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SERIES Q: SWITCHING AND SIGNALLING

Bearer independent call control protocol

ITU-T Recommendation Q.1901

(Formerly CCITT Recommendation)

ITU-T Q-SERIES RECOMMENDATIONS

SWITCHING AND SIGNALLING

SIGNALLING IN THE INTERNATIONAL MANUAL SERVICE	Q.1–Q.3
INTERNATIONAL AUTOMATIC AND SEMI-AUTOMATIC WORKING	Q.4–Q.59
FUNCTIONS AND INFORMATION FLOWS FOR SERVICES IN THE ISDN	Q.60–Q.99
CLAUSES APPLICABLE TO ITU-T STANDARD SYSTEMS	Q.100–Q.119
SPECIFICATIONS OF SIGNALLING SYSTEMS No. 4 AND No. 5	Q.120–Q.249
SPECIFICATIONS OF SIGNALLING SYSTEM No. 6	Q.250–Q.309
SPECIFICATIONS OF SIGNALLING SYSTEM R1	Q.310–Q.399
SPECIFICATIONS OF SIGNALLING SYSTEM R2	Q.400–Q.499
DIGITAL EXCHANGES	Q.500–Q.599
INTERWORKING OF SIGNALLING SYSTEMS	Q.600–Q.699
SPECIFICATIONS OF SIGNALLING SYSTEM No. 7	Q.700–Q.799
Q3 INTERFACE	Q.800–Q.849
DIGITAL SUBSCRIBER SIGNALLING SYSTEM No. 1	Q.850–Q.999
PUBLIC LAND MOBILE NETWORK	Q.1000–Q.1099
INTERWORKING WITH SATELLITE MOBILE SYSTEMS	Q.1100–Q.1199
INTELLIGENT NETWORK	Q.1200–Q.1699
SIGNALLING REQUIREMENTS AND PROTOCOLS FOR IMT-2000	Q.1700–Q.1799
BROADBAND ISDN	Q.2000–Q.2999

For further details, please refer to the list of ITU-T Recommendations.

ITU-T Recommendation Q.1901

Bearer independent call control protocol

Summary

This Recommendation describes the adaptation of the narrow-band ISDN User Part (ISUP) for the support of narrow-band ISDN services independent of the bearer technology and signalling message transport technology used.

Source

ITU-T Recommendation Q.1901 was prepared by ITU-T Study Group 11 (1997-2000) and approved under the WTSC Resolution 1 procedure on 15 June 2000.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Conference (WTSC), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

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In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

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CONTENTS

ITU-T Recommendation Q.1901

Bearer independent call control protocol

1 Scope

This Recommendation describes the adaptation of the narrow-band ISDN User Part (ISUP) for the support of narrow-band ISDN services independent of the bearer technology and signalling message transport technology used.

This Recommendation is written as a set of exceptions to the ISUP Recommendations. The exceptions to certain sections of text from the ISUP Recommendations are indicated by using revision marks. (Deleted text is shown using strikeouts, and added text is shown underlined.)

The protocol defined by this Recommendation 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 Recommendation.

Three types of Serving Node (SN) are defined:

- Interface Serving Node (ISN) – this type of node provides an interface to circuit switched networks.
- Transit Serving Node (TSN) – this type of node provides transit functionality, for call and bearer, within one network using the BICC protocol.
- Gateway Serving Node (GSN) – this type of node provides inter-network gateway functionality, for call and bearer, using the BICC protocol.

The main body of this Recommendation defines the protocol at Transit Serving Nodes and Gateway Serving Nodes. The scope is thus as shown in Figure 1.

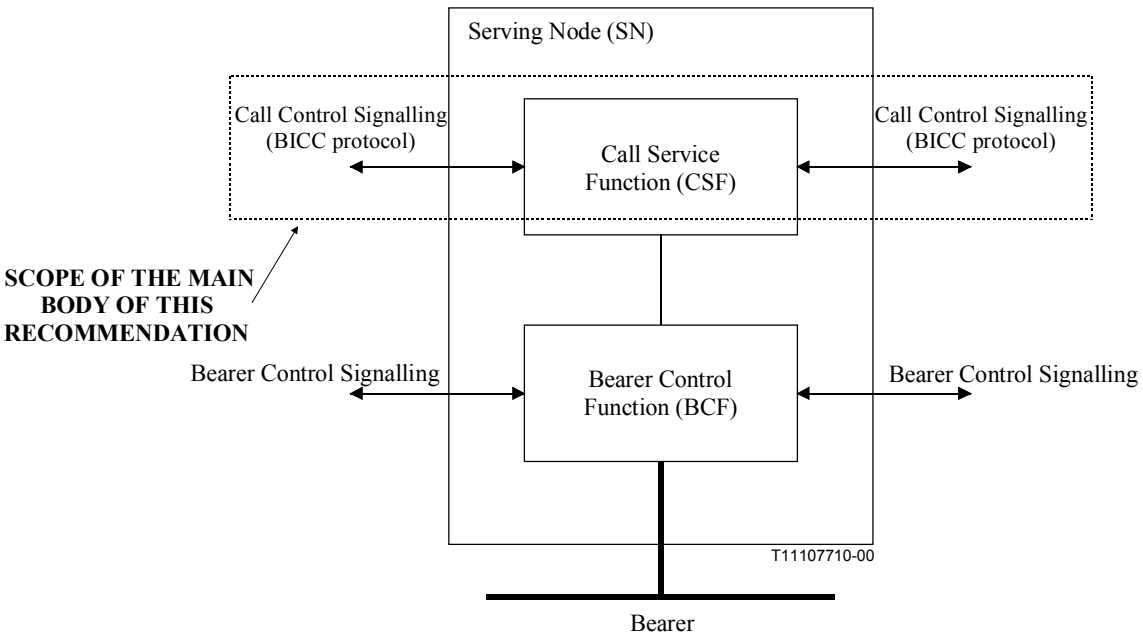

Figure 1/Q.1901 – Scope of ITU-T Q.1901

In defining the procedures for BICC at an Interface Serving Node this Recommendation also defines how BICC interworks with other protocols. These descriptions are contained in Annexes to this Recommendation.

This Recommendation also contains Appendix III that is relevant to a Call Mediation Node, where call control functions may reside, without any bearer control capability.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; all users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published.

[1] ITU-T Q.761 (1999), *Signalling system No. 7 – ISDN User Part functional description.*

[2] ITU-T Q.762 (1999), *Signalling system No. 7 – ISDN User general functions of messages and signals.*

[3] ITU-T Q.763 (1999), *Signalling system No. 7 – ISDN User Part formats and codes.*

[4] ITU-T Q.764 (1999), *Signalling system No. 7 – ISDN User Part signalling procedures.*

[5] ITU-T Q.730 (1999), *ISDN User Part supplementary services.*

[6] ITU-T Q.765.5 (2000), *Signalling system No. 7 – Application transport mechanism: Bearer Independent Call Control (BICC).*

[7] ITU-T Q.765 (2000), *Signalling system No. 7 – Application Transport Mechanism.*

[8] ITU-T Q.724 (1988), *Telephone user part signalling procedures.*

[9] ITU-T Q.115 (1999), *Logic for the control of echo control devices.*

[10] ITU-T Q.766 (1993), *Performance objectives in the integrated services digital network application.*

[11] ITU-T Q.701 (1993), *Functional description of the message transfer part (MTP) of Signalling system No. 7.*

[12] ITU-T Q.704 (1996), *Signalling network functions and messages.*

[13] ITU-T Q.2210 (1996), *Message Transfer Part Level 3 Functions and Messages using the Services of ITU-T Recommendation Q.2140.*

[14] ITU-T Q.2110 (1994), *B-ISDN ATM adaptation layer – Service specific connection oriented protocol (SSCOP).*

[15] ITU-T Q.2111 (1999), *Service specific connection oriented protocol in a multi-link and connectionless environment (SSCOPMCE).*

3 Definitions

This Recommendation defines the following terms:

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 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 Recommendation.

3.2 Bearer InterWorking 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 interworking with narrow-band 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), 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 Coordination Function (CSF-C) provides the call coordination 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 ITU-T Q.765.5.

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 interworking 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 interworking functions (BIWF) which interact with the 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 Recommendation.

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 ITU-T Q.765.5.

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 SNs. This functional entity contains the call service function (CSF-T), and supports one or more bearer interworking functions (BIWF). TSNs interact with other TSNs, GSNs and ISNs within their own backbone network domain.

4 Abbreviations

This Recommendation uses the following abbreviations:

ACM	Address Complete Message
AEI	Application Entity Invocation
APM	Application Transport Mechanism
APP	Application Transport Parameter
ASE	Application Service Element
ATII	Application Transport Instruction Indicators
BAT	Bearer Association Transport
BCF	Bearer Control Function
BCF-G	Bearer Control Gateway Function
BCF-N	Bearer Control Nodal Function
BCF-T	Bearer Control Transit Function
BICC	Bearer Independent Call Control
BIWF	Bearer InterWorking Function
BNC-ID	Backbone Network Connection Identifier
CIC	Call Instance Code (BICC)
CIC	Circuit Identification Code (ISUP)
CMN	Call Mediation Node
COT	Continuity message

CPG	Call Progress message
CSF	Call Service Function
CSF-C	Call Service Coordination Function
CSF-G	Call Service Gateway Function
CSF-N	Call Service Nodal Function
CSF-T	Call Service Transit Function
DPC	Destination Point Code
EH	Errors Handling
GRS	Group Reset message
GSN	Gateway Serving Node
IAM	Initial Address Message
ISDN	Integrated Services Digital Network
ISN	Interface Serving Node
ISUP	ISDN User Part
LSB	Least Significant Bit
MLPP	Multi-Level Precedence and Pre-emption
MSB	Most Significant Bit
MTP	Message Transfer Part
MTP3	Message Transfer Part level 3 (Narrow band)
MTP3b	Message Transfer Part level 3 (Broadband)
NI	Network Indicator (in SIO), or Network Interface (in specification model)
OPC	Originating Point Code
PLMN	Public Land Mobile Network
PSTN	Public Switched Telephone Network
REL	RELease message
RLC	ReLease Complete message
RSC	Reset Circuit message
SACF	Single Association Control Function
SAM	Subsequent Address Message
SAO	Single Association Object
SCN	Switched Circuit Network
SI	Service Indicator
SIO	Service Information Octet
SLS	Signalling Link Selection
SN	Serving Node
STC	Signalling Transport Converter
STL	Signalling Transport Layers

SWN Switching Node

TE Terminal Equipment

TSN Transit Serving Node

5 Conventions

1) The name of each element of the following classes of terms is capitalized:
   - indicators;
   - parameters;
   - information elements;
   - messages.

   Examples: Called Party Number parameter, Initial Address message.

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

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

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

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

NOTE – Where the text has been imported from other Recommendations then the conventions of this Recommendation do not automatically apply.

6 Architecture

6.1 Network model

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

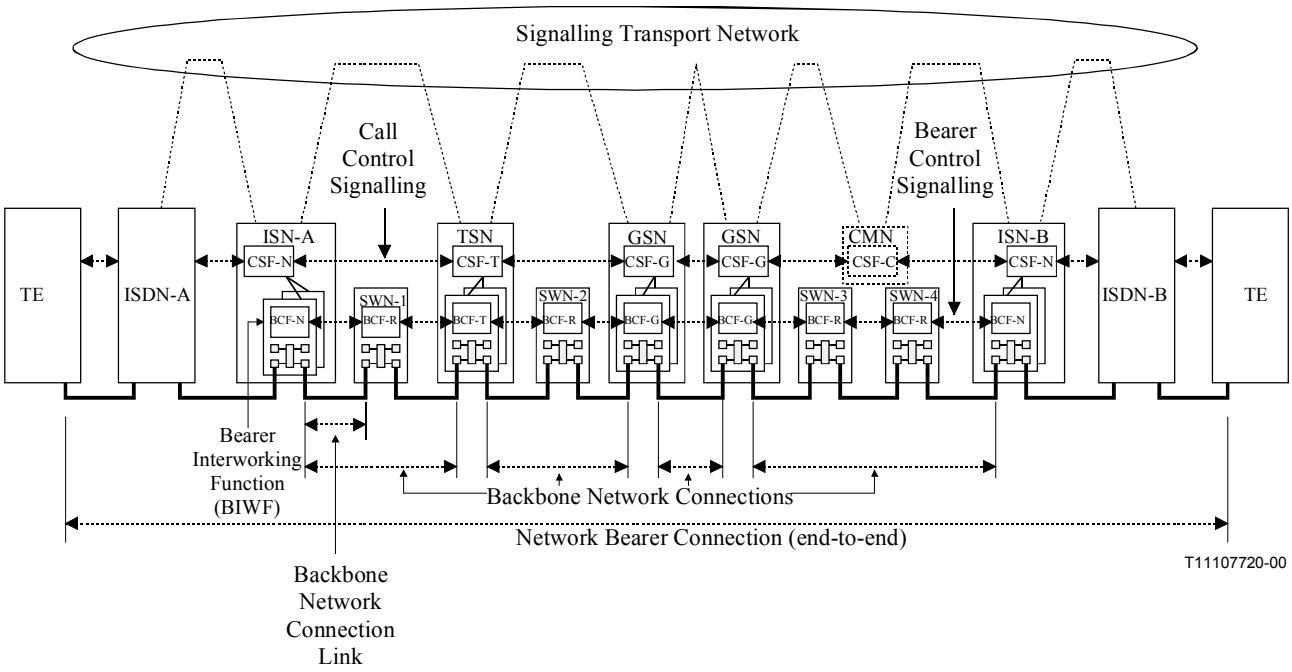

Figure 2/Q.1901 – Network Functional model

NOTE – The functionality of the CMN is not currently defined – see Appendix III.

6.2 Protocol model

Figure 3 shows the protocol model adopted for this Recommendation.

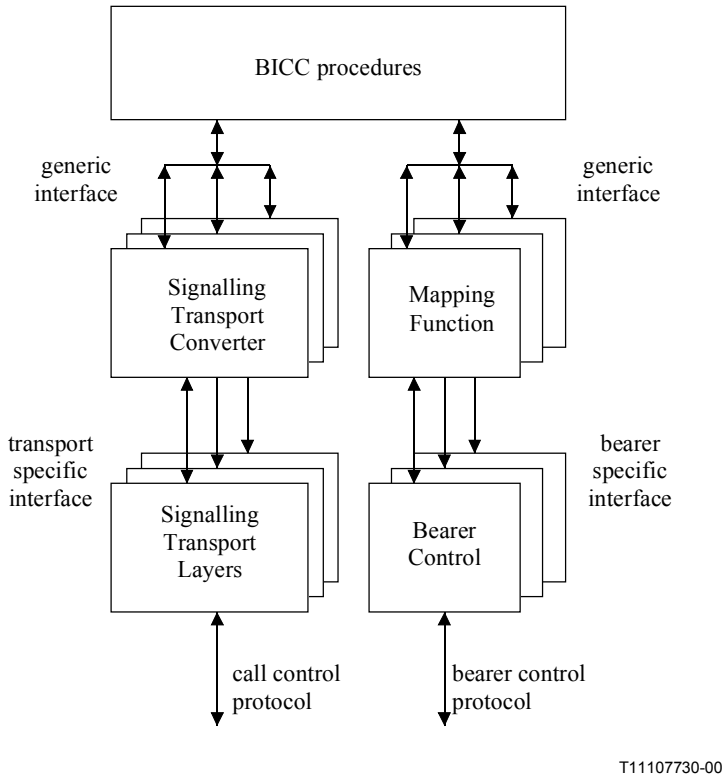

Figure 3/Q.1901 – Protocol model

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

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

6.3 Recommendation structure

This Recommendation 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. It also uses the generic interface to the blocks labelled Mapping Functions and Signalling Transport Converter.

The blocks in Figure 3 labelled Mapping Function are defined in additional publications[1] that are to be provided for each bearer technology to describe specific adaptation for that technology.

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

The following clauses of this Recommendation describe the BICC protocol as a series of exceptions to ITU-T Q.761 to Q.765.

7 Exceptions to ITU-T Q.761

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 APM user application. Thus:

1) Peer-to-peer compatibility of versions of BICC can be assured, as described for ISUP in clause 6/Q.761.
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 unrecognized ISUP parameter will handle it according to 2.9.5/Q.764, 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.

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[1] See Bibliography.

This compatibility mechanism remains unchanged for all capability sets and/or subsets of the BICC protocol defined in this Recommendation. 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;
- for networks using different subsets of the same BICC protocol, etc.

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 Recommendation.

7.2.1 Backward Compatibility rules

Compatible interworking between protocol capability sets should be optimized 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 Capabilities supported

Table 1 shows exceptions to Table 1/Q.761. Items included in Table 1/Q.761, but not mentioned in Table 1 below, apply with no exception.

Table 1/Q.1901 – BICC exceptions to Table 1/Q.761

Function/service	National use	International
Basic call		
Continuity check	(Note 1)	(Note 1)
Propagation delay determination procedure	X	X
Enhanced echo control signalling procedures	–	–
Blocking and unblocking ~~of circuits and circuit groups~~	X	X
Circuit group query	X	–
Dual seizure	X	X
Transmission alarm handling for digital inter-exchange circuits	–	–
Reset ~~of circuits and circuit groups~~	X	X
Temporary trunk blocking	–	–
ISDN User Part signalling congestion control	(Note 2)	(Note 2)
ISDN User Part availability control	(Note 3)	(Note 3)
MTP pause and resume	(Note 2)	(Note 2)

– represents ITU-T non-support for BICC.

X indicates that modified procedures apply.

NOTE 1 – The continuity check function is not supported, but this does not preclude correct operation of the continuity check procedure in preceding or succeeding SCNs.

NOTE 2 – If BICC is deployed on an MTP3 or MTP3b signalling transport service, these functions are provided by the STC sublayer, see Annex C. For other STCs see the relevant annexes.

NOTE 3 – If BICC is deployed on an MTP3 or MTP3b signalling transport service, an equivalent procedure is provided by the STC sublayer, see Annex C. For other STCs see the relevant annexes.

Table 2/Q.761 applies with the following exception:

Concerning the MLPP supplementary service: only transit of MLPP information is supported.

NOTE – BICC usage of the end-to-end methods using SCCP is for further study.

7.4 Primitive interface to the signalling transport service

The BICC protocol uses the STC layer for message transport, and thus clause 4/Q.761 and Table 3/Q.761 are replaced by the generic transport interface as described in Annex B.

7.5 Minimum message set for the international interface

Table 4/Q.761 is replaced by Table 2. This table lists the messages used by BICC that do not contain the Message Compatibility Instruction Indicators, and thus shall be recognized by an SN. This does not impose a requirement that the related functions are implemented, but the function shall be rejected correctly (where applicable).

Table 2/Q.1901 – Minimum message set recognized at the international interface

1	Address complete
2	Answer
~~3~~	~~Blocking~~
~~4~~	~~Blocking Acknowledgement~~
5	Call Progress
6	Circuit Group Blocking
7	Circuit Group Blocking Acknowledgement
8	Circuit Group Reset
9	Circuit Group Reset Acknowledgement
10	Circuit Group Unblocking
11	Circuit Group Unblocking Acknowledgement
12	Connect
13	Continuity
14	Confusion
~~15~~	~~Continuity Check Request~~
16	Facility Accepted
17	Facility Reject
18	Facility Request
19	Forward Transfer
20	Initial Address
21	Release
22	Release Complete
23	Reset Circuit
24	Resume
25	Subsequent Address
26	Suspend
~~27~~	~~Unblocking~~
~~28~~	~~Unblocking Acknowledgement~~
29	User-to-user information

8 Exceptions to ITU-T Q.762

General: In the descriptions of messages and parameters, replace "circuit" with "CIC value".

1) Blocking message, 2.4/Q.762, is not used.
2) Blocking Acknowledgement message, 2.5/Q.762, is not used.
3) Continuity message, 2.18/Q.762, 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.
4) Continuity Check Request message, 2.19/Q.762, is not used.
5) Loop Back Acknowledgement message, 2.30/Q.762, is not used.
6) Overload message, 2.33/Q.762, is not used.
7) Unblocking message, 2.44/Q.762, is not used.
8) Unblocking Acknowledgement message, 2.45/Q.762, is not used.
9) User Part Available message, 2.47/Q.762, is not used.

10) User Part Test message, 2.48/Q.762, is not used.

11) Circuit Assignment Map parameter, 3.24/Q.762, is not used.

12) Circuit Group Supervision Message Type parameter, 3.25/Q.762, can only indicate "maintenance" blocking.

13) Continuity Indicators parameter, 3.32/Q.762, 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.

14) Hop Counter parameter, 3.45/Q.762. Replace "ISUP interexchange circuits" by "call control associations".

15) Circuit Identification Code, 4.27/Q.762, is used by BICC to indicate the instance of call control signalling. i.e. it is the "Call Instance Code".

16) Continuity Check indicator, 4.36/Q.762, 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.

17) Routing Label, 4.132/Q.762, 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 description of the relevant STC in Annex C.

9 Exceptions to ITU-T Q.763

9.1 Message format

The format of the message at the BICC to STC interface is according to ITU-T Q.763 with the following exceptions:

1) The Routing Label, as in Figure 1/Q.763 and Figure 3/Q.763, is not passed from BICC to STC.

2) The Circuit Identification Code format Figure 2/Q.763 is modified as shown in Figure 4. (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 4/Q.1901 – CIC field

9.2 CIC allocation

The CIC allocation rules described in 1.2/Q.763 do not apply to BICC. 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.

9.3 Messages

The messages defined in ITU-T Q.763 are used with the following exceptions:

1) Blocking message is not used.
2) Blocking Acknowledgement message is not used.
3) Continuity Check Request message is not used.
4) Loop Back Acknowledgement message is not used.
5) Overload message is not used.
6) Unblocking message is not used.
7) Unblocking Acknowledgement message is not used.
8) User Part Available message is not used.
9) User Part Test message is not used.

9.4 Parameters

Q.763 parameter definitions apply with the following exceptions:

1) The value "*hardware failure oriented"* of the Circuit Group Supervision Message Type indicator in the Circuit Group Supervision Message Type parameter, 3.13/Q.763, is not used.
2) The Hardware blocking states, bits FE, of the Circuit State Indicator parameter, 3.14/Q.763 are not used.
3) The value "*continuity check required on this circuit"* of the Continuity Check indicator in the Nature of Connection Indicators parameter, 3.35/Q.763, is not used.
4) The Circuit Assignment Map parameter, 3.69/Q.763 is not used, and is thus deleted from Table 32/Q.763.

10 Exceptions to ITU-T Q.764

10.1 General

10.1.1 Use of CIC field

Unlike ITU-T Q.764 where the signalling procedures are applicable to call and/or circuit control, the signalling procedures in this Recommendation are applicable to call control and its coordination 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 and its role, as "Call Instance Code", in the BICC protocol is clarified as follows:

The CIC in ISUP, in conjunction with the OPC/DPC/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 12 bit CIC defined in ISUP.

As the DPC/OPC/NI information is not seen in BICC (only in the STC for MTP3, MTP3b), 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.

10.1.2 Use of Application Transport Mechanism

This subclause describes how BICC uses the transport mechanism defined in ITU-T Q.765.5.

The BICC procedures require transfer of information between peer SNs. The Bearer Association Transport (BAT), APM ASE is used to provide a transport mechanism for this information. The interface between this Recommendation, and the BAT ASE is provided by the following primitive elements:

Table 3/Q.1901 – 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.

10.1.2.1 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

10.1.2.2 Handling of Addressing Information

Implicit addressing shall be used, (see ITU-T Q.765).

10.1.2.3 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 *"unrecognized information"*, the Compatibility procedure in 10.1.2.4 applies.

10.1.2.4 Compatibility for the BICC APM user application

10.1.2.4.1 General requirements on receipt of unrecognized signalling information

It may happen that a node receives unrecognized 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 ITU-T Q.765.5 [6].

The procedures to be used on receipt of unrecognized information make use of:

- compatibility field received within the information elements;
- the BAT Compatibility Report information element, including a Report Reason and Diagnostics.

The following Report Reasons are used:

- *"Information element non-existent or not implemented"*;
- *"BICC data with unrecognized information element, discarded"*.

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

The procedures are based on the following assumptions:

1) 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 unrecognized information element received, it assumes interaction with a node supporting a different functional level.

When an unrecognized information element is received, the node will find some corresponding instructions contained in the information element compatibility information field.

The instruction indicators consist of two subfields, one to indicate how to handle unrecognized information elements and the other to indicate what to do when an unrecognized information element cannot be passed on. The following general rules apply to the interpretation of these instruction indicators:

a) "Reserved" subfields of the compatibility field are not examined. They may be used by future capability sets of this Recommendation; in this case, the future capability sets will set the currently defined instruction indicators to a reasonable value for nodes implementing the current capability set. This rule ensures that more types of instructions can be defined in the future without creating a backward compatibility problem.
b) The call is released, using Cause value #31 *"normal, unspecified"*, if the instruction indicator is set to *"Release Call"*.
c) If the instruction indicator is set to: *"Discard information element"*, the information element is discarded, as instructed. If the Send Notification indicator is set to *"Send Notification"*, the BAT Compatibility Report information element with the appropriate Report Reason and Diagnosis fields is issued towards the node that sent the unrecognized information.
d) If the instruction indicator is set to *"pass-on"*, the unrecognized information element is passed to the signalling association on the other side of the SN for this call. If the ability to *"pass-on"* is not possible at an 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 unrecognized information element, it is possible for the instruction to require that either the unrecognized information element or all the information elements relating to received APP parameter containing the information element are discarded. This provides for the case where the sending node determines that it is not acceptable for the APP parameter to continue being processed without this information element.

10.1.2.4.2 Procedures for the handling of unrecognized information elements

10.1.2.4.2.1 Unrecognized information elements

Unrecognized information elements are received via the BICC_Error indication primitive, indicating *"unrecognized information"*.

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

Depending on the instructions received in the Information Element Compatibility Information field, a node receiving an unrecognized information element will perform one of the following actions:

a) release the call;

b) discard all the associated information elements and send notification;

c) discard all the associated information elements;

d) discard the information element and send notification;

e) discard the information element; or

f) transfer the information element transparently.

In case d), the BAT Compatibility Report information element shall include the Report Reason *"information element non-existent or not implemented"* followed by a Diagnostic field containing the pairs of Information Element Identifier and Index subfields for each unrecognized information element being referred to.

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

The Index subfield shall be coded as follows:

The Index subfield contains a pointer to the unrecognized Information Element Identifier octet. Thus:

1) for a "Simple" information element, see ITU-T Q.765.5, the Index is always coded as "0";

2) for a "Constructor" information element the Index is coded as "0" if the Constructor information element itself is not recognized, but is coded with an octet offset value, (see ITU-T Q.765.5), if the unrecognized information element is a sub-element within the Constructor information element.

   This applies to Constructor information elements at the top level of the structure within an APP parameter. It shall not apply recursively within a Constructor information element.

On receiving a BICC_Error indication primitive including multiple unrecognized information elements, the different instruction indicators associated with those information elements, shall be processed in priority order, according to the list, a) - f), above.

When the call is released due to compatibility procedures, the BAT Compatibility Report information element shall be sent in a BICC_Data request primitive, (corresponding to a Pre-Release Information message) towards the node that sent the unrecognized information element, including

the Report Reason *"information element non-existent or not implemented"* followed by a Diagnostic field containing the Information Element Identifier (of the first detected unrecognized information element which caused the call to be released) and the Index subfield.

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

10.1.2.4.2.2 Unrecognized fields

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

10.1.2.4.3 Procedures for the handling of a response indicating unrecognized information has been sent

Action taken on receipt of a BAT Compatibility Report information element will depend on whether the 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.

10.1.3 General introduction to the Q.764 exceptions

The procedures described in ITU-T Q.764 [4] 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 clause numbering within this subclause corresponds to the numbering within ITU-T Q.764, 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 reused for a subsequent call. (Reuse of idle bearers is a network option, see Annex A.)

Optional procedures are provided for support of Codec negotiation and modification.

10.1.4 Exchange types

ITU-T Q.764 defines the ISUP procedures related to six "exchange types":

1) Originating exchange;

2) Intermediate national exchange;

3) Outgoing international exchange;

4) Intermediate international exchange;

5) Incoming international exchange

6) Destination exchange.

The functional model for BICC refers to three SN types: ISN, TSN and GSN. Table 4 indicates which BICC SN types can exist at each of the Q.764 exchange types.

Table 4/Q.1901 – Relationship between Q.764 exchange types and SN types

Q.764 exchange type	SN type
Originating exchange	Not applicable
Intermediate national exchange	ISN, TSN, GSN
Outgoing international exchange	ISN, GSN
Intermediate international exchange	ISN, TSN
Incoming international exchange	ISN, GSN
Destination exchange	Not applicable

10.2 Basic call control and signalling procedures

10.2.1 Successful call set-up

10.2.1.1 Forward address signalling - *En bloc* operation

10.2.1.1.1 Actions required at the originating exchange

Clause 2.1.1.1/Q.764 is not applicable to BICC.

10.2.1.1.2 Actions required at an intermediate national exchange (Intermediate SN)

For each of the optional bearer handling cases the following modified 2.1.1.2/Q.764 procedures apply:

a) ~~*Circuit*~~*Outgoing selection*

An intermediate national exchange, on receipt of a initial address message will analyse the called party number and the other routing information (see 2.1.1.1 a)/Q.764) to determine the routing of the call. If the intermediate national exchange can route the call using the connection type specified in the transmission medium requirement parameter, ~~a free inter-exchange circuit is seized and an initial address message is sent to the succeeding exchange.~~ a free CIC value is selected, and the IAM Sending Control procedure

(10.2.1.1.2.3) is applied. The BICC incoming set-up procedures (10.2.1.1.2.2) are started when the call can be routed. Within a network if the intermediate national exchange does not route the call using just the connection type specified in the transmission medium requirement parameter, the exchange may also examine the user service information containing the bearer capability information and/or the user teleservice information containing the high layer compatibility information, if available, to determine if a suitable route can be selected. In this case, if a new connection type is provided, the transmission medium requirement parameter is modified to the new connection type.

b) *Parameters in the initial address message*

An intermediate national 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 indicator and propagation delay counter. 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. The order of information elements carried in the access transport parameter received from the incoming exchange shall be retained.

The satellite indicator in the nature of connection parameter should be incremented if the selected outgoing circuit is a satellite circuit. Otherwise, the indicator is passed on unchanged.

c) *Completion of transmission path*

Through connection of the transmission path in both directions will be ~~completed at an intermediate national exchange immediately after the initial address message has been sent, except in those cases where conditions on the outgoing circuit prevent it (see clause 7/Q.724 [15]).~~ as described in 10.2.1.1.2.6.

10.2.1.1.2.1 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.

10.2.1.1.2.1.1 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[2] is set to "notification required", else it is set to "notification not required".

[2] 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.

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. Transmission Medium Requirements (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 CON are received, as Bearer Set-up Connect indication has not yet been received the ACM/CON shall be handled according to 10.2.1.4, and Bearer Set-up Connect or Bearer Set-up Failure indication is awaited.

10.2.1.1.2.1.2 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 the SN that sent the IAM, and to allow the bearer set-up indication to be correlated with the call.

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

10.2.1.1.2.2 BICC incoming set-up procedures

When an IAM (plus SAMs, as appropriate for call routing), 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.

10.2.1.1.2.2.1 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 initiate the bearer connection.

1) The IAM is further processed, according to Q.764 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 (10.2.1.1.2.4) 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[3] 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.

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.

10.2.1.1.2.2.2 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 Q.764 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 (10.2.1.1.2.4) 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. Transmission Medium Requirements (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.

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[3] 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.

10.2.1.1.2.3 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 10.2.1.1.2 or 10.2.1.2.2. 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, 10.2.1.1.2.1.

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.

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

10.2.1.1.2.4.1 SN initiating codec negotiation

At an SN generating an IAM the procedures in 10.2.1.1.2.1 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 10.2.1.1.2.4.4.

10.2.1.1.2.4.2 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 Q.764 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 cannot be used for the call.

2) When the outgoing set-up procedure, 10.2.1.1.2.4.4, receives Selected Codec and Available Codecs List information it is passed to the relevant incoming set-up procedure in 10.2.1.1.2.4.5.

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

- 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 10.2.1.1.2.4.3 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 10.2.1.1.2.4.1 for an SN initiating codec negotiation.

10.2.1.1.2.4.3 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 10.2.1.1.2.2 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 cannot be used for the call. (The selected codec is also included in the list of available codecs.)

Subsequent procedures are according to the relevant incoming set-up procedure, as amended by the exceptions in 10.2.1.1.2.4.5.

10.2.1.1.2.4.4 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.

10.2.1.1.2.4.4.1 Per-call bearer set-up in forward direction

The procedures in 10.2.1.1.2.1.1 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 10.2.1.1.2.1.1, 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 10.2.1.1.2.1.1 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.

10.2.1.1.2.4.4.2 Per-call bearer set-up in backward direction

The procedures in 10.2.1.1.2.1.2 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.

10.2.1.1.2.4.5 Incoming set-up procedure

10.2.1.1.2.4.5.1 Per-call bearer set-up in forward direction

The procedures in 10.2.1.1.2.2.1 apply with the following exceptions:

The incoming set-up procedure shall wait, at 10.2.1.1.2.2.1, item 1), until the Selected Codec and the Available Codecs List for the call become available[4], the procedure then continues. The Selected Codec and the Available Codecs List shall be included in the BICC_Data request primitive sent at 10.2.1.1.2.2.1, 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.
- 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).

10.2.1.1.2.4.5.2 Per-call bearer set-up in backward direction

The procedures in 10.2.1.1.2.2.2 apply with the following exceptions:

The incoming set-up procedure shall wait, at 10.2.1.1.2.2.2, item 1), until the Selected Codec information and the Available Codecs List for the call become available[5], 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"*.

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

[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.

- Selected Codec, coded as the Single Codec information element.
- 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 10.2.1.1.2.2.2, item 2).

10.2.1.1.2.4.6 Abnormal cases

10.2.1.1.2.4.6.1 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.

10.2.1.1.2.4.6.2 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 10.2.1.1.2.1.1;

b) for the backward bearer set-up case: proceed as described from item 4) in 10.2.1.1.2.1.2.

10.2.1.1.2.4.6.3 Codec negotiation in an SN transiting codec negotiation

a) Whenever an SN transiting codec negotiation for a call, as described in 10.2.1.1.2.4.2, 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.

10.2.1.1.2.5 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 any time 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 following subclauses refer to the direction of the modification flow not of the direction of the call set-up flow.

10.2.1.1.2.5.1 SN initiating codec modification

In an SN, a codec modification procedure can be initiated in any direction and at any time 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.

10.2.1.1.2.5.2 SN terminating codec modification

In an SN terminating codec modification, a codec modification request can be received at any time during the active phase of a call, after 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.

10.2.1.1.2.5.3 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.

10.2.1.1.2.6 Through connection of the bearer path

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

- the Incoming 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 when 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.

10.2.1.1.3 Actions required at an outgoing international exchange

Clause 2.1.1.3/Q.764 applies with the following exceptions:

a) Where Q.764 refers to receipt of an IAM, the 10.2.1.1.2.2 procedures apply.
b) Where Q.764 refers to seizing a circuit, and sending an IAM, the 10.2.1.1.2.3 procedures apply.
c) Through connection of the transmission path will be as described in 10.2.1.1.2.6.
d) Codec negotiation and codec modification as described in 10.2.1.1.2.4 and 10.2.1.1.2.5 are optionally applicable.

10.2.1.1.4 Actions required at an intermediate international exchange

Clause 2.1.1.4/Q.764 applies with the following exceptions:

a) Where Q.764 refers to receipt of an IAM, the 10.2.1.1.2.2 procedures apply.
b) Where Q.764 refers to seizing a circuit, and sending an IAM, the 10.2.1.1.2.3 procedures apply.

c) Through connection of the transmission path will be as described in 10.2.1.1.2.6.

d) Codec negotiation and codec modification as described in 10.2.1.1.2.4 and 10.2.1.1.2.5 are optionally applicable.

10.2.1.1.5 Actions required at an incoming international exchange

Clause 2.1.1.5/Q.764applies with the following exceptions:

a) Where Q.764 refers to receipt of an IAM, the 10.2.1.1.2.2 procedures apply.

b) Where Q.764 refers to seizing a circuit, and sending an IAM, the 10.2.1.1.2.3 procedures apply.

c) Through connection of the transmission path will be as described in 10.2.1.1.2.6.

d) Codec negotiation and codec modification as described in 10.2.1.1.2.4 and 10.2.1.1.2.5 are optionally applicable.

10.2.1.1.6 Actions required at the destination exchange

Clause 2.1.1.6/Q.764 is not applicable to BICC.

10.2.1.1.7 Called party number for operator calls

Clause 2.1.1.7/Q.764 applies.

10.2.1.1.8 Called party number for calls to testing and measuring devices

Clause 2.1.1.8/Q.764 applies.

10.2.1.2 Forward address signalling - Overlap operation

10.2.1.2.1 Actions required at the originating exchange

Clause 2.1.2.1/Q.764 is not applicable to BICC.

10.2.1.2.2 Actions required at an intermediate national exchange (Intermediate SN)

For each of the optional bearer handling cases, the following modified 2.1.2.2/Q.764, procedures apply:

a) ~~*Circuit*~~*Outgoing selection*

An intermediate national exchange, on receipt of an initial address message, will analyse the digits available and the other routing information (see 2.1.2.1 a)/Q.764) to determine the routing of the call. If the intermediate national exchange can route the call using the connection type specified in the transmission medium requirement parameter, ~~a suitable free inter-exchange circuit is seized and an initial address message is sent to the succeeding exchange.~~ a free CIC value is selected, and the IAM Sending Control procedure (10.2.1.1.2.3) is applied. The BICC incoming set-up procedures, (10.2.1.1.2.2), are started when the call can be routed. If the number of digits in the called party number is not sufficient to route the call the routing will be carried out when the intermediate national exchange has received additional digits in subsequent address message(s). Any address digits received in subsequent address messages during the circuit selection process may be included in this initial address message. Any subsequent address messages received after the initial address message has been sent are forwarded to the succeeding exchange as subsequent address message(s).

Within the network if the intermediate national exchange does not route the call just using the connection type specified in the transmission medium requirement parameter, the exchange may also examine the user service information containing the bearer capability

information and/or the user teleservice information containing the high layer compatibility information, if available, to determine if a suitable route can be selected. In this case the transmission medium requirement parameter is modified to the new connection type.

b) *Parameters in the initial address message*

An intermediate national 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 indicator and propagation delay counter. 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. The order of information elements carried in the access transport parameter received from the incoming exchange shall be retained.

The satellite indicator in the nature of connection parameter should be incremented if the selected outgoing circuit is a satellite circuit. Otherwise, the indicator is passed on unchanged.

c) *Completion of transmission path*

Through connection of the transmission path ~~in both directions~~ will be ~~completed at an intermediate national exchange immediately after the initial address message has been sent, except in those cases where conditions on the outgoing circuit prevent it (see clause 7/Q.724 [15]).~~ as described in 10.2.1.1.2.6.

10.2.1.2.3 Actions required at an outgoing international exchange

Clause 2.1.2.3/Q.764 applies with the following exceptions:

a) Where Q.764 refers to receipt of an IAM, the 10.2.1.1.2.2 procedures apply.

b) Where Q.764 refers to seizing a circuit, and sending an IAM, the 10.2.1.1.2.3 procedures apply.

c) Through connection of the transmission path will be as described in 10.2.1.1.2.6.

d) Codec negotiation and codec modification as described in 10.2.1.1.2.4 and 10.2.1.1.2.5 are optionally applicable.

10.2.1.2.4 Actions required at an intermediate international exchange

Clause 2.1.2.4/Q.764 applies with the following exceptions:

a) Where Q.764 refers to receipt of an IAM, the 10.2.1.1.2.2 procedures apply.

b) Where Q.764 refers to seizing a circuit, and sending an IAM, the 10.2.1.1.2.3 procedures apply.

c) Through connection of the transmission path will be as described in 10.2.1.1.2.6.

d) Codec negotiation and codec modification as described in 10.2.1.1.2.4 and 10.2.1.1.2.5 are optionally applicable.

10.2.1.2.5 Actions required at an incoming international exchange

Clause 2.1.2.5/Q.764 applies with the following exceptions:

a) Where Q.764 refers to receipt of an IAM, the 10.2.1.1.2.2 procedures apply.

b) Where Q.764 refers to seizing a circuit, and sending an IAM, the 10.2.1.1.2.3 procedures apply.

c) Through connection of the transmission path will be as described in 10.2.1.1.2.6.

d) Codec negotiation and codec modification as described in 10.2.1.1.2.4 and 10.2.1.1.2.5 are optionally applicable.

10.2.1.2.6 Actions required at the destination exchange

Clause 2.1.2.6/Q.764 is not applicable to BICC.

10.2.1.2.7 Called party number for operator calls

Clause 2.1.2.7/Q.764 applies.

10.2.1.2.8 Called party number for calls to testing and measuring devices

Clause 2.1.2.8/Q.764 applies.

10.2.1.3 Calling party number

Clause 2.1.3/Q.764 applies.

10.2.1.4 Address complete message or connect message

Clause 2.1.4/Q.764 applies with the following exceptions:

a) In clause 2.1.4.8/Q.764, references to interworking with other signalling systems is not applicable, thus timer T10 is not applicable.

b) Clauses 2.1.4.1, 2.1.4.6 and 2.1.4.7/Q.764 are not applicable to BICC.

10.2.1.5 Call progress (Basic call)

Clause 2.1.5/Q.764 applies with the following exception:

Clauses 2.1.5.1 and 2.1.5.3/Q.764 are not applicable to BICC.

10.2.1.6 Information messages

Clause 2.1.6/Q.764 applies.

10.2.1.7 Answer message

Clause 2.1.7/Q.764 applies with the following exception:

Clauses 2.1.7.1, 2.1.7.6 and 2.1.7.7/Q.764 are not applicable to BICC.

10.2.1.8 Continuity-check

Clause 2.1.8/Q.764 applies with the following clarifications/exceptions:

a) Initiation of a continuity check between SNs is not supported.

b) The procedures are modified by the IAM sending control procedure, 10.2.1.1.2.3.

10.2.1.9 Charging

Clause 2.1.9/Q.764 applies.

10.2.1.10 Forward transfer message

Clause 2.1.10/Q.764 applies.

10.2.1.11 Transit network selection (national use)

Clause 2.1.11/Q.764 applies.

10.2.1.12 Simple segmentation

Clause 2.1.12/Q.764 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 Q.764 procedures.

10.2.1.13 Procedure for N × 64 kbit/s Connection Type

Procedures for multirate or N × 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 × 64 kbit/s connection type call between SNs.

b) The TMR parameter in the BICC IAM shall indicate the multirate or N × 64 kbit/s connection type as received from the SCN.

c) Contiguous and non-contiguous circuit selection procedures specified in 2.1.13/Q.764 are not applicable.

10.2.2 Unsuccessful call set-up

Clause 2.2/Q.764 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 10.2.1.1.2.2 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.

10.2.2.1 Actions at exchange initiating a release message

Clause 2.2.1/Q.764 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.

10.2.2.2 Actions at intermediate exchange

Forward/backward release at an intermediate SN is handled as in 10.2.3.1/10.2.3.2.

10.2.2.3 Actions at the controlling exchange (i.e. the exchange controlling the call)

Clause 2.2.3/Q.764 applies with the following exception/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 10.2.3.

10.2.2.4 Tones and announcements

Clause 2.2.4/Q.764 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, and thus no tone or announcement can be played to the calling party from the SN detecting the failure, e.g. in the backward bearer set-up case if the set-up of the bearer fails. In these cases the 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.

10.2.2.5 Address incomplete

Clause 2.2.5/Q.764 applies.

10.2.3 Normal call release

The following modified 2.3/Q.764 procedures apply:

The release procedures are based on a two-message (Release, Release Complete) approach whereby the release message initiates release of the ~~bearer connection.~~call.

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 Recommendation. See Appendix I and Appendix II.

The same procedures are used in the network irrespective of whether they are initiated by the calling party, the called party or the network.

To satisfy the need for rapid transfer of release across the network, it is required that the ~~circuit~~CIC value is selectable from the subsequent exchange within the mean cross-office transfer time, T_{cu}, for simple messages as specified in ITU-T Q.766 [10].

10.2.3.1 Release initiated by a calling party

The following modified 2.3.1/Q.764 procedures apply:

a) *Actions at the 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. A release message is sent to the succeeding exchange and timers T1 and T5 are started to ensure that a release complete message is received from the succeeding exchange (expiration of timers T1 and T5 is covered in 2.9.6).~~

Not applicable to BICC.

b) *Actions at an intermediate exchange (Intermediate SN)*

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 T1 and T5 are started to ensure that a Release Complete message is received from the succeeding exchange (expiration of timers T1 and T5 is covered in 10.2.9.6).

iii) When the Release Complete message is received timers T1 and T5 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.

c) *Actions at the destination exchange*

~~On receipt of a release message from the preceding exchange, the destination exchange will start the release of the switched path. When the circuit is ready for re-selection, a release complete message is returned to the preceding exchange.~~

Not applicable to BICC.

d) *Charging (national use)*

Charging is stopped upon receipt of the Release message at the charging exchange. ~~or~~ The stopping of charging on the receipt of a request to release the call from the calling party when the charging exchange is the originating exchange is not applicable to BICC.

e) *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 will return a Release Complete message to the exchange from which the concerned Release message was received. The Release Complete message will be sent only after the ~~switch path has been released~~BCF has acknowledged the Bearer Release request. The exchange will make the ~~circuit,~~ CIC value available for new calls when both a Release Complete message is received (corresponding to the sent Release message) and a Release Complete message is sent (corresponding to the received Release message).

10.2.3.2 Release initiated by a called party

The procedures in 10.2.3.1 apply, with the words "preceding"/"succeeding" and "incoming"/"outgoing" interchanged.

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

10.2.3.3 Release initiated by the network

Release can be initiated at any SN. Releases in the forward direction are treated as in 10.2.3.1, and releases in the backward direction are treated as in 10.2.3.2. 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.

10.2.3.4 Storage and release of initial address message information

Clause 2.3.4/Q.764 applies.

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

10.2.3.5 Pre-release information transport

Clause 2.3.5/Q.764 applies.

10.2.4 Suspend, resume

Clause 2.4/Q.764 applies.

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

10.2.5 Signalling procedures for connection type allowing fallback

Clause 2.5/Q.764 applies.

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

Some fallback actions may not apply at all SNs. This is for further study.

10.2.6 Propagation delay determination procedure

Clause 2.6/Q.764 applies with the following clarification/exception:

The determination of the propagation delay value to be added, when the bearer is to be routed through separate/independent network elements from the call, is likely to be approximate, and is considered network/implementation specific.

10.2.7 Echo control signalling procedures

10.2.7.1 Introduction

Clause 2.7.1/Q.764 applies with the following exception:

The Enhanced echo control signalling procedures are not supported.

10.2.7.2 Enhanced echo control signalling procedures

Not used.

NOTE – The SNs act as Q.115 Type 2 exchanges and therefore pass the Echo Control Information parameter and the NRM message, if received from ISUP. (See 2.7.2.3/Q.764.)

10.2.7.3 Simple echo control signalling procedures

Clause 2.7.3/Q.764 applies with the following exception:

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

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

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 ITU-T 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 ITU-T Q.115.

10.2.8 Network features

10.2.8.1 Automatic repeat attempt

Clause 2.8.1/Q.764 applies with the following exception/clarifications:

a) Where the text refers to reception of the Blocking message this shall be interpreted to mean reception of a Circuit Group Blocking message including the relevant status bit for this CIC set to "1".

b) Item iv) is not applicable to BICC.

10.2.8.2 Blocking and unblocking of circuits and circuit groups (CIC values)

Modified clause 2.8.2/Q.764 procedures apply:

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 ~~the distant terminal(s) of a circuit or group of circuits because of a fault or to permit testing.~~ <u>CIC values, thus providing a means to control the amount of traffic that can be presented to the SN.</u>

~~Since the circuits served by the ISDN User Part have both-way capability, t~~<u>The</u> ~~blocking message or~~ circuit group blocking message can be originated by either exchange. The receipt of ~~a blocking message or a~~ circuit group blocking message will have the effect of prohibiting non-test calls on the relevant ~~circuit(s)~~ <u>CIC(s)</u> outgoing from the exchange until a~~n unblocking message or an appropriate~~ circuit group unblocking message is received, but will not prohibit test calls incoming to that

exchange. Test calls generated in the outgoing direction from the exchange that sent the ~~blocking or~~ circuit group blocking message will also be processed. Non-test Initial Address Messages will result in an abnormal case (see 2.8.2.3/Q.764, item xiv)]. An acknowledgement sequence is always required for the ~~blocking and unblocking message as well as for the~~ circuit group blocking message and circuit group unblocking messages using the ~~blocking acknowledgement message, the unblocking acknowledgement message, the appropriate~~ circuit group blocking acknowledgement messages and the ~~appropriate~~ circuit group unblocking acknowledgement message respectively. The acknowledgement is not sent until the appropriate action – either blocking or unblocking – has been taken. The release message should not override a blocking ~~message~~ condition and return ~~circuits~~CICs to service ~~which might be faulty~~. The blocked ~~circuit(s)~~ CIC(s) will be returned to service on transmission of the unblocking acknowledgement message or the appropriatecircuit group unblocking acknowledgement message at one exchange and on receipt of ~~the unblocking acknowledgement message or the appropriate~~ circuit group unblocking acknowledgement message at the other exchange.

~~The use of circuits for multirate calls or N × 64 kbit/s connection type has no effect on the blocking (unblocking) procedures, which apply on a per circuit, not per call basis.~~

10.2.8.2.1 Other actions on receipt of a blocking message

Clause 2.8.2.1/Q.764 applies with the following exception/clarifications:

a) Where the text refers to a Blocking message this shall be interpreted to mean a Circuit Group Blocking message including the relevant status bit for this CIC set to "1".

b) Where the text refers to a blocking (unblocking) acknowledgement message this shall be interpreted to mean a circuit group blocking (unblocking) acknowledgement message.

c) The last paragraph shall be replaced by: "When a CIC value is blocked by use of the circuit group blocking message, the maintenance system should be informed at both ends of the signalling association."

10.2.8.2.2 Circuit group blocking and unblocking messages

Clause 2.8.2.2/Q.764 applies with the following clarifications/exceptions:

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

b) The 5th paragraph, which starts "A circuit is controlled by the ISDN User Part if...." is not applicable.

c) Hardware group blocking and unblocking procedures are not supported by BICC.

d) Blocking of a single CIC is supported using the Circuit Group Blocking message.

e) The 7th paragraph, which starts "The maintenance oriented circuit group blocking..." is not applicable because the Blocking (Unblocking) messages are not supported.

f) The 8th paragraph, which starts "The maintenance blocked state..." is not applicable.

10.2.8.2.3 Abnormal blocking and circuit group blocking procedures

Clause 2.8.2.3/Q.764 applies with the following clarifications:

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

b) Items x), xi), xii) and xiii) are not applicable.

10.2.8.3 Circuit group query (national use)

Clause 2.8.3/Q.764 applies with the following clarifications:

a) All text concerning hardware blocking states is not applicable.

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

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

10.2.9 Abnormal conditions

10.2.9.1 Dual seizure

Clause 2.9.1/Q.764 applies with the following clarifications/exceptions:

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

b) The 2nd paragraph of 2.9.1.2/Q.764 is not applicable.

c) For preventive action, method 1 (2.9.1.3/Q.764) shall be applicable for all connection types (64 kbit/s, multirate or N × 64 kbit/s). Method 2 is not applicable.

d) For the determination of control exchange, method a), 2.9.1.4/Q.764 shall be applicable irrespective of the connection type of the calls involved, (64 kbit/s, multirate or N × 64 kbit/s), 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 signalling route. Methods b), c) and d) are not applicable.

10.2.9.2 Transmission alarm handling for digital inter-exchange circuits

Not applicable to BICC.

10.2.9.3 Reset of circuits and circuit groups (CIC values)

Clause 2.9.3/Q.764 applies 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 reuse.

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 reuse.

e) Item b) 2.9.3.2/Q.764 is not applicable as hardware failure oriented blocking is not applicable to BICC.

f) Item c) 2.9.3.2/Q.764 is replaced by "respond by a circuit group reset acknowledgement message in which the status indicator bits of the CICs available for service are coded 0 and the status indicator bits of all CICs blocked for maintenance reasons are set to 1".

g) Item h) 2.9.3.1/Q.764 and item g) 2.9.3.2/Q.764 are not applicable as no procedure specific to multirate or N × 64 kbit/s connection type call is required.

h) 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".

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.

10.2.9.4 Failure in the blocking/unblocking sequence

Clause 2.9.4/Q.764 applies with the following clarifications:

a) 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.

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

10.2.9.5 Receipt of unreasonable signalling information messages

Clause 2.9.5/Q.764 applies, 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[6] shall be treated as unrecognized.

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

d) For multirate and N × 64 kbit/s connection type calls 2.9.5.1, item c) applies. (2.9.5.1, item e), is not applicable.)

e) The text specific to multirate and N × 64 kbit/s connection type calls in 2.9.5.1, item f), third bullet, is not applicable.

f) If a message is received with a CIC value that is not provisioned within the SN it shall be discarded, however if the SN supports the national option using the Unequipped Circuit Identification Code message, (10.2.12), that procedure shall be performed instead.

g) 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, 10.2.9.3, 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.

10.2.9.6 Failure to receive a "Release Complete" message – Timers T1 and T5

Clause 2.9.6/Q.764 applies with the following exception/clarifications:

a) 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.

b) When timer T1 expires the BCF is requested to release the bearer, as in 10.2.3.1.

10.2.9.7 Failure to receive a response to an information request message (national use)

Clause 2.9.7/Q.764 applies.

10.2.9.8 Other failure conditions

10.2.9.8.1 Inability to release in response to a Release message

Not applicable to BICC.

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6 As indicated in clause 9.

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

10.2.9.8.2 Call failure

Clause 2.9.8.2/Q.764 applies.

10.2.9.8.3 Abnormal release conditions

Clause 2.9.8.3/Q.764 applies.

10.2.9.9 Temporary Trunk Blocking (TTB) (national use)

Not applicable to BICC.

10.2.10 ISDN User Part signalling congestion control

Clause 2.10/Q.764 is not applicable.

BICC can receive the CONGESTION.indication primitive on the interface to the STC, see Annex B. BICC will adjust traffic load for this signalling relation, according to the value of the Level parameter received in the primitive.

10.2.11 Automatic congestion control

Clause 2.11/Q.764 applies.

10.2.12 Unequipped Circuit Identification Code message (national use)

Clause 2.12/Q.764 applies with the following clarifications:

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

b) Where the text refers to "unequipped circuit(s)," this shall be interpreted to mean "CIC(s) that are not provisioned for use".

10.2.13 ISDN User Part availability control

Clause 2.13/Q.764 is not applicable. (Procedures in 10.2.14 apply.)

10.2.14 MTP Pause/Resume

Clause 2.14/Q.764 is not applicable.

BICC can receive the OUT-OF-SERVICE.indication and IN-SERVICE.indication primitives from the STC, see Annex B.

a) On receipt of the OUT-OF-SERVICE.indication primitive no new calls shall be routed towards this signalling relation. Calls in progress need not be released even though signalling messages cannot be sent to the affected exchange. (While it may not be technically necessary to release calls in progress, network providers may choose to release such calls, perhaps after some time interval, if there is a concern about overcharging due to the exchange's inability to completely clear the call when either the calling or called party disconnects.)

b) On receipt of the IN-SERVICE.indication primitive traffic is restarted. The traffic load offered to this signalling relation should be according to the value of the Level parameter received in the primitive.

10.2.15 Overlength messages

Clause 2.15/Q.764 applies with the following exception:

The Q.764 procedure for reducing the message size shall only be applied if the message length would exceed the octet limit of the underlying message transport mechanism as indicated by the START-INFO.indication primitive received from the STC, see Annex B.

10.2.16 Support for Temporary Alternative Routing (TAR)

Clause 2.16/Q.764 applies with the following clarification:

The TAR procedure relates to call routing only.

10.2.17 Hop counter procedure

Clause 2.17/Q.764 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.

10.2.18 Call collect request procedure

Clause 2.18/Q.764 applies.

10.2.19 Support for Hard To Reach Network Management functions

Clause 2.19/Q.764 applies.

10.2.20 Calling Geodetic location procedure

Clause 2.20/Q.764 applies.

10.3 Annex A – Timers in the ISDN User Part

Annex A/Q.764 applies with the following exceptions/clarifications:

a) Timer T3 is not used.

b) Timer T4 is not used.

c) Timer T10 is not used.

d) Timers T12, T13, T14 and T15 are not used.

e) Timers T24, T25, T26 and T27 are not used.

f) Timers T29 and T30 – see Annex C.

g) Timer T36 is not used.

10.4 Annex B – Figures on basic call control signalling procedures

Not applicable, see Appendix I.

10.5 Annex C – Examples of echo control signalling procedures

Clauses C.1, C.2, C.3, C.4.2, C.5.2 and C.7 do not apply.

In clauses C.4.1, C.5.1, C.6.1 and C.6.2 a SN can act as the exchanges supporting the "simple" procedure.

10.6 Annex D – Examples of signalling procedures for connection type allowing fallback

Annex D/Q.764 applies.

10.7 Annex E – Test calls

Annex E/Q.764 applies.

10.8 Annex F – Cause values

Annex F/Q.764 applies.

10.9 Annex G – Start up procedures

Annex G/Q.764 applies with the following exception:

Item G.3 b) is not applicable.

11 Exceptions to ITU-T Q.765

ITU-T Q.765 applies with the following exceptions.

The reference to Signalling System No. 7 in the title is not relevant. Where the text refers to ISUP this shall be interpreted to mean BICC.

The subsequent subclause numbers within this clause correspond to the numbering within ITU-T Q.765.

11.6.2.2.1 General model

BICC is an adaptation of the narrow-band 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 generalized model for the ISUP Application Transport Mechanism Application Process is presented in Figure 2/Q.765.

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

ISUP basic call Recommendation (ITU-T Q.764) 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. ITU-T Q.765 also does not define the functionality split for ISUP basic call.

The model from Figure 2/Q.765 applied on the BICC basic call is shown in Figure 5.

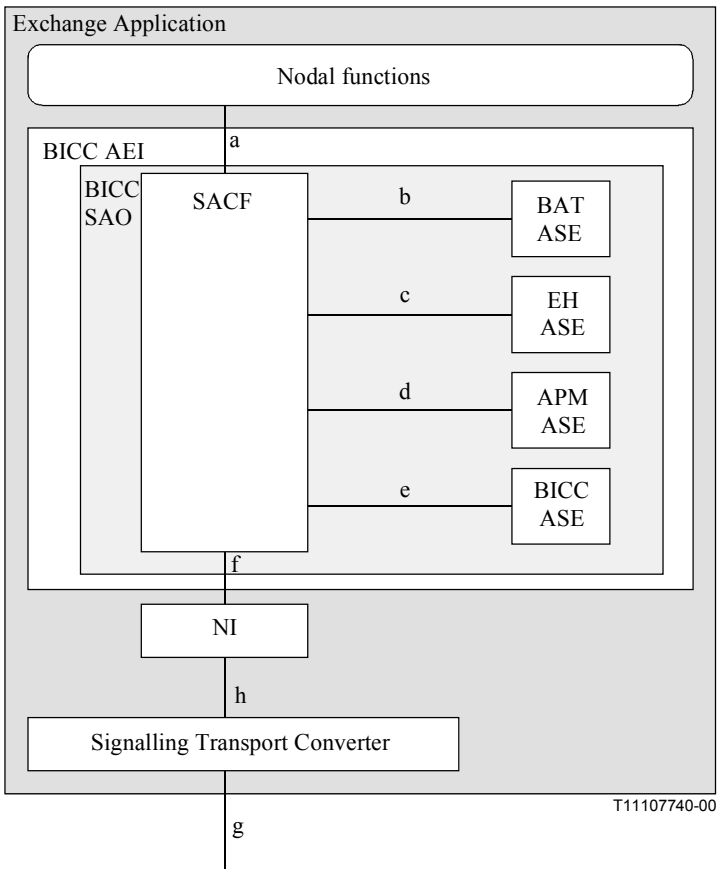


Figure 5/Q.1901 – BICC specification model

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 Q.765). 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, 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 while interface (g) is the specific signalling transport service, and, in case of MTP3 signalling transport, is the same as described in ITU-T Q.765.

11.10.2.1 Normal procedures – Sending

Clause 10.2.1/Q.765 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, 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 ITU-T Q.763.

11.12 Network Interface function

Clause 12/Q.765 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 ITU-T Q.763 it shall be interpreted to be a reference to clause 9.
4) When the text refers to ITU-T Q.764 it shall be interpreted to be a reference to clause 10.
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 Recommendation.

ANNEX A

Procedures for reuse of idle bearers (network option)

A.1 Introduction

This annex describes the procedures to be performed for reuse 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 – Reuse of idle bearers is a network option. Network connections are "owned" by the ISN which originally set them up. The management of a set of idle bearers is therefore a local issue in the BCF which has established them.

- This specification does not define the procedures used at the node which owns a network connection to determine whether and when network connections should be retained (left idle) and released.
- To protect against the error case in which the node owning a network connection neglects to release it when it has not been reused 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 reuse 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 Recommendation.
- Reuse 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 10.

A.2.1 Outgoing set-up procedures

A.2.1.1 Reuse of forward idle bearer

During the forward set-up procedure, 10.2.1.1.2.1.1, 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 reuse).

- 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 Reuse of backward idle bearer

During the backward set-up procedure, 10.2.1.1.2.1.2, whilst 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 reuse 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 10.2.9.3. (Use of reset causes the realignment of system resources.)

A.2.2 Incoming set-up procedures

A.2.2.1 Reuse of forward idle bearer

During the forward set-up procedure, 10.2.1.1.2.2.1, whilst 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 reuse 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 10.2.9.3. (Use of reset causes the realignment of system resources.)

A.2.2.2 Reuse of backward idle bearer

During the backward set-up procedure, 10.2.1.1.2.2.2, 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 reuse).
   - 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 10.2.1.1.2.3 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 reusing idle bearers.

A.2.5 Release procedure

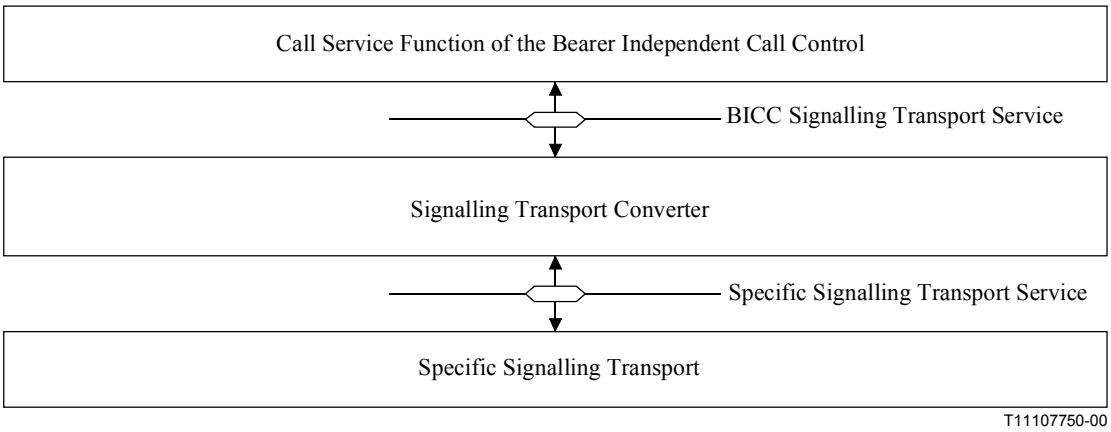
NOTE – In support of this procedure the BCFs may decide not to release the bearer network connection when call release occurs.

ANNEX B

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). Two peer Call Service Function (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.



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.

Figure B.1/Q.1901 – Functional architecture of the CSF signalling

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 a BICC signalling transport.

B.2.2 BICC signalling transport: The function that enables a 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 clause 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 SAP.

B.3.2 Primitive definition

The services are summarized in Table B.1, 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 the 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/Q.1901 – Primitives and parameters of the BICC Signalling Transport Sublayer

Primitive Generic Name	Type			
	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 (Note 2)	BICC Data Priority (Note 2)	–	–
– This primitive is not defined. NOTE 1 – This primitive has no parameters. NOTE 2 – This parameter is a national option.				

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. The value of the Level parameter is implementation dependent.

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 odd or even CICs on this signalling association.

f) **Priority**

This parameter indicates the priority of the BICC signalling message.

B.3.4 Establishment

On the establishment of a signalling transport converter entity and the associated signalling transport converter user entity, for example at power up, the initial condition is 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

Additional specification for the deployment of ITU-T Q.1901 on MTP3 and MTP3b

C.1 Scope

This annex specifies the signalling transport converter sublayer on top of the message transfer part (MTP) specified in ITU-T Q.704 [12] "MTP3" and ITU-T Q.2210 "MTP3b"; both Recommendations specify the peer-to-peer protocol for the transfer of information and control between any pair of MTP level 3 entities. This annex covers the specification of the sublayer structure, the additional PDU structures of the signalling transport converter sublayer, and the procedures for the provision of the signalling transport service that are specified in Annex B.

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 signalling transport converter (STC) resides on top of the Message Transfer Part. It deploys the services provided by level 3 of the Message Transfer Part defined in ITU-T Q.704 [12] and ITU-T Q.2210 [13].

The STC provides for the service that is requested by the Signalling Transport Service defined in Annex B, where the Bearer Independent Call Control 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 odd or even CIC values on this signalling 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.

C.6.2 The Service provided by MTP

The primitives and parameters are shown in Table C.1.

NOTE – This service corresponds to the "Specific Signalling Transport Service" in Figure B.1.

Table C.1/Q.1901 – Message Transfer Part service primitives

Primitive Generic Name	Type			
	Request	**Indication**	**Response**	**Confirm**
MTP-TRANSFER	OPC (see 2.2/Q.704) DPC (see 2.2/Q.704) SLS (see 2.2/Q.704) (Note 1) SIO (see 14.2/Q.704) User Data (see 2.3.8/Q.703)	OPC (see 2.2/Q.704) DPC (see 2.2/Q.704) SLS (see 2.2/Q.704) (Note 1) SIO (see 14.2/Q.704) User Data (see 2.3.8/Q.703)	–	–
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/Q.701 [11].

NOTE 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 which contain the same SLS code.

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

i) Signalling network congested (plus optional level)

The level value is included if national options with congestion priorities or multiple signalling link states without congestion priorities as in ITU-T Q.704 [12] are implemented.

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 (see 7.2.6/Q.701 [11]).

NOTE 1 – 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 is not allowed to send 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 (see 7.2.6/Q.701 [11]).

This primitive corresponds to the destination accessible state as defined in ITU-T Q.704 [12].

NOTE 2 – 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. The primitive is also used to indicate to a User that a remote corresponding User is unavailable and the cause for unavailability (see 11.2.7/Q.704 [12]).

In the case of national option with congestion priorities or multiple signalling link congestion states without priorities, are implemented as in ITU-T Q.704 [12], this "MTP-STATUS" primitive is also used to indicate a change of congestion level.

This primitive corresponds to the destination congested/User Part unavailable state as defined in ITU-T Q.704 [12].

NOTE 3 – 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, no message will be delivered but each 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 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 showing each signalling point's accessibility or inaccessibility. The means of doing this is implementation dependent (see clause 9/Q.704 [12]).

C.6.3 Primitives between the STC and layer management

This clause 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/Q.1901 – Primitives and parameters between the STC and layer management

Primitive Generic Name	Type			
	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

The STC entity requires the following timer:

a) **Timer_Long**

This timer corresponds to timer T30 2.10.2/Q.764 [4].

NOTE 1 – This timer is used by the congestion indication procedure. Receipt of a repeated congestion indication from MTP before the expiry of this timer is interpreted that the congestion situation has become worse in the meantime. On the other hand, if no congestion indication is received from MTP before expiry of this timer, the congestion situation is considered to have become better.

b) **Timer_Short**

This timer corresponds to timer T29 in 2.10.2/Q.764 [4].

NOTE 2 – This timer is used by the congestion indication procedure. The role of this timer is to avoid overreacting if multiple congestion indications are received from MTP in quick succession.

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 for national use to indicate message priority. The network indicator must indicate to which network the signalling relation belongs. The service indicator must indicate "BICC signalling".

NOTE 1 – The value of the Service Indicator for the Bearer Independent Call Control is "13" (see ITU-T Q.704 [12] and ITU-T Q.2210 [13] and its respective Implementors' Guides).

d) **Value of Timer_Long**

The value of Timer_Long is defined in 2.10.2/Q.764 [4] as the value for timer T30.

NOTE 2 – Timer_Long is typically in the range of 5 to 10 seconds.

e) **Value of Timer_Short**

The value of Timer_Short is defined in 2.10.2/Q.764 [4] as the value for timer T29.

NOTE 3 – Timer_Short is typically in the range of 0.3 to 0.6 seconds.

f) **Value of Max_Length**

The value of Max_Length can be set to either "272" or "4096".

NOTE 4 – The Max_Length parameter is set as follows:

- If BICC is deployed in an MTP3 signalling relation, the Max_Length parameter is set to "272".
- If BICC is deployed in an MTP3b signalling relation, 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 parameter is network dependent. If the Level indicates congestion then the congestion indication procedure (specified in 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.

Table C.3/Q.1901 – 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 may be augmented, as a national option, with priority indication with the value received in the Priority parameter.	

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. As a national option, the TRANSFER.indication primitive may indicate priority as 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 parameter is network dependent. If the Level indicates congestion then the congestion indication procedure (specified in C.8.4) is started.

C.8.4 Congestion Indication procedure

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

1) When the first congestion indication is received by the STC, a CONGESTION.indication primitive with the parameter Level indicating onset of congestion shall be issued towards BICC. At the same time, timers Timer_Short and Timer_Long shall be started.
2) While Timer_Short is running, all received congestion indications for the same destination point code shall be ignored in order not to reduce traffic too rapidly.
3) Reception of a congestion indication after the expiry of timer Timer_Short, but still while Timer_Long is running, shall result in the transfer of a CONGESTION.indication primitive being sent to BICC. It contains a Level parameter that is stepped up from the previous level. At the same time, Timer_Short and Timer_Long shall be restarted.
4) This stepwise increase of the congestion level shall continue until a maximum level is reached by arriving at the last step.

5) If Timer_Long expires (i.e. no congestion indications have been received while Timer_Long was running), a CONGESTION.indication containing the Level parameter that is stepped down from the previous level shall be sent to the BICC. Timer_Long shall be restarted unless full traffic load has been resumed.

The number of steps of congestion level and/or amount of increase/decrease are considered to be an implementation matter.

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 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 network dependent. If the Level indicates congestion then the congestion indication procedure (specified in C.8.3) is started.

Table C.4/Q.1901 – 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

Additional specification for the deployment of ITU-T Q.1901 on SSCOP and on SSCOPMCE

D.1 Scope

This annex specifies the signalling transport converter sublayer directly on top of 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 ITU-T Q.2110 [14]. In a multi-link or connectionless environment, its operation (SSCOPMCE) is specified in ITU-T Q.2111 [15]. Since the service provided by either of these Recommendations is the same, this Annex only describes the actions in terms of ITU-T Q.2110 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.

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 Service Specific Connection-Oriented Protocol (SSCOP), and between the STC and layer management.

D.2 Definitions

This annex is based upon the concepts developed in ITU-T Q.2110 [1], 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
SN	Sequence Number
SSCOP	Service Specific Connection-Oriented Protocol (ITU-T Q.2110 [14])
SSCOPMCE	Service Specific Connection-Oriented Protocol in a multi-link or Connectionless Environment (ITU-T Q.2111 [15])
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 signalling transport converter (STC) resides on top of the Service Specific Convergence Sublayer (SSCS) of the ATM Adaptation Layer (AAL). It deploys the services provided by the Service Specific Connection-Oriented Protocol (SSCOP) defined in ITU-T Q.2110 [13]. 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 D.7.2) but identified as AAL-primitives instead of AA-signals consistent with the primitive naming convention at a SAP (see 6.1/Q.2110 [13]).

The STC provides for the service that is requested by the Signalling Transport Service defined in Annex B, where the Bearer Independent Call Control 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 ITU-T Q.2110 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 odd or even CIC values on this signalling association.

In addition, the following SSCOP services are utilized (see ITU-T Q.2110 [1]):

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.

D.7.2 The Service provided by SSCOP

This clause specifies the information flow across the BICC signalling transport converter – AAL Service Specific Convergence Sublayer (SSCOP) boundary. This boundary is defined in 6.1/Q.2110 [13] and summarized below. In the event of any differences between the following summary and the definitions in ITU-T Q.2110, the definitions in ITU-T Q.2110 take precedence.

NOTE – This service corresponds to the "Specific Signalling Transport Service" in Figure B.1.

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

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 Recommendation; 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/Q.1901 – SSCOP primitives and parameters

Primitive Generic Name	Type			
	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. NOTE 1 – This primitive has no parameters. NOTE 2 – This primitive is not used by the STC.				

D.7.2.2 Parameter definition

Table D.1 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, ITU-T Q.2110 [13]). 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) **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 1 500 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 initialized, 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).

D.9.2 State Transition Table

The following states are used in this Recommendation. 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) for STC describes the primitives and primitives that lead to state transitions.

Table D.2/Q.1901 – 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

Interworking with ISUP at an ISN

E.1 Scope

This annex defines the procedures to be performed at an ISN which interfaces to an SCN using ISUP signalling. Such a node is illustrated by Figure E.1.

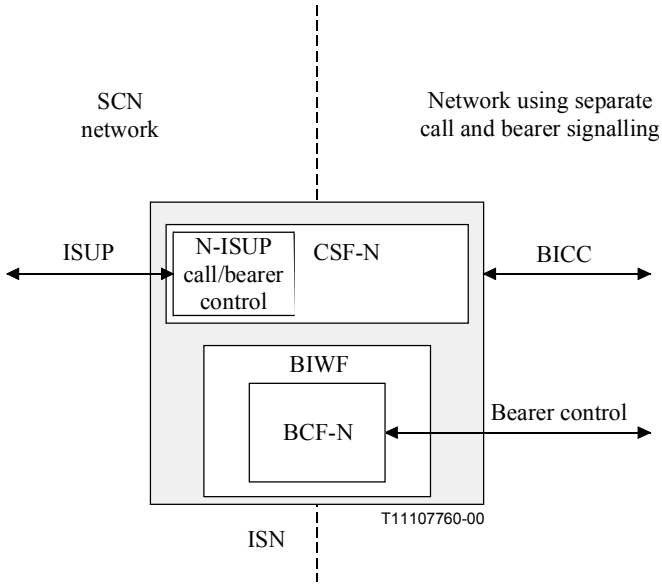


Figure E.1/Q.1901 – ISUP ISN Functional model

E.2 General

The protocol at the ISUP interface shall be according to the ISUP Recommendations, see ITU-T Q.761.

The protocol at the BICC interface shall be according to this Recommendation.

Transfer of signalling information between the two signalling interfaces shall be done as if the ISN was an ISUP intermediate exchange. Since both protocols use signalling information defined in ITU-T Q.763 a one-to-one mapping is performed, (unless explicitly specified to the contrary in this Recommendation).

The ISN may act as a Type A or Type B exchange for the purposes of the Q.764 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 10.2.1.1.2.3 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 ITU-T Q.764 apply. No continuity check test is performed by BICC.

The IAM is sent when determined by the outgoing selection procedures in 10.2.1.1.2 or 10.2.1.2.2. The Continuity Check indicator in the Nature of Connection Indicators parameter is set according to Q.764 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, 10.2.1.1.2.1.

The Continuity message, with the Continuity Indicators parameter set to *"continuity check successful"* is sent when received from ISUP, according to ITU-T Q.764 intermediate exchange procedures.

E.3.1.2 Through connection of the bearer path

Clause 10.2.1.1.2.6 is replaced by the following procedure:

The bearer path shall 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 shall be connected in both directions when the Bearer Set-up request is sent.

E.3.2 Call release

Clause 10.2.3.1 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 T1 and T5 are started to ensure that a release complete message is received from the succeeding exchange (expiration of timers T1 and T5 is covered in 10.2.9.6).

iii) When the Release Complete message is received timers T1 and T5 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 10.2.1.1.2.3 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 Q.764 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 10.2.1.1.2 or 10.2.1.2.2. 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 indicates 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 10.2.1.1.2.6 is replaced by the following procedure:

The bearer path shall 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 7/Q.724.

E.4.2 Call release

Clause 10.2.3.1 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 T1 and T5 are started to ensure that a release complete message is received from the succeeding exchange (expiration of timers T1 and T5 is covered in 10.2.9.6).

APPENDIX I

Message Flow Examples

I.1 Introduction to message flows

This appendix 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 generalized 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 10.2.1.1.2.6.

I.2 Contents

1) *Call set-up*

1.1) Forward establishment of backbone network connection, no notification of bearer connect required.

1.2) Forward establishment of backbone network connection, notification of bearer connect is required.

1.3) Backward establishment of backbone network connection.

1.4) 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.

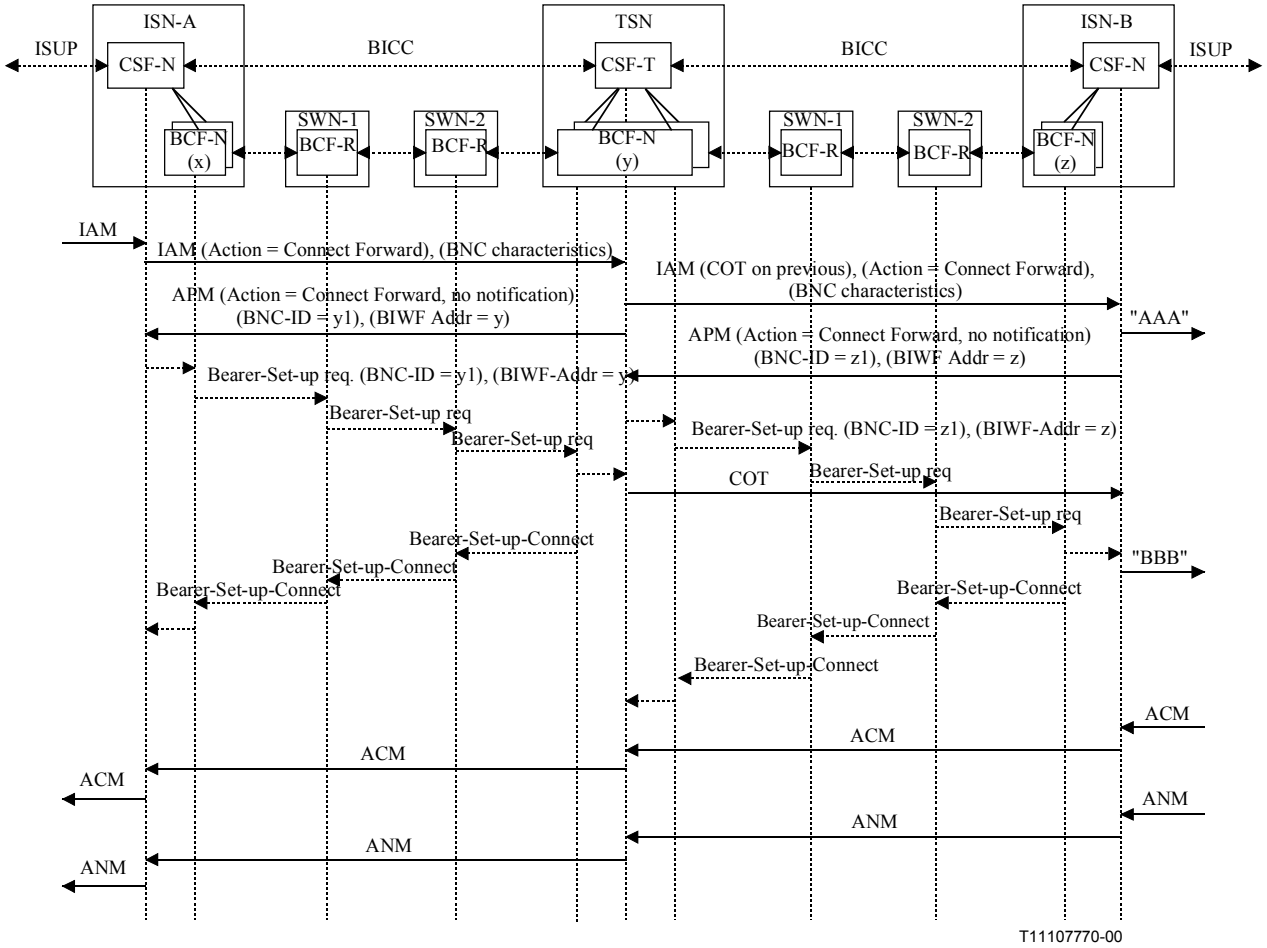


Figure I.1/Q.1901 – Forward establishment of backbone network connection, no notification of bearer connect required

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"*

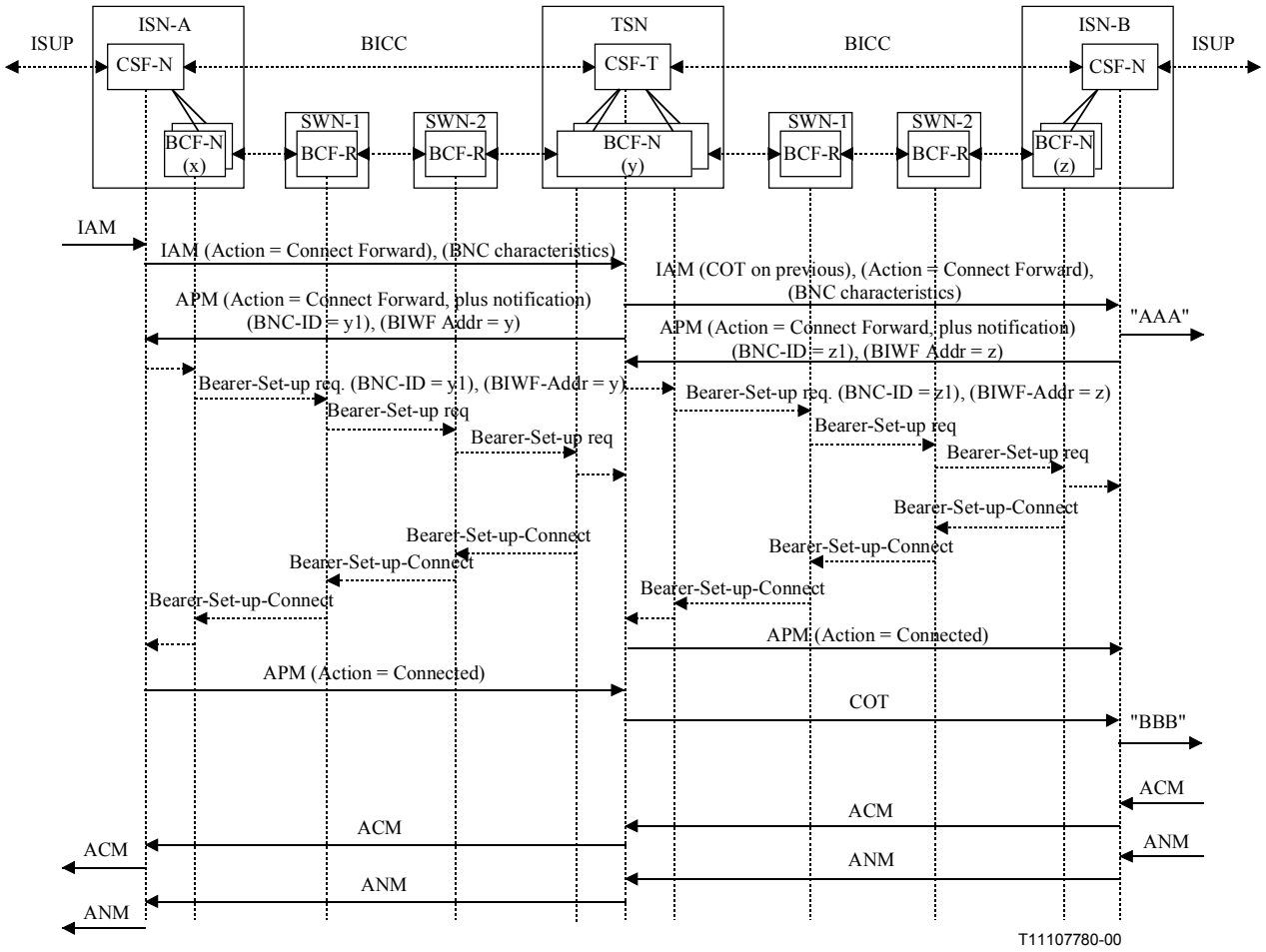


Figure I.2/Q.1901 – Forward establishment of backbone network connection, notification of bearer connect is required

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"*

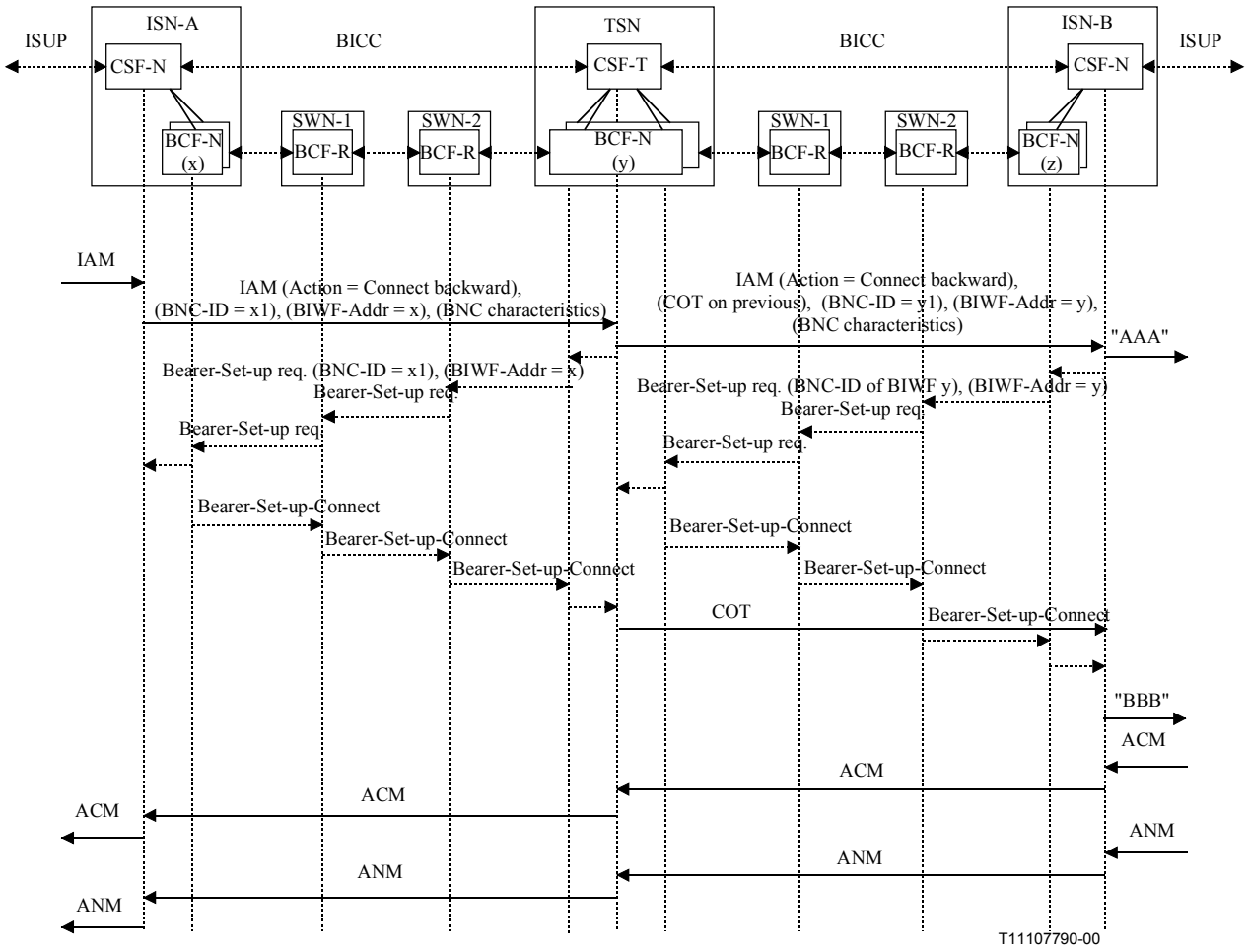


Figure I.3/Q.1901 – Backward establishment of backbone network connection

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"*

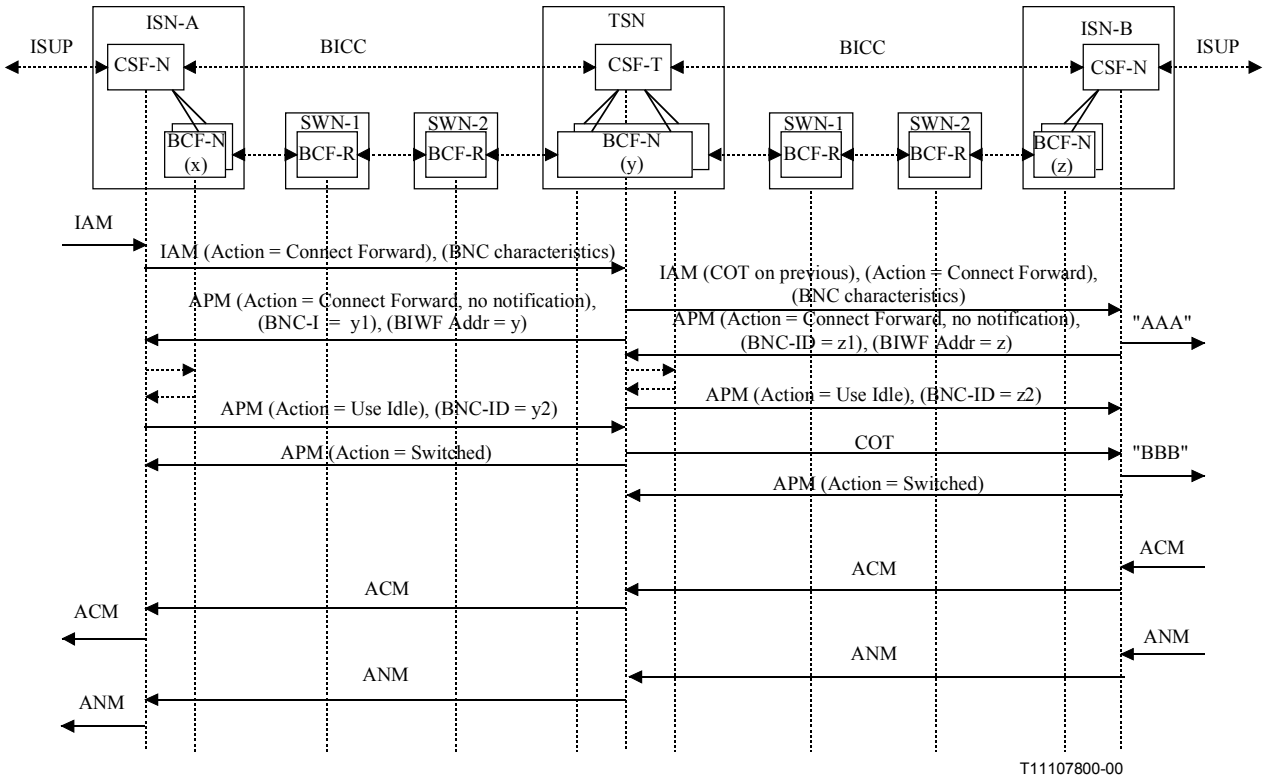


Figure I.4/Q.1901 – Use of idle backbone network connection, established in the forward direction

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"*

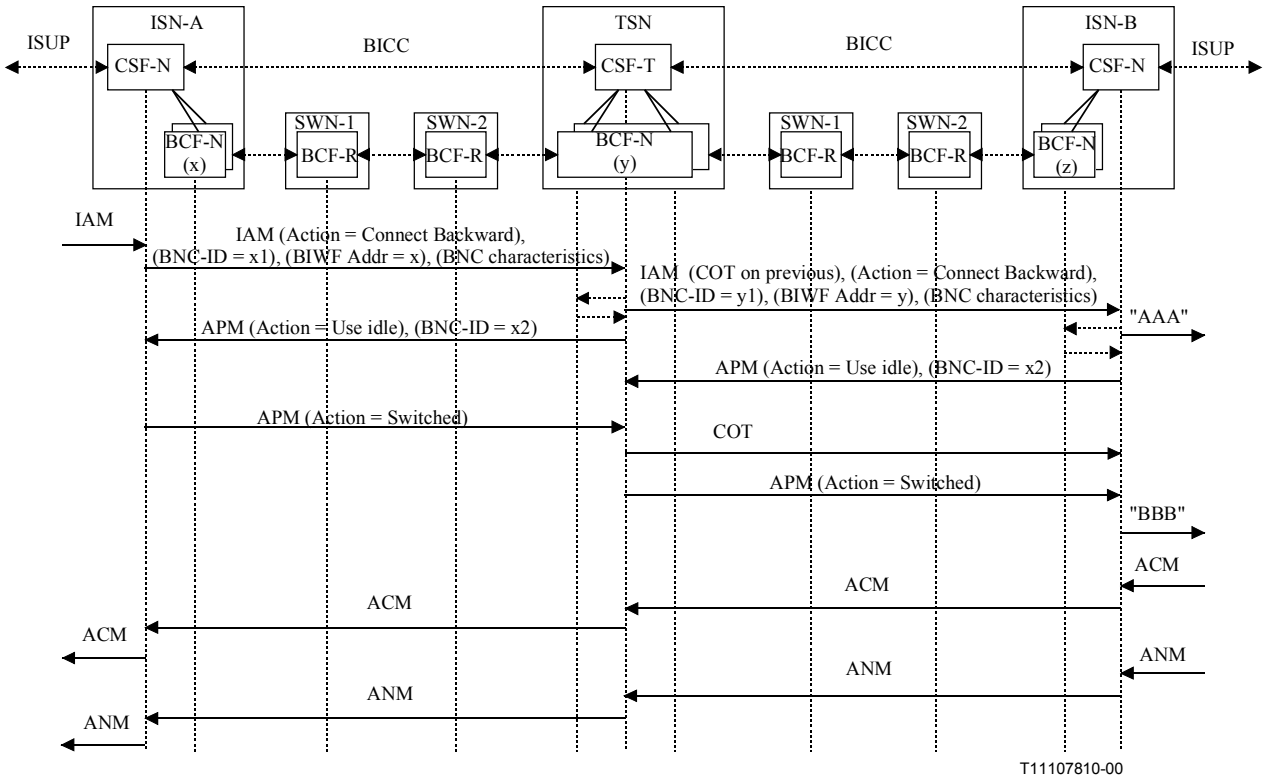


Figure I.5/Q.1901 – Use of idle backbone network connection, established in the backward direction

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"*

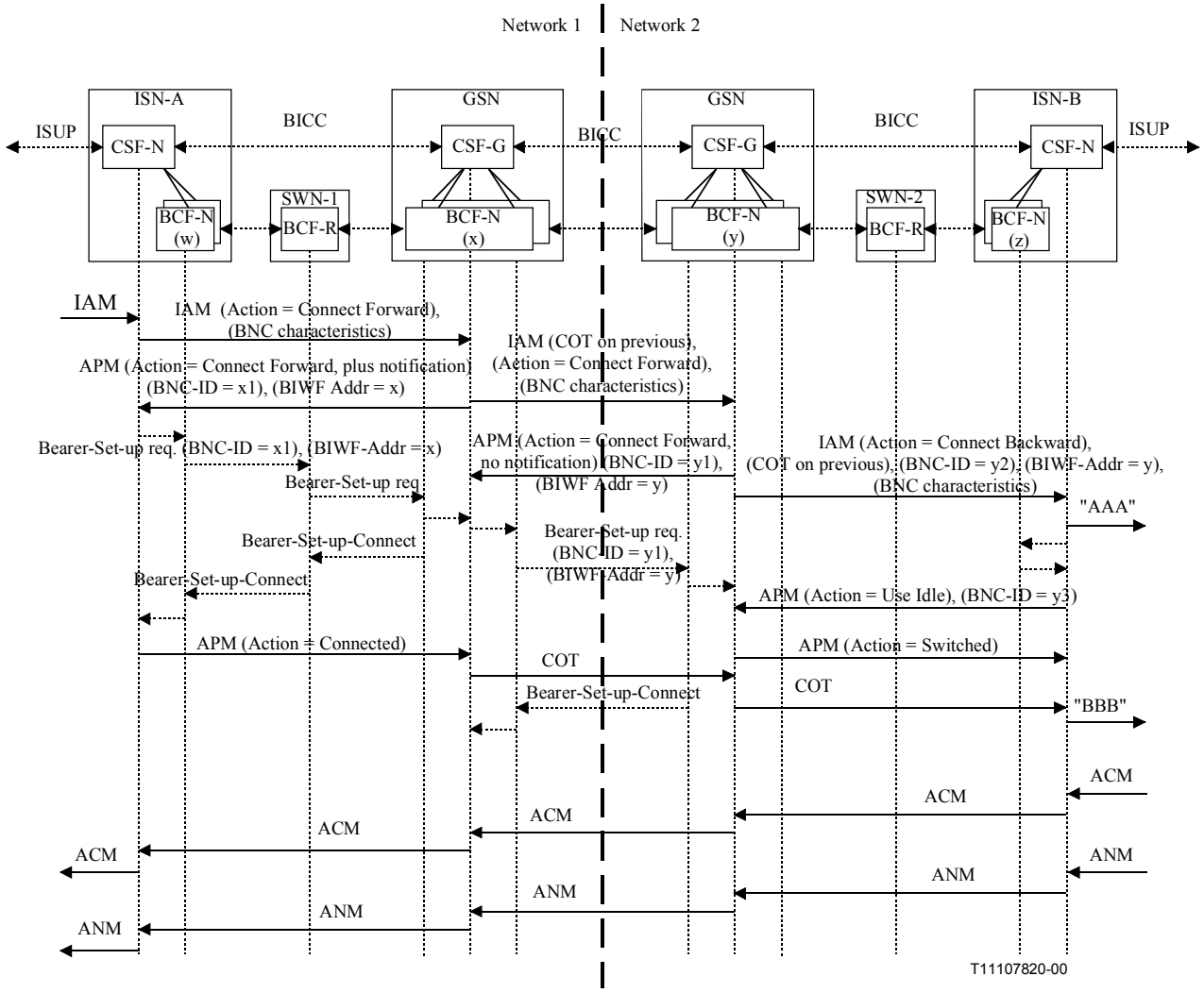


Figure I.6/Q.1901 – Multi-network example: Connect forward, plus notification, followed by Connect forward, no notification, followed by Connect backward, reuse of idle bearer

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"*

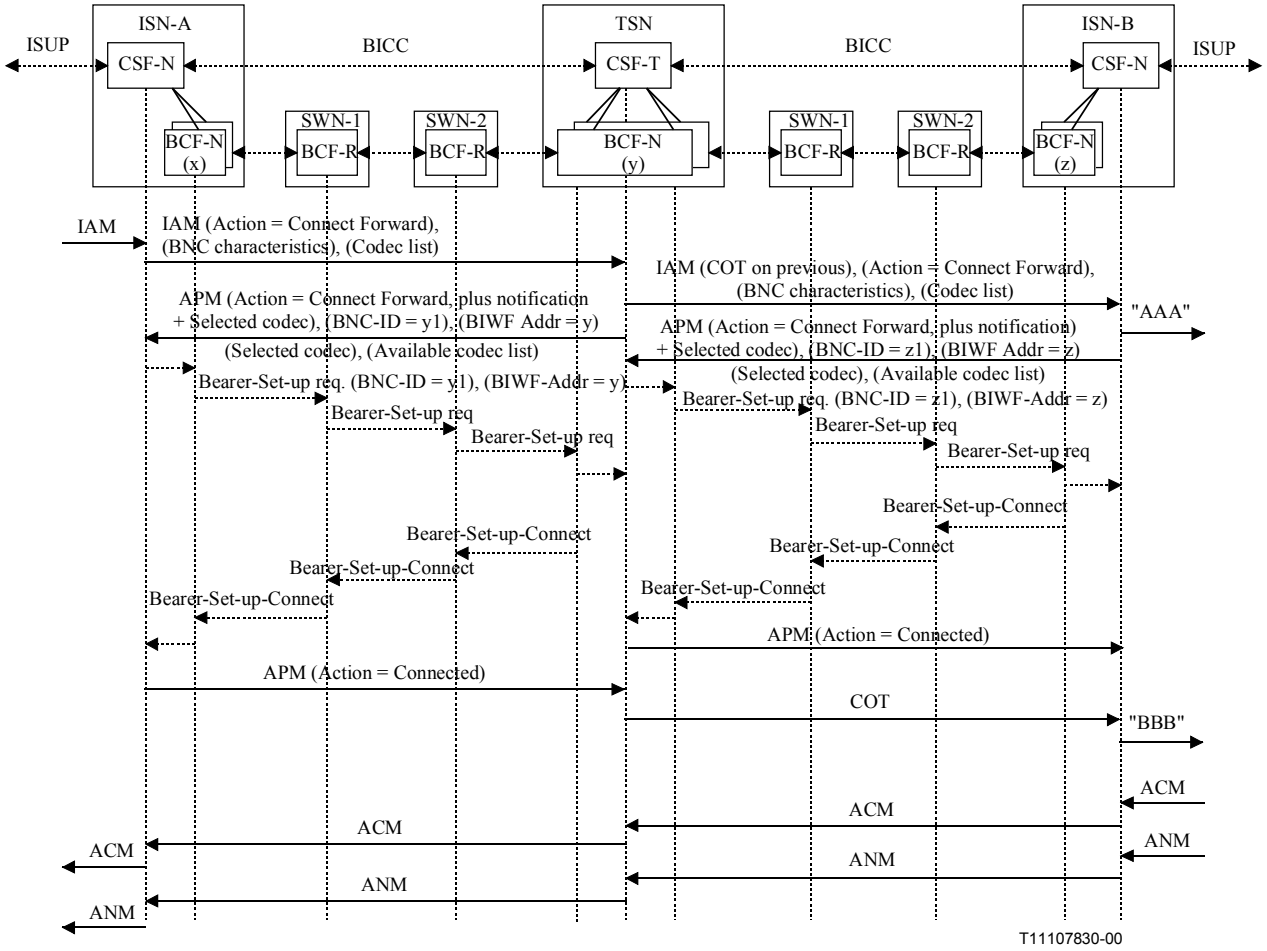


Figure I.7/Q.1901 – Forward establishment of backbone network connection, (plus notification of bearer connect), with Codec negotiation

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"*

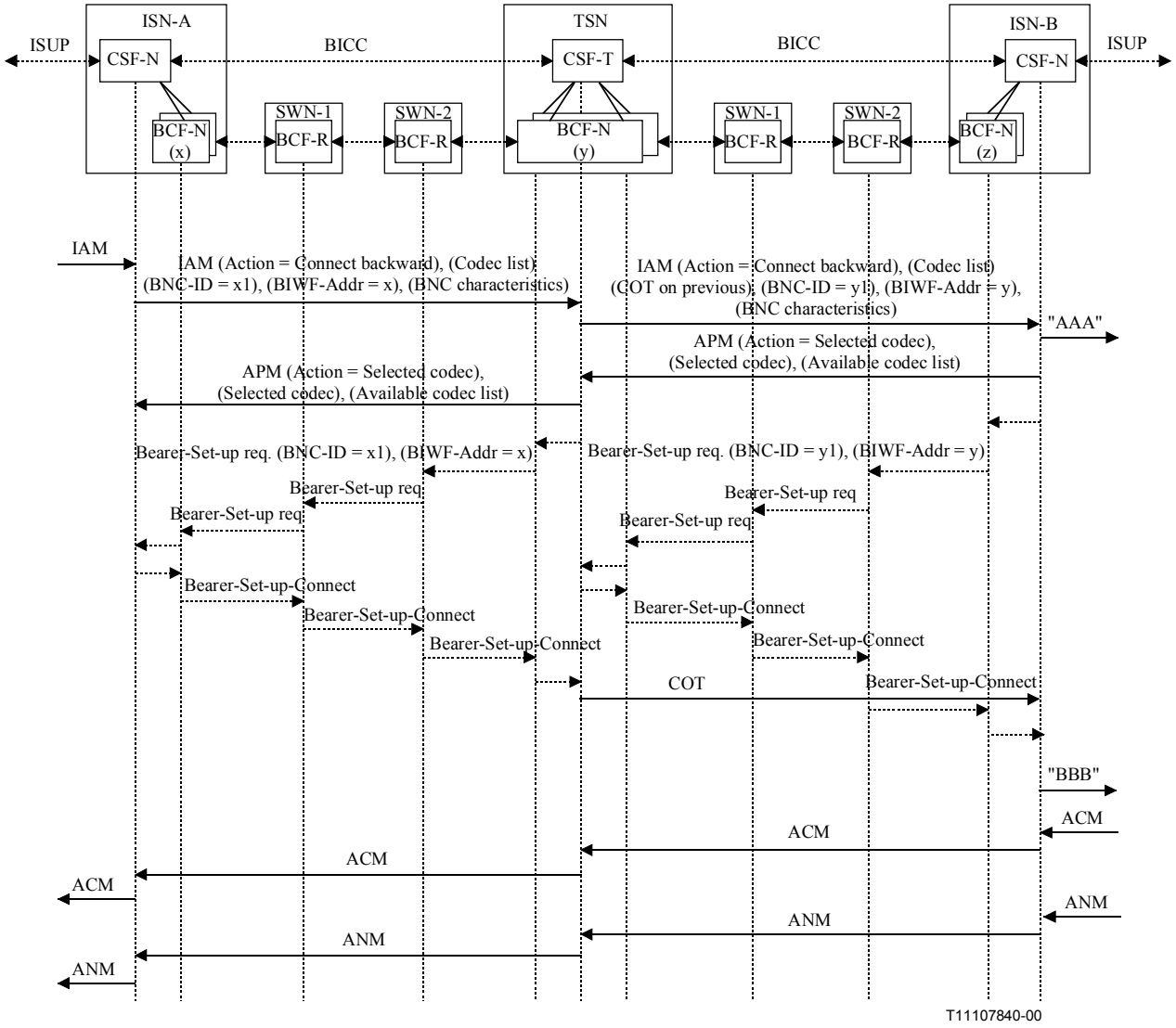


Figure I.8/Q.1901 – Backward establishment of backbone network connection, with Codec negotiation

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"*

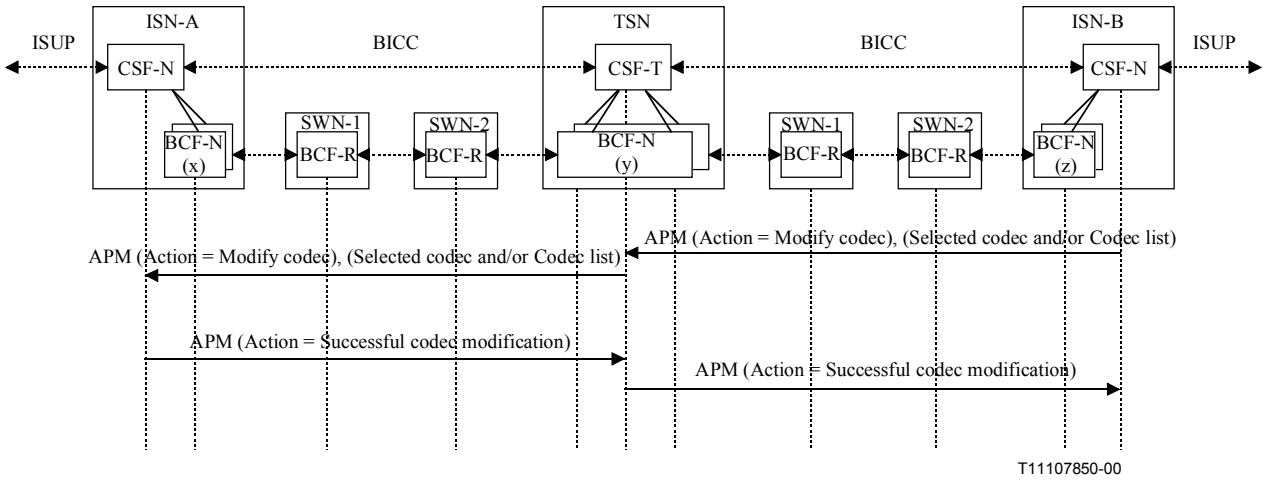


Figure I.9/Q.1901 – Codec modification

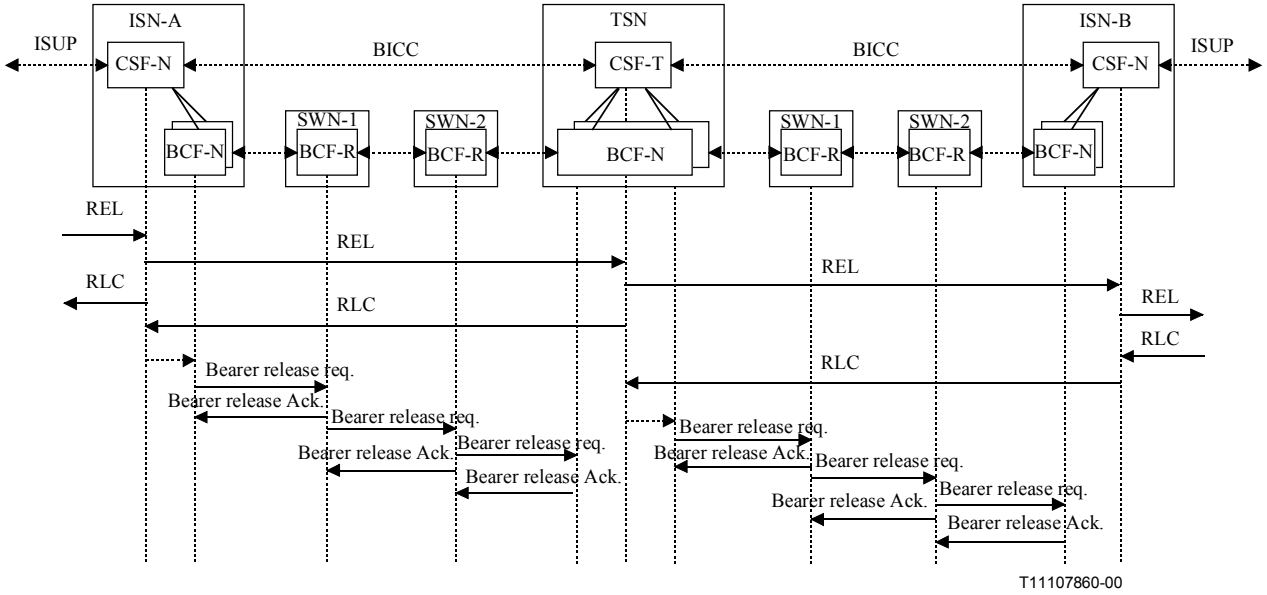


Figure I.10/Q.1901 – Forward call and bearer release. Forward bearer set-up

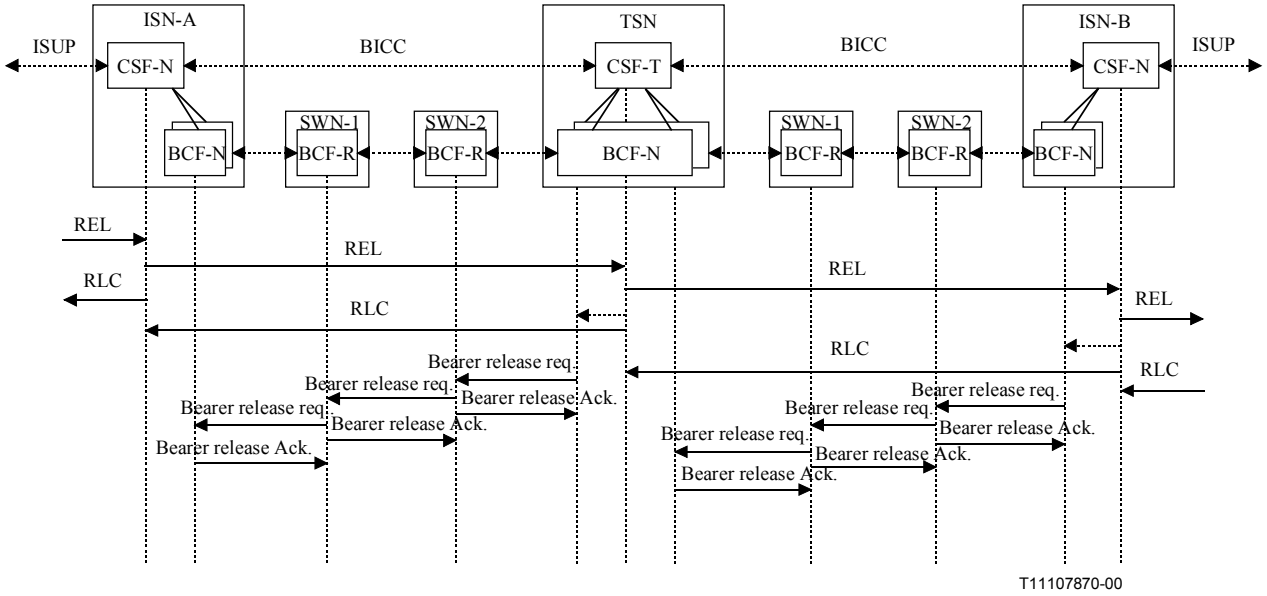


Figure I.11/Q.1901 – Forward call and bearer release. Backward bearer set-up

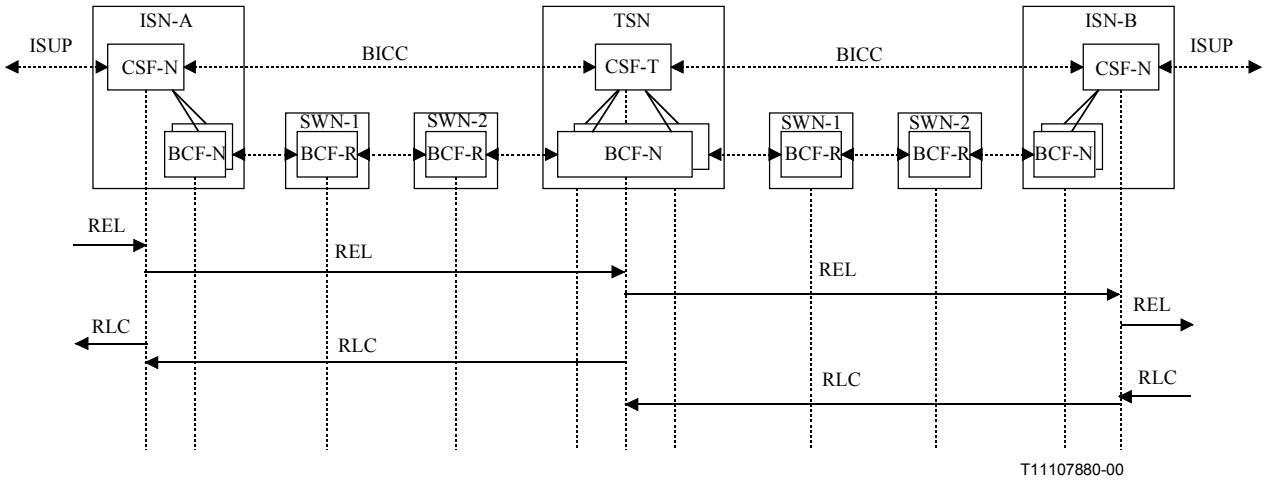


Figure I.12/Q.1901 – Forward call release. Bearers not released

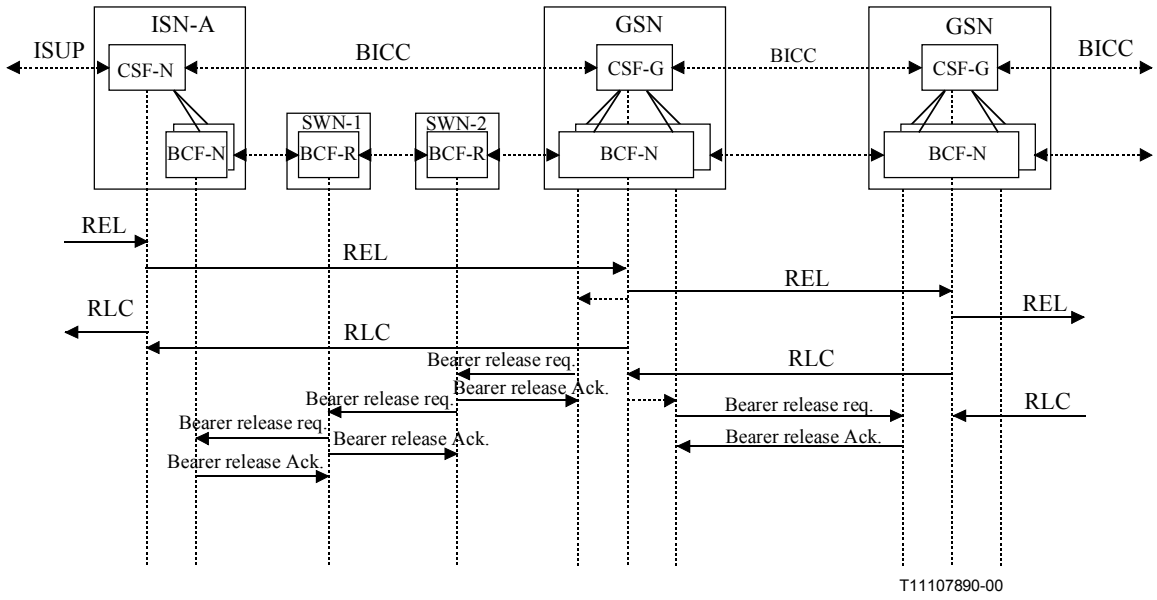


Figure I.13/Q.1901 – Forward call and bearer release. Gateway interworking between forward and backward bearer set-up

APPENDIX II

Generic BCF functions

II.1 Introduction

According to the functional model, as shown in clause 6/Q.1901, the BCF contains a number of discrete types of functionality. The BCF switching and bearer signalling functions are beyond the scope of this Recommendation, but this appendix describes certain procedures to be performed by the BCF that are independent of the switching functions and technology employed to provide bearers.

II.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.

II.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;
- 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 coordination mechanisms used by the connectionless communications platform.

II.2.2 BNC-ID usage for idle bearer reuse procedure (network option)

For the network option that provides for reuse of idle bearers, each BCF may manage pools of idle bearers to adjacent SNs. Within each pool there are two sets of bearers: those set up, and thus "owned" by this BCF, and those set up by the remote BCF, (and thus not "owned" by this BCF). 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 Recommendation.

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, and for those bearers owned by the far BCF the BNC-ID was allocated by this BCF.

During the call set-up procedure, when a bearer is to be reused the BNC-ID is transferred by the BICC protocol to indicate to the remote BCF which bearer is to be reused. A BCF can only select a bearer for reuse that it originally set up, i.e. one that it owns.

II.3 Bearer release control

Under normal call handling situations a bearer shall only be released by the BCF that originally set it up, i.e. by the BCF that "owns" the bearer. Thus when a request to release a bearer is received from the BICC CSF procedures the BCF shall only initiate the bearer release protocol if it owns the bearer. It may also choose not to release a bearer it owns if it is determined by the BCF management function that it is needed for the reuse 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.

II.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.

II.5 BNC Characteristics

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

APPENDIX III

Procedures at a Call Mediation Node (network option)

III.1 Introduction

This appendix describes protocol functions 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 Recommendation, 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.

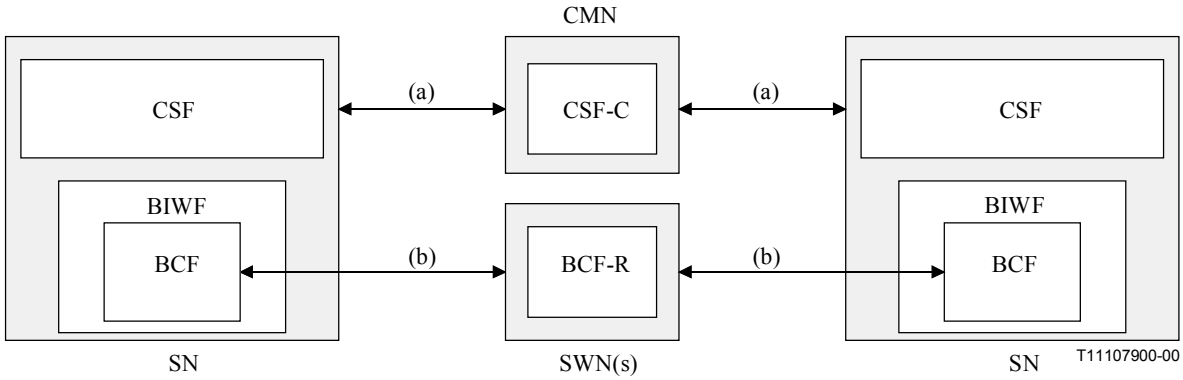


Figure III.1/Q.1901 – CMN Functional model

III.2 Procedures

III.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 10.1.2.2.

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

III.2.2 Call release

A CMN, when there is a BICC signalling association set up through it, shall relay both REL and RLC messages[7]. The CIC values shall be released at the CMN when the RLC is passed through.

III.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[8]. 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.

Bibliography

[1] ITU-T Q-series Recommendations – Supplement 16 (1999), *Technical Report TRQ 2140: Signalling requirements for the support of narrow-band services via Broadband transport technologies.*

[2] ITU-T Q-series Recommendations – Supplement 22 (1999), *Technical Report TRQ 3000: Operation of the bearer independent call control (BICC) protocol with digital subscriber signalling system No. 2 (*DSS2*)*.

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[7] 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.

[8] 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.

[3] ITU-T Q-series Recommendations – Supplement 23 (1999), Supplement to ITU-T Q.1901 Recommendation – *TRQ 3010: Operation of the bearer independent call control (BICC) protocol with AAL type 2 signalling protocol (CS1)*.

[4] ITU-T Q-series Recommendations – Supplement 24 (1999), *Technical Report TRQ 3020: Operation of the Bearer Independent Call Control (BICC) protocol with Broadband Integrated Services Digital Network User Part (B-ISUP) protocol for AAL1 Adaptation.*

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