures to be performed at an ISN that interfaces to an SCN using ISUP signalling. Such a node is illustrated by Figure E.1/T1.T1.672.4.
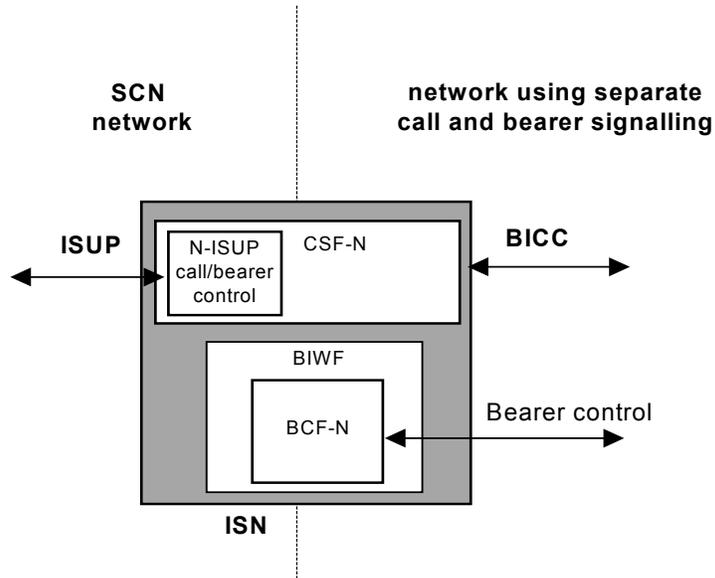
Figure E.1/T1.672.4 - ISUP ISN Functional model

E.2   General

The protocol at the ISUP interface shall be according to the ISUP American National Standard (see T1.113-2000).

The protocol at the BICC interface shall be according to this American National Standard.

Transfer of signalling information between the two signalling interfaces shall be done as if the ISN was a ISUP intermediate exchange. Since both protocols use signalling information defined in T1.113.3-2000, a one-to-one mapping is performed (unless explicitly specified to the contrary in this American National Standard).

The ISN may act as a Type A or Type B exchange for the purposes of the Compatibility procedure.

The following clauses detail the only exceptions to the above statements.

E.3   Incoming ISUP, outgoing BICC, (Incoming ISN)

E.3.1   Successful call set-up

E.3.1.1 IAM sending control procedure

Clause 2.1.1.2.3 is replaced by the following procedure:

> This procedure arbitrates between the incoming and outgoing set-up procedures to determine when the IAM and COT messages are to be sent forward, depending on events received by the incoming signalling.

> The Incoming ISUP Continuity check procedures in T1.113.4-2000 apply. No continuity check test is performed by BICC.

> The IAM is sent when determined by the outgoing selection procedures in 2.1.1.2 or 2.1.2.2. The Continuity Check indicator in the Nature of Connection Indicators parameter is set according to T1.113.4-2000 procedures (either *"continuity check performed on previous circuit"* or *"continuity check not required"* can be sent). The sending of the IAM is done by invoking the BICC Outgoing set-up procedures (see 2.1.1.2.1).

> The Continuity message, with the Continuity Indicators parameter set to *"continuity check successful"* is sent when received from ISUP, according to T1.113.4-2000 intermediate exchange procedures.

E.3.1.2 Through connection of the bearer path

Clause 2.1.1.2.6 is replaced by the following procedure:

- The bearer path may be connected in both directions when the BICC Outgoing set-up procedure is successfully completed.

- In addition, if BICC is performing the "Per-call bearer set-up in the forward direction" Outgoing set-up procedure and the Connect Type is *"notification not required"*, the bearer path may be connected in both directions when the Bearer Set-up request is sent.

- Clause 2.1.1.2 item 3) specifies when through connection shall be completed.

E.3.2   Call release

Clause 2.3.1 b) is replaced by the following procedure:

> b)   Actions at an incoming ISN:

> On receipt of a release message from the preceding exchange, an intermediate exchange:

> i)   Immediately starts the release of the switched path; when the circuit is re-selectable, a release complete message is returned to the preceding exchange.

> ii)   At the same time as the start of the release of the switched path, sends a release message to the succeeding exchange. Timers T_1 and T_5 are started to ensure that a release complete message is received from the succeeding exchange (expiration of timers T_1 and T_5 is covered in 2.9.6).

> iii)   When the Release Complete message is received timers T_1 and T_5 are stopped and call release at the outgoing side is indicated to the BCF. The Cause parameter in the original Release message is passed to the BCF.

E.4   Incoming BICC, outgoing ISUP, (Outgoing ISN)

E.4.1   Successful call set-up

E.4.1.1 IAM sending control procedure

Clause 2.1.1.2.3 is replaced by the following procedure:

This procedure arbitrates between the incoming and outgoing set-up procedures to determine when the IAM and COT messages are to be sent forward, depending on events received by the incoming signalling.

When the outgoing signalling is ISUP the T1.113.4-2000 procedures apply, with the following clarifications and exceptions with regards to when IAM and Continuity messages are to be sent:

Two cases are supported:

1. Sending an early IAM, using the continuity check protocol to withhold call completion until establishment of the bearer is complete.

2. Withholding the sending of the 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 determined by the outgoing selection procedures in 2.1.1.2 or 2.1.2.2. 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 *"continuity check performed on previous circuit"*, a Continuity message, with the Continuity Indicators parameter set to *"continuity check successful"* shall be received.

2. One of the following events, which indicate successful completion of bearer set-up, shall also be received by the incoming 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 case where the incoming Connect Type is *"notification required"*.

    2.3. Bearer Set-up Connect indication – for the backward bearer set-up case.

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 *"continuity check performed on previous circuit"*, a Continuity message, with the Continuity Indicators parameter set to *"continuity check successful"* shall be received.

2. One of the following events, which indicate successful completion of bearer set-up, shall be received by the incoming set-up procedure:

   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 case where the incoming Connect Type is *"notification required"* .

   2.3. Bearer Set-up Connect indication – for the backward bearer set-up case.

E.4.1.2 Through connection of the bearer path

Clause 2.1.1.2.6 is replaced by the following procedure:

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

- The Incoming set-up procedure is successfully completed, and;

- If the ISUP continuity check procedure is being performed, when conditions on the outgoing circuit allow (see clause 2.1.6).

Clause 2.1.1.2 item 3) specifies when through connection shall be completed.

E.4.2   Call release

Clause 2.3.1 b) is replaced by the following procedure:

b)   Actions at an outgoing ISN:

On receipt of a release message from the preceding exchange, an intermediate exchange:

i)   ~~immediately starts the release of the switched path; when the circuit is re-selectable,~~ 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 side is indicated. When the BCF acknowledges successful disconnection of the bearer path a Release Complete message is returned to the preceding exchange.

ii)   At the same time as the start of the release of the switched path, sends a release message to the succeeding exchange. Timers T_1 and T_5 are started to ensure that a release complete message is received from the succeeding exchange (expiration of timers T_1 and T_5 is covered in 2.9.6).

Annex F/T1.672.4-2000

(Informative)

Annex F/T1.672.4-2000   Message Flow Examples

F.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).

- 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 signalling flows between BCFs are generalised flows, not relating to any specific bearer control protocol.

- The only flows shown between CSF and BCF are those directly related to signalling 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. This is performed as described in 2.1.1.2.6.

F.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. Use of idle backbone network connection, established in the forward direction.

    1.5. Use of idle backbone network connection, established in the backward direction.

    1.6. Multi-network example.

2. Codec negotiation:

    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.

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.
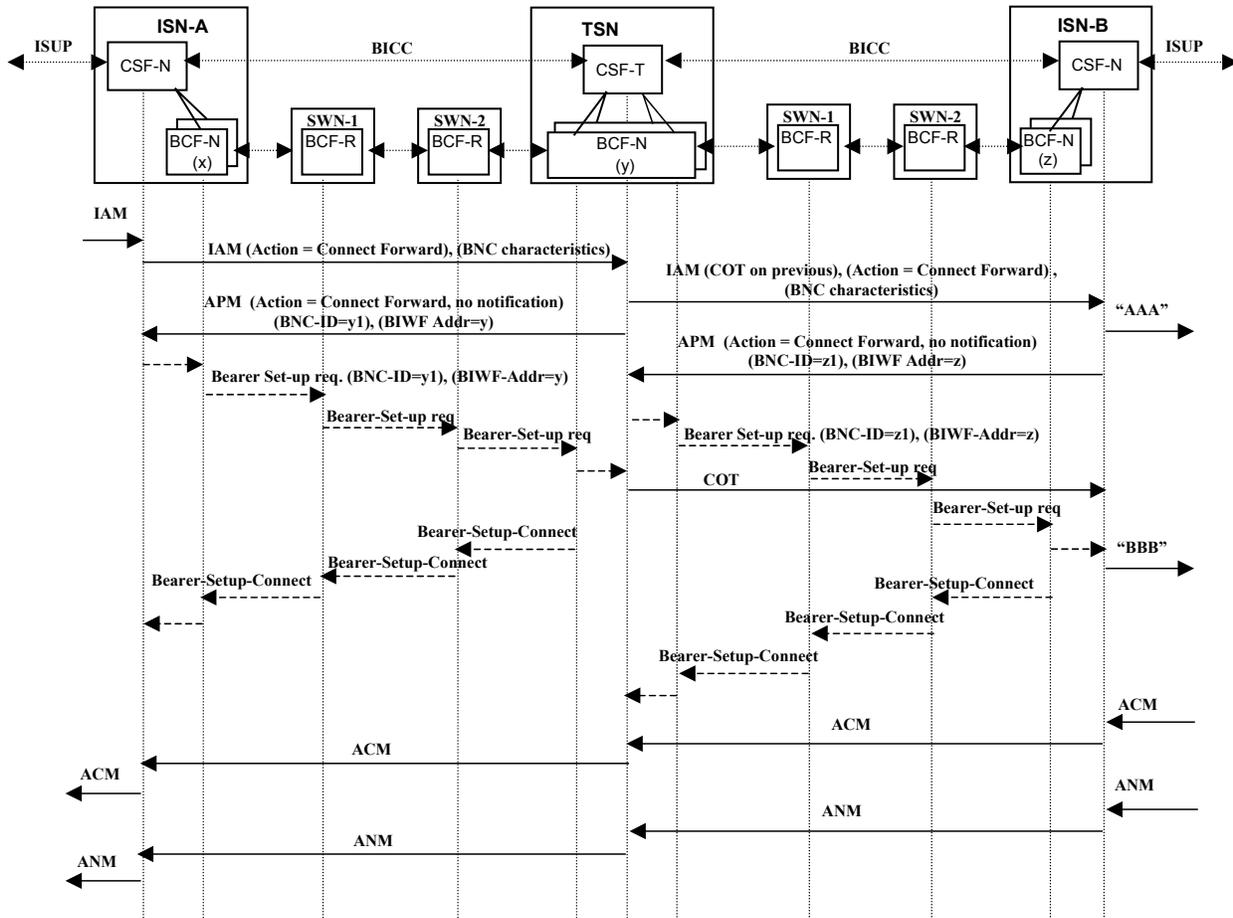
Figure F.1/T1.672.4 - Forward establishment of backbone network connection, no notification of bearer connect required.

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 *"continuity check performed on previous circuit"*	COT indicating *"continuity check successful"*
Continuity is not supported:	No message is sent at this time	IAM indicating *"continuity check not required"*

Figure F.2/T1.672.4 - Forward establishment of backbone network connection, notification of bearer connect is required.

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 *"continuity check performed on previous circuit"*	COT indicating *"continuity check successful"*
Continuity is not supported:	No message is sent at this time	IAM indicating *"continuity check not required"*

Figure F.3/T1.672.4 - Backward establishment of backbone network connection

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 *"continuity check performed on previous circuit"*	COT indicating *"continuity check successful"*
Continuity is not supported:	No message is sent at this time	IAM indicating *"continuity check not required"*

Figure F.4/T1.672.4 - Use of idle backbone network connection, established in the forward direction

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 *"continuity check performed on previous circuit"*	COT indicating *"continuity check successful"*
Continuity is not supported:	No message is sent at this time	IAM indicating *"continuity check not required"*

Figure F.5/T1.672.4 - Use of idle backbone network connection, established in the backward direction

NOTE - The messages AAA and BBB are dependent on whether the Continuity procedure is supported in the subsequent SCN:

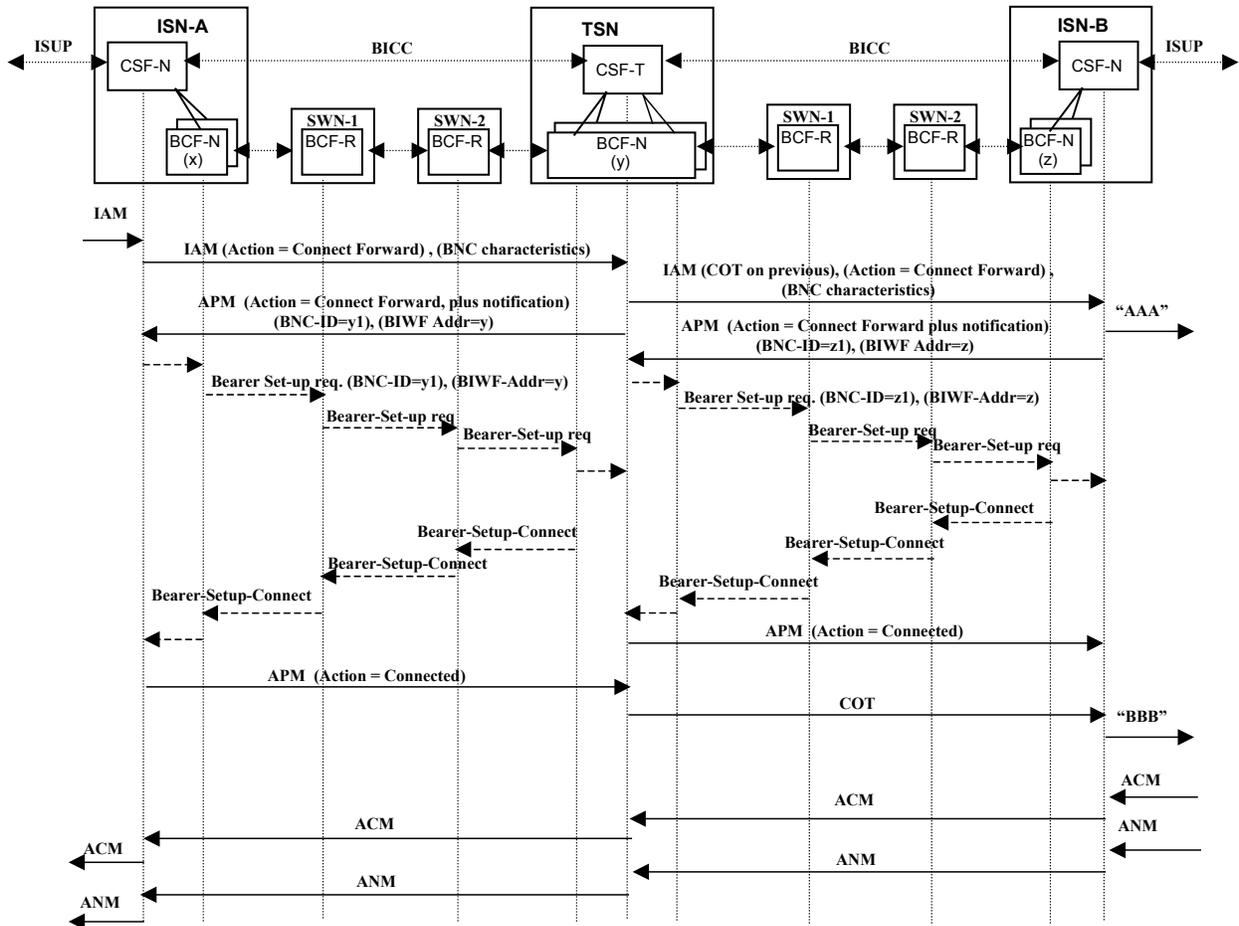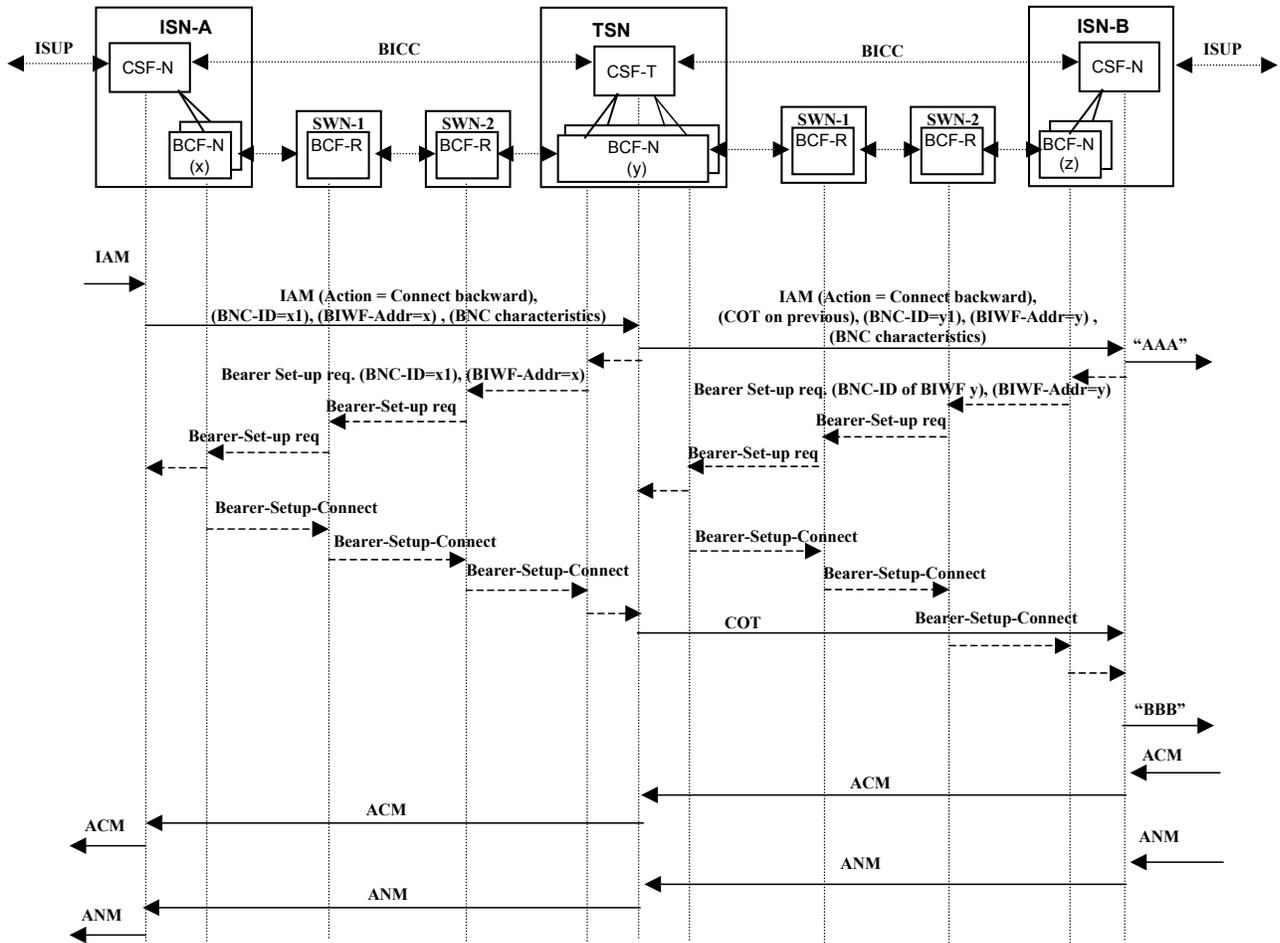| Case	Message AAA	Message BBB
Continuity is supported:	IAM indicating *"continuity check performed on previous circuit"*	COT indicating *"continuity check successful"*
Continuity is not supported:	No message is sent at this time	IAM indicating *"continuity check not required"*

Network 1 | Network 2

ISN-A — CSF-N — BCF-N (w)
BICC
SWN-1 — BCF-R
GSN — CSF-G — BCF-N (x)
BICC
GSN — CSF-G — BCF-N (y)
BICC
SWN-2 — BCF-R
ISN-B — CSF-N — BCF-N (z)

ISUP

IAM

IAM (Action = Connect Forward) , (BNC characteristics)

IAM (COT on previous), (Action = Connect Forward) , (BNC characteristics)

APM (Action = Connect Forward, plus notification) (BNC-ID=x1), (BIWF Addr=x)

Bearer Set-up req. (BNC-ID=x1), (BIWF-Addr=x)

APM (Action = Connect Forward, no notification) (BNC-ID=y1), (BIWF Addr=y)

IAM (Action = Connect Backward), (COT on previous), (BNC-ID=y2), (BIWF-Addr=y) , (BNC characteristics)

Bearer-Set-up req

"AAA"

Bearer-Setup-Connect

Bearer Set-up req. (BNC-ID=y1), (BIWF-Addr=y)

Bearer-Setup-Connect

APM (Action = Use Idle), (BNC-ID=y3)

APM (Action = Connected)

COT

APM (Action = Switched)

Bearer-Setup-Connect

COT

"BBB"

ACM

ACM

ACM

ACM

ANM

ANM

ANM

ANM

Figure F.6/T1.672.4 - Multi-network example: Connect forward, plus notification, followed by Connect forward, no notification, followed by Connect backward, re-use of idle bearer

NOTE - The messages AAA and BBB are dependent on whether the Continuity procedure is supported in the subsequent SCN:

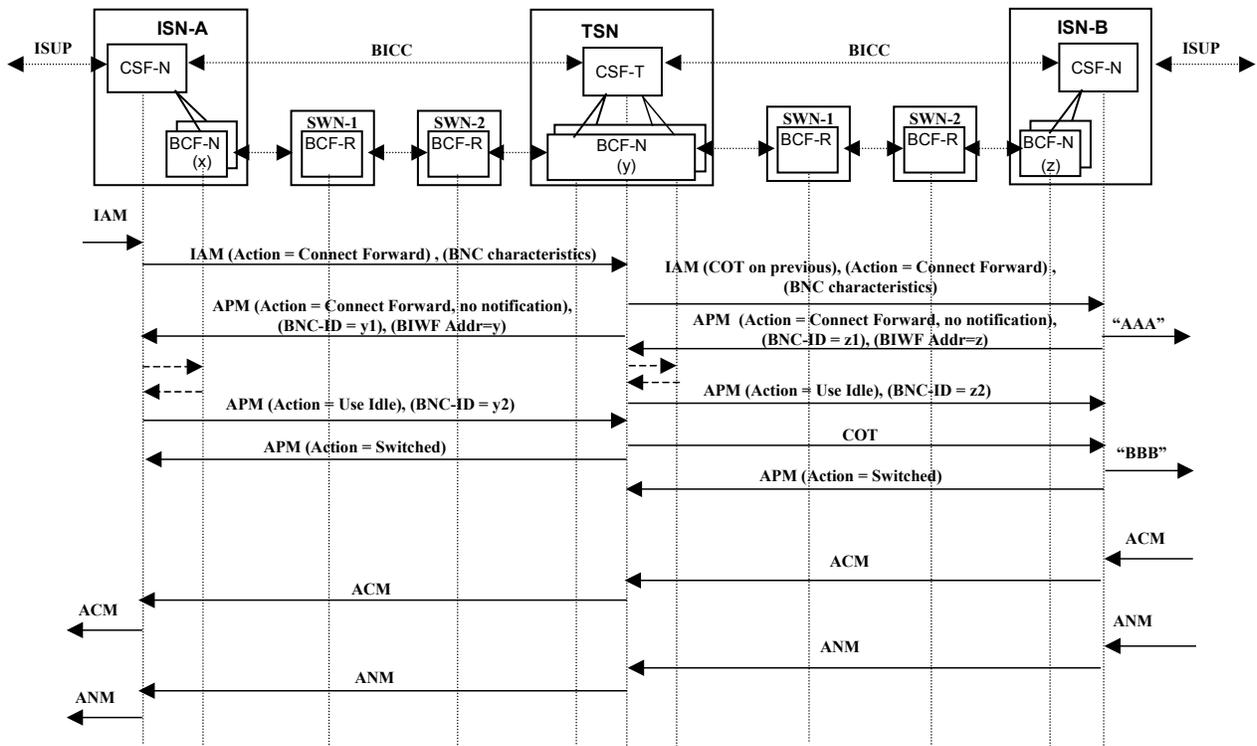| Case	Message AAA	Message BBB
Continuity is supported:	IAM indicating *"continuity check performed on previous circuit"*	COT indicating *"continuity check successful"*
Continuity is not supported:	No message is sent at this time	IAM indicating *"continuity check not required"*

Figure F.7/T1.672.4 - Forward establishment of backbone network connection (plus notification of bearer connect), with Codec negotiation

NOTE - The messages AAA and BBB are dependent on whether the Continuity procedure is supported in the subsequent SCN:

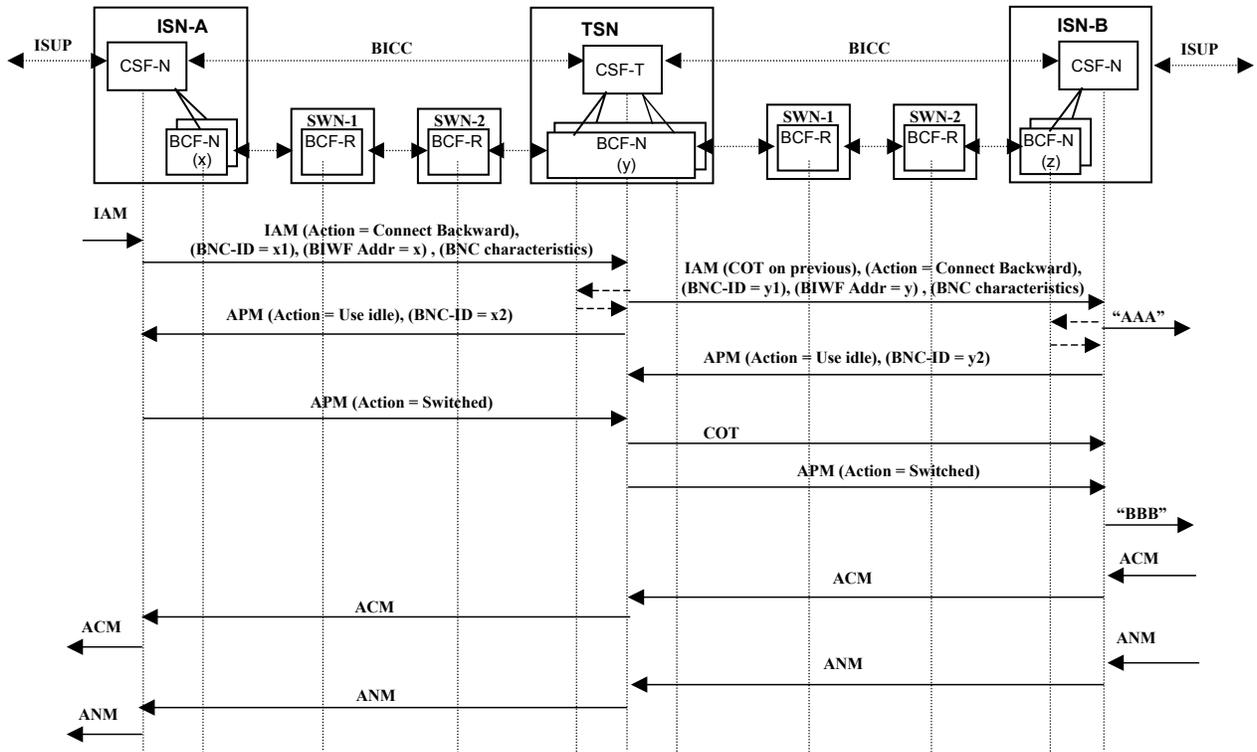| Case	Message AAA	Message BBB
Continuity is supported:	IAM indicating *"continuity check performed on previous circuit"*	COT indicating *"continuity check successful"*
Continuity is not supported:	No message is sent at this time	IAM indicating *"continuity check not required"*

Figure F.8/T1.672.4 -Backward establishment of backbone network connection, with Codec negotiation

NOTE - The messages AAA and BBB are dependent on whether the Continuity procedure is supported in the subsequent SCN:

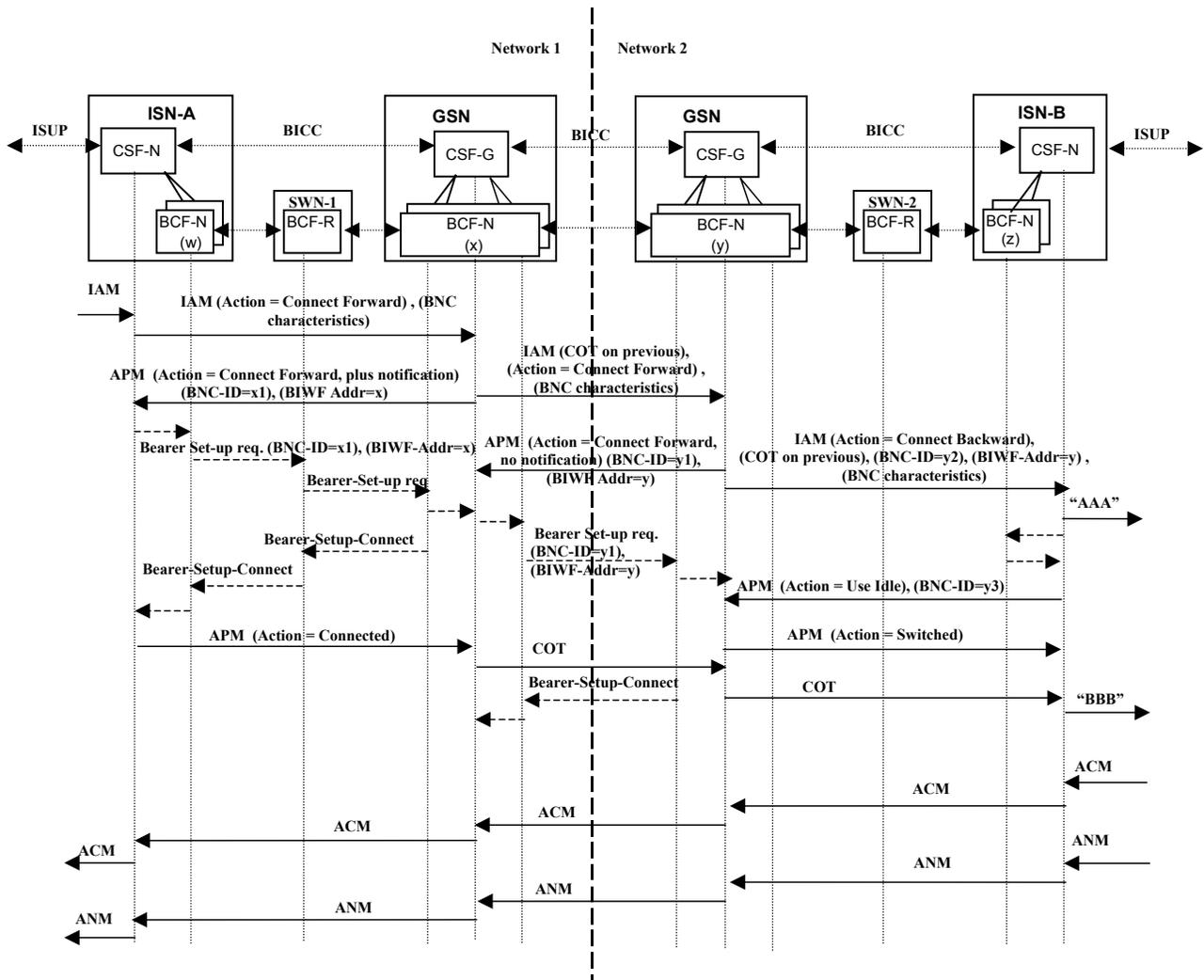| Case	Message AAA	Message BBB
Continuity is supported:	IAM indicating *"continuity check performed on previous circuit"*	COT indicating *"continuity check successful"*
Continuity is not supported:	No message is sent at this time	IAM indicating *"continuity check not required"*

Figure F.9/T1.672.4 - Codec modification
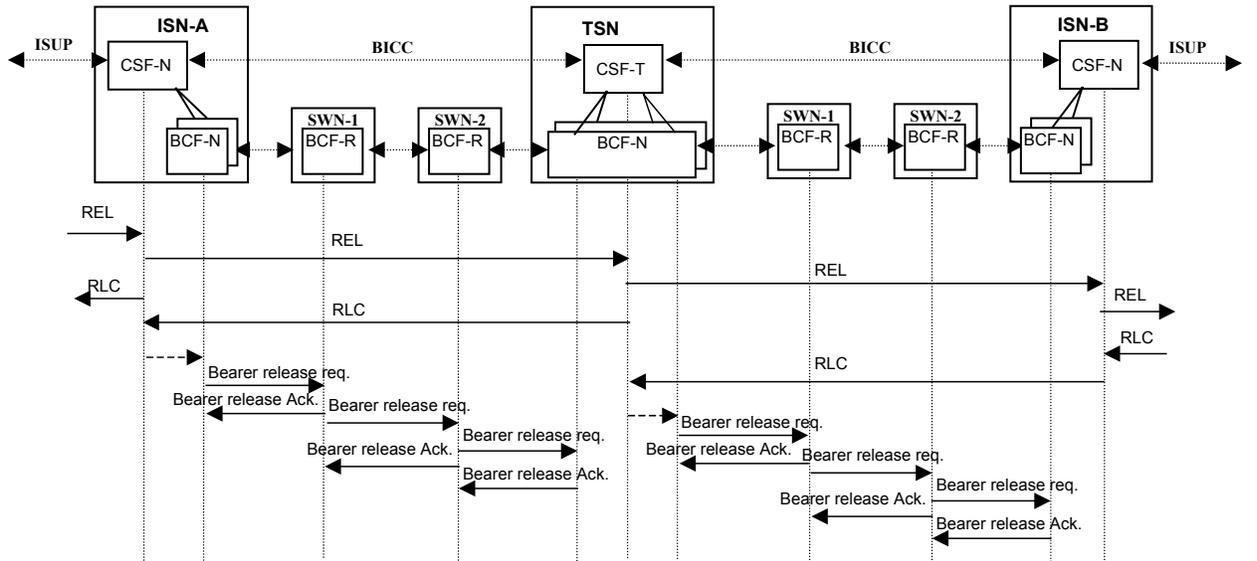
Figure F.10/T1.672.4 - Forward call and bearer release; Forward bearer set-up
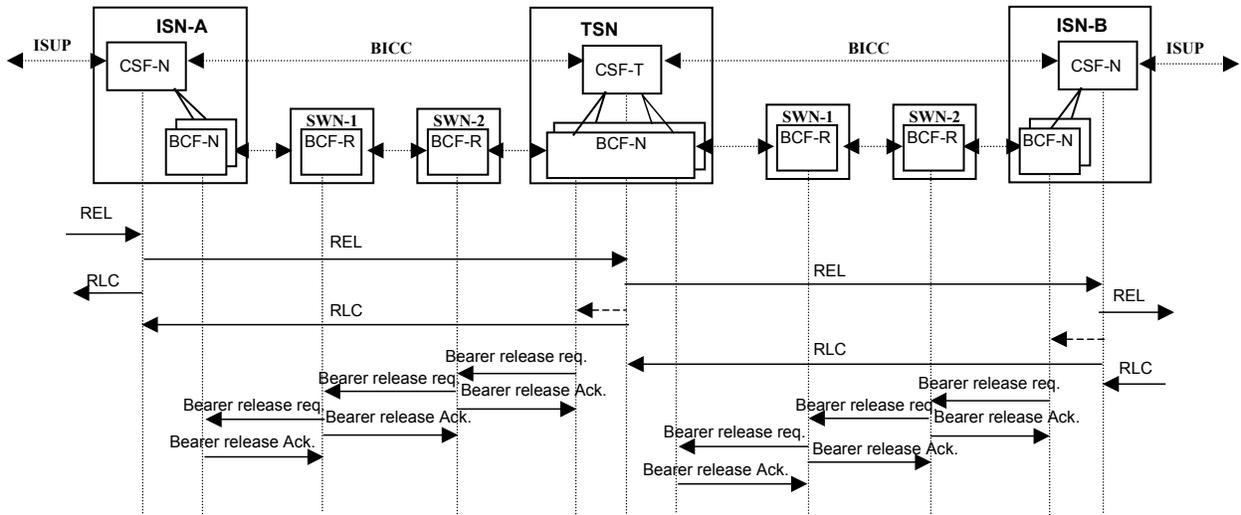
Figure F.11/T1.672.4 - Forward call and bearer release; Backward bearer set-up
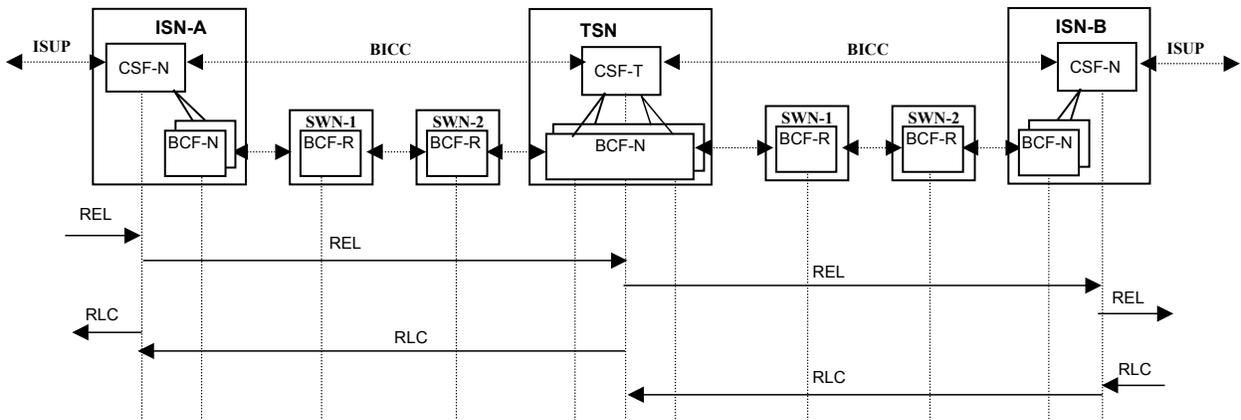
Figure F.12/T1.672.4 - Forward call release; Bearers not released
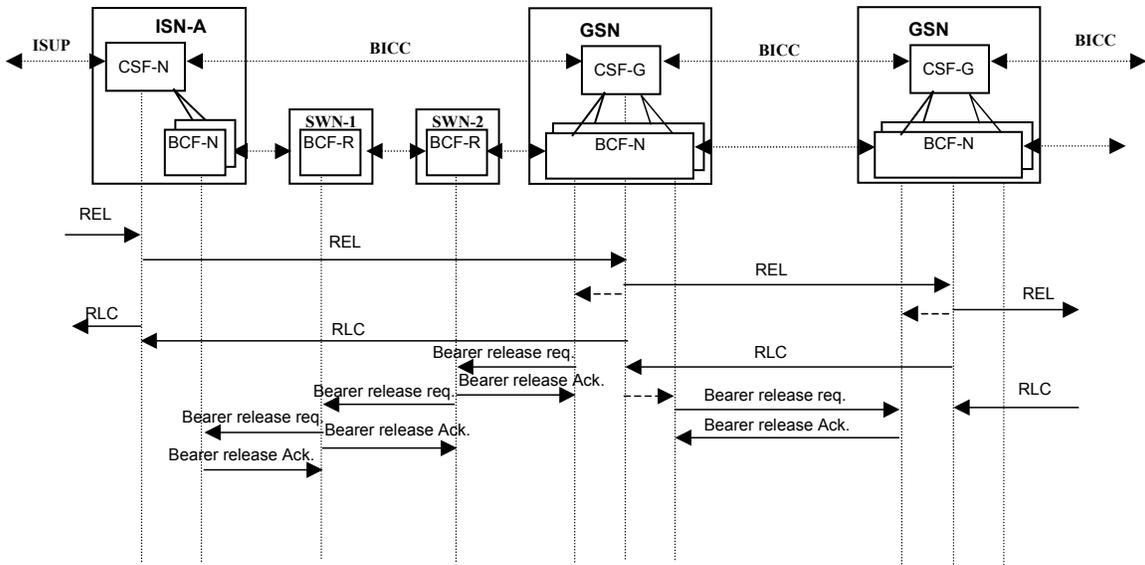
Figure F.13/T1.672.4 - Forward call and bearer release; Gateway interworking between forward and backward bearer set-up

Annex G/T1.672.4-2000

(Informative)

Annex G/T1.672.4-2000   Generic BCF functions

G.1   Introduction

According to the functional model, as shown in T1.672.1-2000, the BCF contains a number of discrete types of functionality. The BCF switching and bearer signalling 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.

G.2   BNC-ID

A Bearer Network Connection identifier (BNC-ID) is an identity, unique within the scope of one BCF, that identifies a Bearer Network Connection. It is exchanged between SNs for the purposes described below.

G.2.1   BNC-ID usage during call and bearer set-up

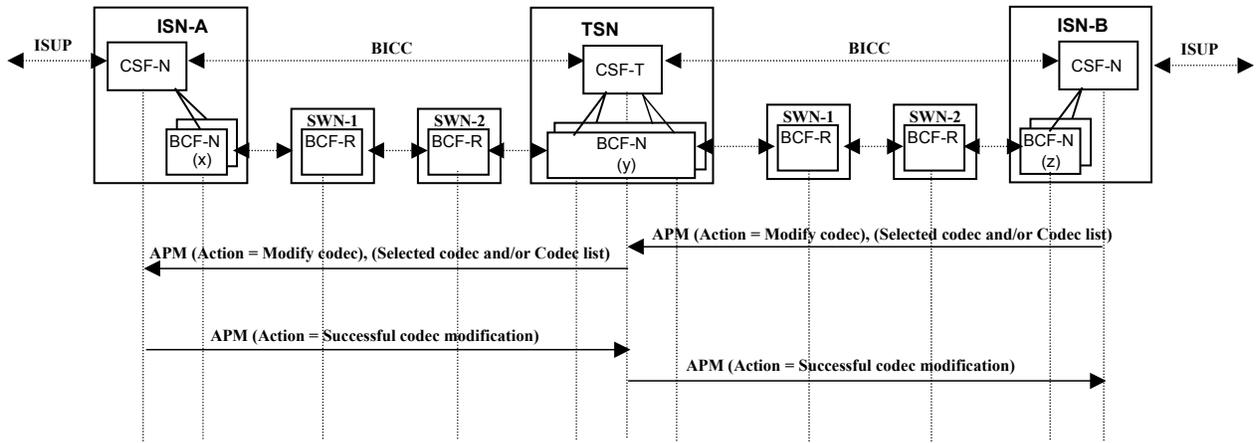For the cases where a new bearer is set-up for a new call, using a bearer type that has a set-up protocol, the BNC-ID is:

- 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

- It is used to identify the relevant call for the newly set-up bearer connection.

It is anticipated that interoperation with connectionless bearers, e.g., IP-based transport, may be specified in the future. For such situations, the third bullet in the above list should be understood to refer to the appropriate bearer control co-ordination mechanisms used by the connectionless communications platform.

G.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 labelled with BNC-IDs. For bearers owned by this BCF, the BNC-ID was allocated by the far BCF; 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.

G.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 chose 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).

Under abnormal conditions the BICC CSF procedures can request reset of the bearer connection and in this case the BCF shall unconditionally initiate the bearer release protocol.

G.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.

G.5   BNC Characteristics

The BNC Characteristics is information exchanged between SNs to identify the selected BNC type, i.e., AAL1 or AAL2.

Annex H/T1.672.4-2000

(Informative)

Annex H/T1.672.4-2000   Procedures at a Call Mediation Node (network option)

N. B. - This Annex is marked as "informative" because the use of CMN nodes within a network is an option. If this option is implemented, certain procedures should be followed in order to interoperate correctly with adjacent SNs in the network, hence the use of "normative" wording in H.2.2 and H.2.3.

H.1   Introduction

This annex describes protocol function that should be performed by a Call Mediation Node (CMN) if a network operator chooses to deploy such nodes. The procedures described are necessary for correct operation of the associated SNs controlling the bearers. Other procedures that may be performed at a CMN are not specified in this American National Standard, but may be defined in future.

NOTE - Within a network domain, the presence of an intermediate Call Mediation Node (CMN) is a network option, the inclusion of which depends on implementation and operator reasoning. A CMN supports no functionality directly related to bearer connections. The BICC protocol does not preclude the existence of such a node.
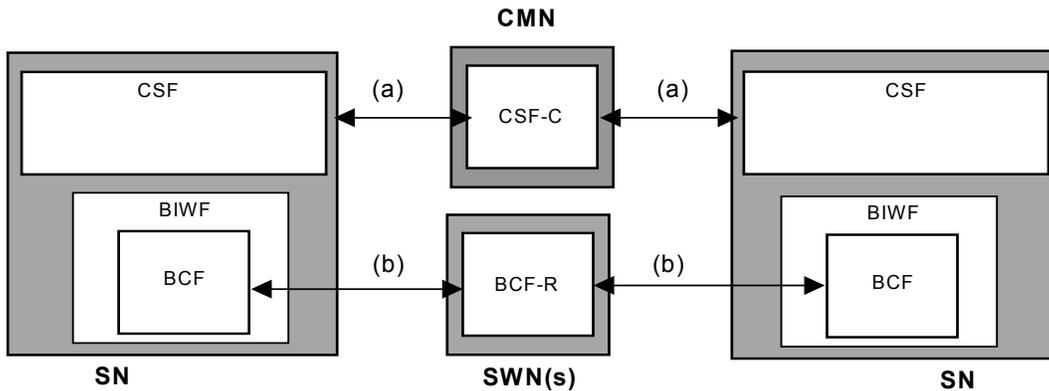
Figure H.1/T1.672.4 - CMN Functional model

H.2   Procedures

H.2.1   BAT ASE Addressing

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 by the BAT ASE as stated in 1.7.1.2.2.

The application procedures at CMN node may pass on the information unchanged.

H.2.2   Call release

A CMN, when there is a BICC signalling association set-up through it, shall relay both REL and RLC messages[11]. The CIC values shall be released at the CMN when the RLC is passed through.

H.2.3   Reset

A CMN, when there is a BICC signalling association set-up through it, on reception of an RSC shall send an RSC to the next SN. It shall not convert a received RSC to a REL sent to the next SN[12]. Normal reset procedures shall apply towards both SNs.

A CMN, when there is a BICC signalling association set-up through it, on receipt of a GRS shall send RSC or GRS message(s) towards the next SN. It shall not convert a received GRS to RELs sent to the next SN(s). Normal reset procedures shall apply towards both SNs.

---

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

[12] The reset request needs to be relayed through a CMN to ensure that bearer resources are released at the peer SN. The SN 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.

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Chapter 5
Performance Objectives in the BICC Application

T1.113.5-2000 applies with the exception that the number of circuits in a user signalling relationship (T1.113.5-2000, clause 5.1.2) is changed to refer to the number of call control associations in a signalling relationship, which is 2^{32}.

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Chapter 6
State Transition Diagrams

T1.113.6-2000 does not apply to BICC.

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for Telecommunications –

Chapter 7
BICC Application Transport Mechanism

1   Scope

This chapter describes the extensions required for the transport of bearer related information associated with the 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 APM (see T1.113.7-2000 and T1.672.4-2000) 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   Layout of Chapter

The description of the BICC procedures in this chapter are structured according to the model described in 3.2. 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 signalling 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 BICC. The AP relevant BICC functionality can be found in T1.672.4-2000.

The service primitive technique, used to define the ASEs and the SACF specific to the application's signalling 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) – the SACF or the 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 T1.113.7-2000, and T1.672-2000) / operation structure (as specified in this chapter) and in the proper sequence (as specified in T1.672.4-2000 and this chapter).

The structure and examples of its usage are illustrated in 3.2.

The relationship between the existing ISDN network functionality and the APM service provided by the public NNI (BICC) is described as a network model in 3.1.

3 Modeling

The models described in this clause introduce concepts and terminology used in this chapter of the BICC use of the capability of the APM.

3.1   Network model
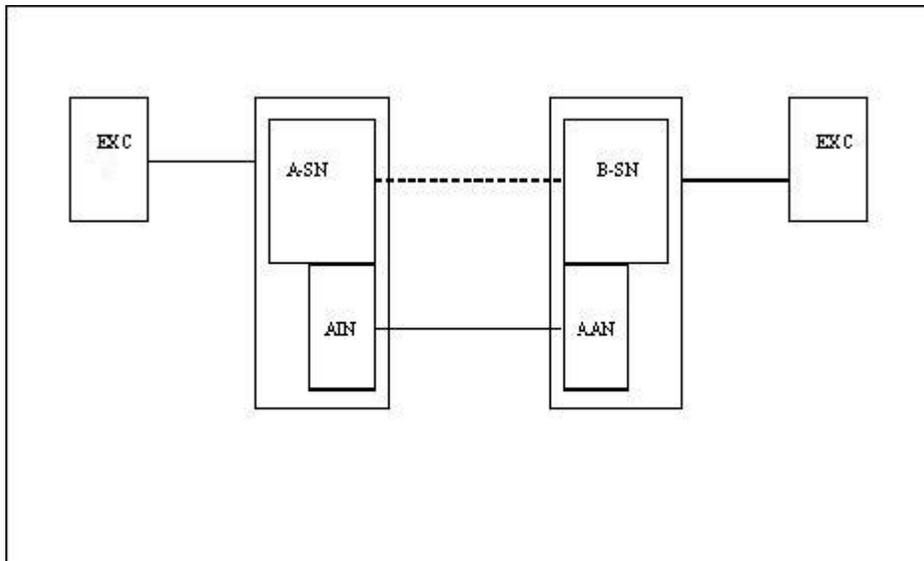
Figure 1/T1.672.7 - BICC Network Topology

This clause 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/T1.672.7 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 narrowband 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 T1.113.7-2000 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 T1.113.7-2000) is used for the BICC, the 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 T1.672.4-2000.

3.2   Specification model

3.2.1   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 clause 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 APM which is described in detail in T1.113.7-2000 and T1.672.4-2000.

3.2.2   General model

The generalized model for the BICC Process is shown in Figure 2/T1.672.7. 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/T1.672.7 shows the primitive interfaces between the functional blocks, as used in the body of this chapter for calls using BICC.
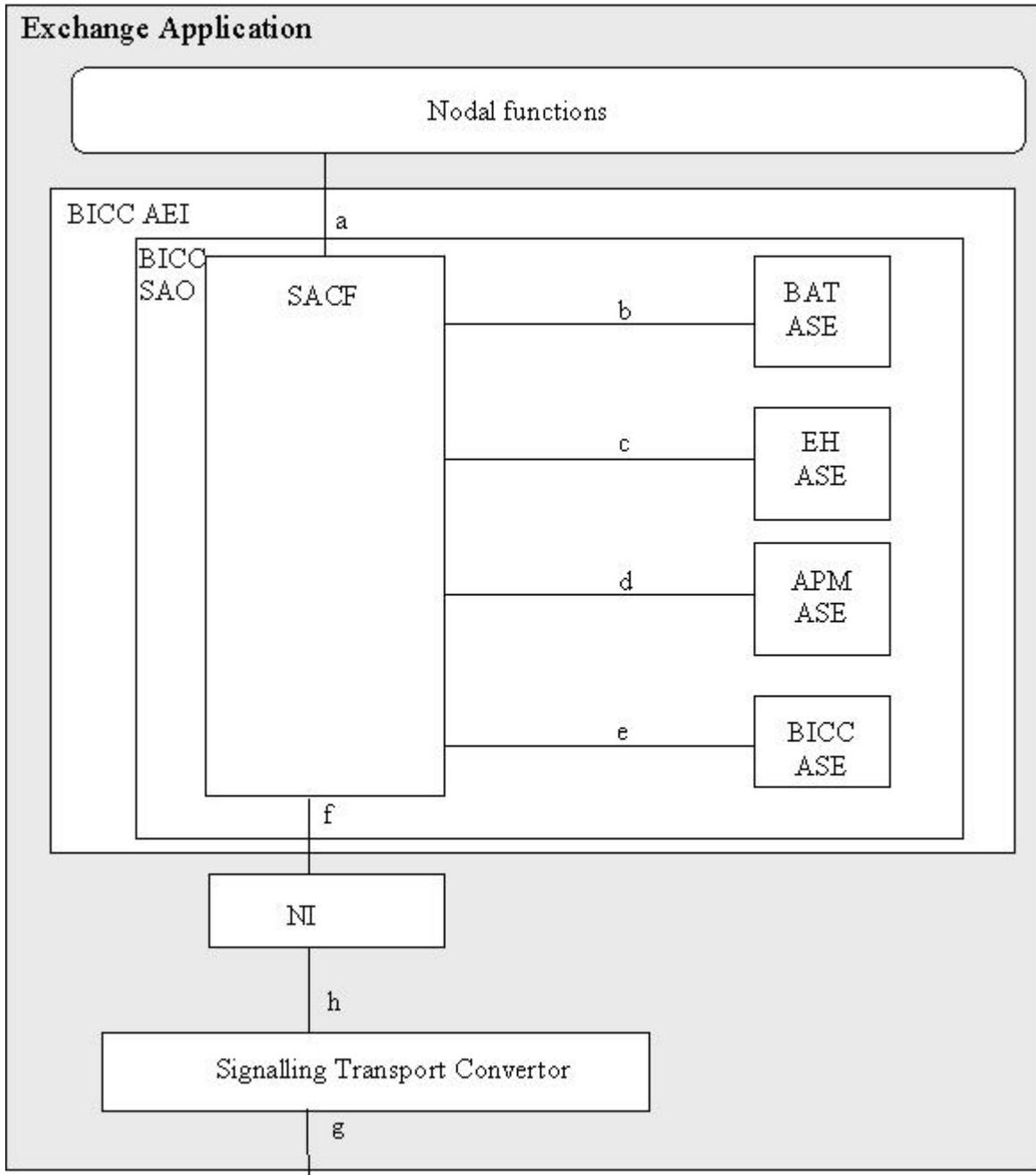
Figure 2/T1.672.7 – BICC specification model

With respect to Figure 2/T1.672.7, 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.

The APM ASE and EH ASE are described in detail in T1.113.7-2000 and T1.672.4-2000.

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 T1.113.7-2000.

> NOTE - Further clarifications about the BICC protocol modeling and relationships between BICC AEI, BICC ASE and ISUP AEI, ISUP ASE are given in T1.672.4-2000.

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 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 Signalling 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 T1.113.7-2000 and T1.672.4-2000.

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.

3.2.3   Signalling Flows

Figure 3/T1.672.7 and Figure 4/T1.672.7 illustrate the dynamic primitive flows for an BICC call over the BICC for the case that a call control message is coincident with the application information flow. Figure 3/T1.672.7 shows the case when a message is being sent; Figure 4/T1.672.7 shows the case when a message is being received.
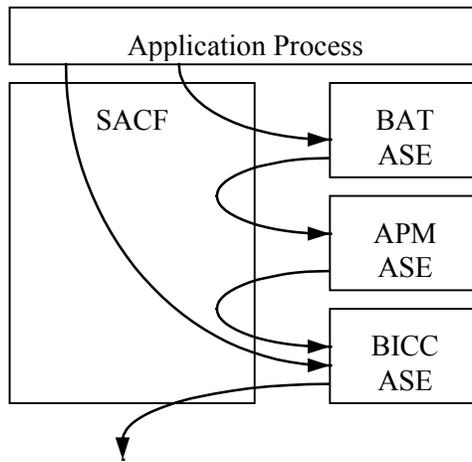
Figure 3/T1.672.7
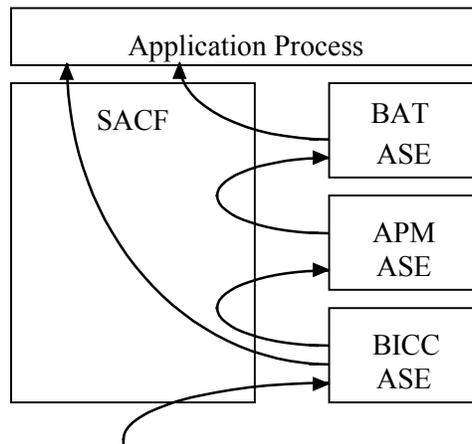
Figure 4/T1.672.7

Figure 5/T1.672.7 and Figure 6/T1.672.7 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.
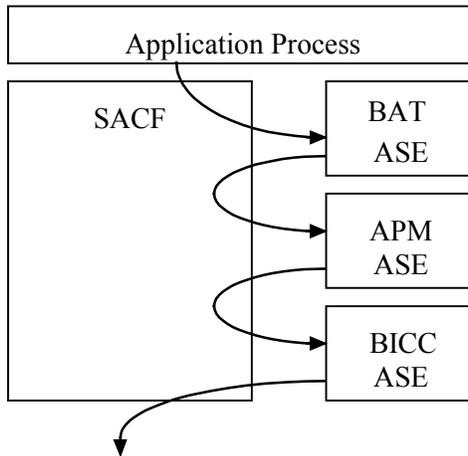
Figure 5/T1.672.7
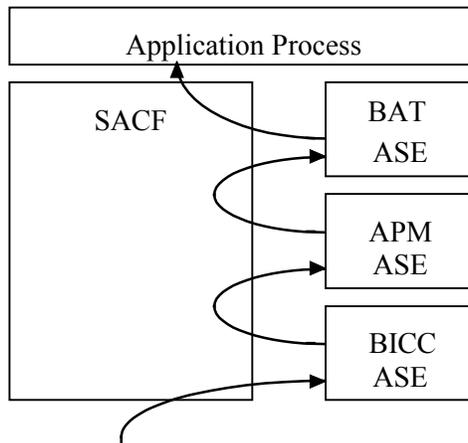
Figure 6/T1.672.7

4   BICC Application Process Functions

4.1   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 chapter. These AP-functions are specified in T1.672.4-2000 and the relevant bearer specific Technical Report.

4.2   Primitive interface (AP – BICC SACF)

The primitive interface [interface (a) in Figure 2/T1.672.7] 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 chapter, although references are made to them through functional inferences within the text. The public basic call (see T1.672.4-2000) 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 T1.672.4 are described in this chapter, see Table 1/T1.672.7 and 4.3.

Table 1/T1.672.7 – 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: ⬅		

4.3   Primitive contents

Table 2/T1.672.7 and Table 3/T1.672.7 contain the list of parameters in the primitives of Table 1/T1.672.7.

Mandatory/Optional (M/O) indications are provided as well as a reference for a detailed description of the parameters.

Table 2/T1.672.7 – Contents of the BICC_Data Ind/Req primitive

Parameter	Mandatory/Optional	Reference
ATII	M	See T1.672.4
Action Indicator	O	See clause 7.1
Backbone Network Connection Identifier	O	See clause 7.1
Interworking Function Address	O	See clause 7.1
Codec List	O	See clause 7.1
Single Codec	O	See clause 11.1
BAT Compatibility Report	O	See clause 7.1
Bearer Network Connection Characteristics	O	See clause 7.1

Each parameter (except ATII) is accompanied by compatibility information, see T1.672.4-2000 and clause 7.1.

Table 3/T1.672.7 – Contents of the BICC_Error Ind primitive

Parameter	Mandatory/Optional	Reference
Error Notification	M	See clauses 6.2.1.2 and 6.2.1.3

5   Single Association Control Function (SACF) – BICC SACF

5.1   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/T1.672.7] towards NI [interface (f) in Figure 2/T1.672.7] or vice versa. Therefore, the SACF is also responsible to ensure that when multiple primitives are generated by the ASEs towards the AP, that 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 American National Standard. The mapping of primitives in Table 4/T1.672.7 and Table 7/T1.672.7 are in T1.113.7-2000 and are included here for informative purposes only.

5.2   Information flows related to messages sent by the node

On receipt of a primitive (request or response) from the AP [interface (a) in Figure 2/T1.672.7], 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/T1.672.7].

Table 4/T1.672.7 – Mapping between BAT ASE and APM ASE primitives

Interface (b), from BAT ASE	Interface (d), APM ASE
APM_U_Data	APM_Data

Table 5/T1.672.7 – Mapping between AP and BAT ASE primitives

Interface (a), from AP	Interface (b), BAT ASE
BICC_Data	BICC_Data

5.3   Information flows related to messages received by the node

These procedures are described in T1.113.7-2000 where the APM-user ASE corresponds with the BAT ASE.

Table 6/T1.672.7 – 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/T1.672.7 – Mapping between APM ASE and BAT ASE primitives

Interface (d), from APM ASE	Interface (b), BAT ASE
APM_Data	APM_U_Data

Table 8/T1.672.7 – Mapping between EH ASE and BAT ASE primitives

Interface (c), from EH ASE	Interface (b), BAT ASE
APM_Error	APM_U_Error

6   BAT ASE

The BAT ASE is responsible for preparing the information in the appropriate form that can be passed to the APM for transportation.

6.1   Primitive interface

Table 9/T1.672.7 lists the primitive interface between the BAT ASE and BICC SACF [interface (b) in Figure 2/T1.672.7].

Table 9/T1.672.7 – 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: ←		

6.2   Signalling procedures

6.2.1   Application Initiating Node

6.2.1.1 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.

6.2.1.2 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 analyzed, the BICC_Data.indication primitive and/or the BICC_Error.indication primitive shall be sent.

6.2.1.3 APM_U_Error Primitive

On reception of the APM_U_Error.indication primitive, the contents should be passed unchanged in the BICC_Error primitive.

6.2.2   Application Addressed Node

See clause 6.2.1.

6.2.3   Signalling congestion

In order to avoid congestion in the signalling network, it is necessary that applications that contribute signalling load towards a congested destination limit their signalling traffic in a controlled manner. The congestion control procedures are outside the scope of this document. Refer to T1.672.4-2000.

6.3   Primitive contents

Table 10/T1.672.7 and Table 11/T1.672.7 list the mandatory and optional contents for the BAT ASE service primitives. These primitives are defined in T1.113.7-2000 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/T1.672.7) is described in clause 4.3.

M/O indications are provided.

NOTE - In the context of BAT, implicit addressing is used, see T1.113.7-2000 and T1.672.4-2000.

Table 10/T1.672.7 – 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/T1.672.7 – Contents of the APM_U_Error Ind primitive

Parameter	Mandatory/Optional
Notification	M

7   BICC Transport – Formats and codes of application data

7.1   Encapsulated Application Information

7.1.1   General layout

The general layout of the Encapsulated Application Information field of the Application Transport parameter (see T1.113.7-2000 and T1.672.4-2000) is shown in Figure 7/T1.672.7.

	8=MSB	7	6	5	4	3	2	1=LSB
1	Identifier 1							
2	Length indicator 1							
3	Compatibility information 1							
4	Contents 1							
m	Identifier n							
	Length indicator n							
	Compatibility information n							
	Contents n							
p								
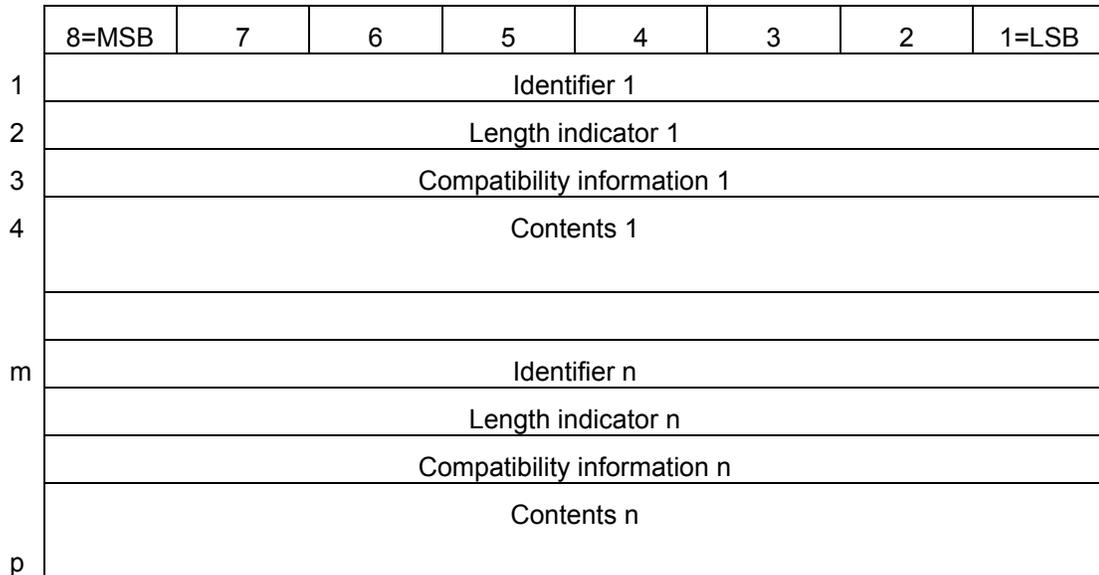
Figure 7/T1.672.7 - Encapsulated Application Information field

Each information element within the Encapsulated Application Information field has the same structure. An information element consists of four fields that always appear in the following order:

1. Identifier (one octet);

2. Length indicator;

3. Compatibility information; and

4. 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 or the Length indicator. The format of the Length indicator is shown in Figure 8/T1.672.7. 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/T1.672.7 - 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/T1.672.7.

8	7	6	5	4	3	2	1	
	pass-on not possible				general action			Octet 1
Ext	send notification indicator	instruction indicator		reserved	send notification indicator	instruction indicator		

Figure 9/T1.672.7 - 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.

7.1.2   List of Identifiers

Table 12/T1.672.7 contains the list of Identifiers. The use and the meaning of these information elements are bearer specific and are specified in the relevant Technical Reports to T1.672-2000.

Table 12/T1.672.7 – List of Identifiers

Value	Information Element Name	Type	Reference
0000 0000	ITU-T spare	-	-
0000 0001	Action Indicator	simple	7.1.3
0000 0010	Backbone Network Connection Identifier	simple	7.1.4
0000 0011	Interworking Function Address	simple	7.1.5
0000 0100	Codec List	constructor	7.1.6
0000 0101	Single Codec	simple	7.1.7
0000 0110	BAT Compatibility Report	simple	7.1.8
0000 0111	Bearer Network Connection Characteristics	simple	7.1.9
0000 1000 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.

7.1.3   Action Indicator

The format of the Action Indicator is shown in Figure 10/T1.672.7.

MSB 8	7	6	5	4	3	2	1 LSB
Action indicator							
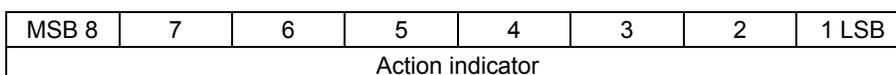
Figure 10/T1.672.7 – Action Indicator

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 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.

7.1.4   Backbone Network Connection Identifier

The format of the Backbone Network Connection Identifier is shown in Figure 11/T1.672.7.

	8	7	6	5	4	3	2	1
1	MSB							
			Backbone Network Connection Identifier					
n								LSB
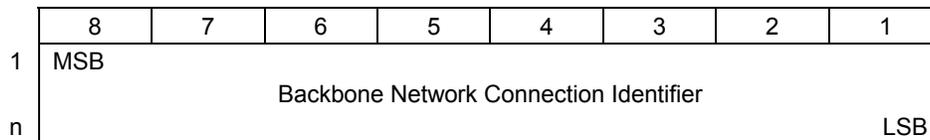
Figure 11/T1.672.7 – Backbone Network Connection Identifier

The contents of the Backbone Network Connection Identifier is bearer specific and is specified in the relevant Supplement to T1.672-2000. The maximum length of this field is 4 octets.

7.1.5   Interworking Function Address

The format of the Interworking Function Address is shown in Figure 12/T1.672.7.

8	7	6	5	4	3	2	1
MSB							
		Interworking Function Address					
							LSB

(1 ... n)
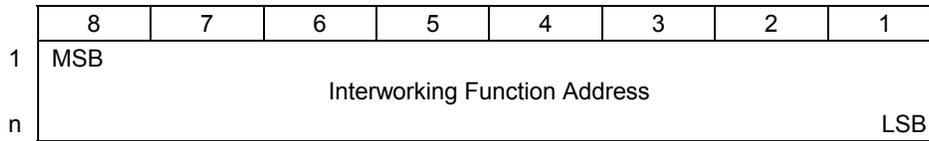
Figure 12/T1.672.7 – Interworking Function Address

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.

7.1.6   Codec List

7.1.6.1 Format

The format of the Codec List is shown in Figure 13/T1.672.7.

8	7	6	5	4	3	2	1
Single Codec information element							
Single Codec information element							
Single Codec information element							
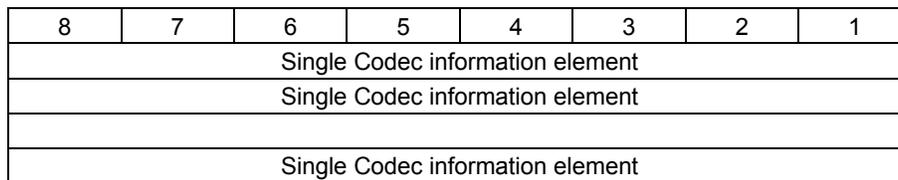
Figure 13/T1.672.7 – Codec List

The Single Codec information element is specified in 7.1.7.

7.1.6.2 List of codecs

Figure 13/T1.672.7 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.

7.1.7   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; and
- Codec Information subfield.

Figure 14/T1.672.7 illustrates the layout of the Single Codec information element.

MSB 8	7	6	5	4	3	2	1 LSB
1			Organisation Identifier				
2							
n			Codec Information				
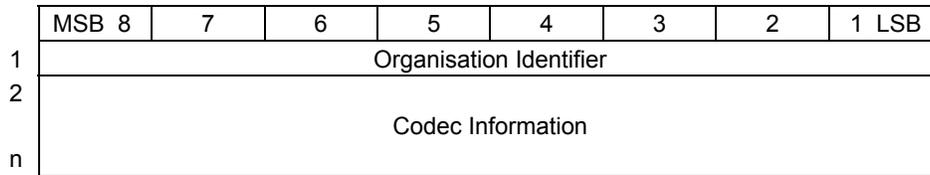
Figure 14/T1.672.7 - Single Codec

7.1.7.1 Organization Identifier subfield

The following codes are used for the Organization Identifier subfield:

00000000		no indication
00000001		ITU-T
00000010	⎤	
to	⎬	reserved for use by IMT2000 family members
00100001	⎦	
00100010	⎤	
to	⎬	ITU-T spare
11011111	⎦	
11100000	⎤	
to	⎬	ANSI spare
11101111	⎦	
11110000	⎤	
to	⎬	reserved for network specific use (note)
11111111	⎦	

NOTE - Code points marked as "reserved for network specific use" should be assigned in descending order.

7.1.7.2 Codec Information subfield

7.1.7.2.1   ITU-T

The format of the Codec Information subfield in case of Organization ID = ITU-T is shown in Figure 15/T1.672.7.

MSB 8	7	6	5	4	3	2	1 LSB
1			Codec Type				
2							
n			Codec Configuration				
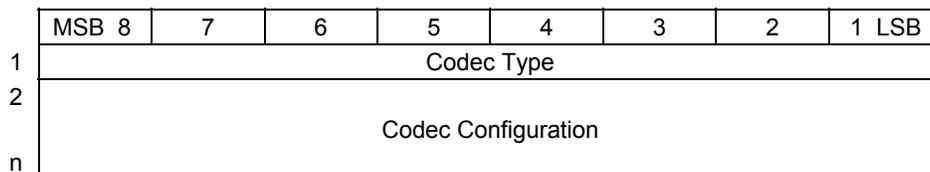
Figure 15/T1.672.7 - Codec Information subfield

7.1.7.2.1.1 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	⎫
to	⎬ ITU-T spare
11111111	⎭

7.1.7.2.1.2 Codec Configuration subfield

There are no configuration data in the case of the 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 signalling). 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/T1.672.7 and Table 13/T1.672.7 show the configuration data coding for each of the aforementioned codecs.

MSB   LSB

Spare	d	c	b	a
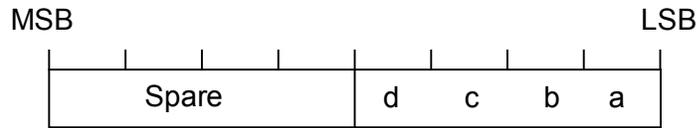
a) G.726 and G.727 codec types

MSB   LSB

Spare	c	b	a

b) G.728, G.729, and G.729 Annex B codec types

Figure 16/T1.672.7 – Coding for the 1 octet long configuration field

Table 13/T1.672.7 – 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 correspond 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'.

7.1.8   BAT Compatibility Report

The format of the BAT Compatibility Report is shown in Figure 17/T1.672.7.

	MSB 8	7	6	5	4	3	2	1 LSB
1	Report reason							
2	Diagnostics							
n								

Figure 17/T1.672.7 – 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
11101111	⎦
11110000	⎤
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/T1.672.7 shows the format of the diagnostics.

MSB 8	7	6	5	4	3	2	1 LSB

1	Identifier 1
2	MSB
3	Index LSB
n	Identifier m
n+1	MSB
n+2	Index LSB

Figure 18/T1.672.7 – Diagnostics

The field "Identifier n" contains the Identifier value of the nth upgraded information element in accordance with Table 12/T1.672.7. 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 that 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 that 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 that is unrecognized or whose contents is 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.

7.1.9   Bearer Network Connection Characteristics

The format of the Bearer Network Connection Characteristics is shown in Figure 19/T1.672.7 – Bearer Network Connection Characteristics

MSB 8	7	6	5	4	3	2	1 LSB
Bearer Network Connection Characteristics							

Figure 19/T1.672.7 – 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	⎫	
to	⎬	ITU-T spare
11011111	⎭	
11100000	⎫	
to	⎬	ANSI spare
11101111	⎭	
11110000	⎫	
to	⎬	reserved for network specific use (note)
11111111	⎭	

NOTE - Code points marked as "reserved for network specific use" should be assigned in descending order.

7.2   Application Context Identifier

The Application Context Identifier field of the Application Transport parameter (see T1.672.4-2000) shall be coded "*BAT ASE*".