INTERNATIONAL TELECOMMUNICATION UNION

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

Q.1902.4

(07/2001)

SERIES Q: SWITCHING AND SIGNALLING

Specifications of signalling related to Bearer Independent Call Control (BICC)

Bearer independent call control protocol (Capability Set 2): Basic call procedures

ITU-T Recommendation Q.1902.4

ITU-T Q-SERIES RECOMMENDATIONS

SWITCHING AND SIGNALLING

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

ITU-T Recommendation Q.1902.4

Bearer independent call control protocol (Capability Set 2): Basic call procedures

Summary

This Recommendation describes the Bearer Independent Call Control (BICC) basic call procedures for the support of narrow-band ISDN services independent of the bearer technology and signalling message transport technology used (Capability Set 2).

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 Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

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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As of the date of approval of this Recommendation, ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementors are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database.

CONTENTS

ITU-T Recommendation Q.1902.4

Bearer independent call control protocol (Capability Set 2): Basic call procedures

1 Scope

This Recommendation describes Capability Set 2 (CS-2) of Bearer Independent Call Control (BICC) basic call procedures for the support of narrow-band ISDN services independent of the bearer technology and signalling message transport technology used.

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

ITU-T Q.1902.1 provides an overview of the BICC protocol.

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; 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.1902.1 (2001), *Bearer independent call control protocol (Capability Set 2): Functional description*.

See ITU-T Q.1902.1 [1] for all the references used within this Recommendation.

3 Definitions

See ITU-T Q.1902.1 [1].

4 Abbreviations

This Recommendation uses the following abbreviations:

ACM   Address Complete Message

APM   Application Transport Mechanism

APP   Application Transport Parameter

ASE   Application Service Element

ATII   Application Transport Instruction Indicators

BAT   Bearer Association Transport

BCF   Bearer Control Function

BCU-ID   Bearer Control Unit Identifier

BICC   Bearer Independent Call Control

BIWF	Bearer InterWorking Function
BNC-ID	Backbone Network Connection Identifier
CIC	Call Instance Code
CMN	Call Mediation Node
COT	Continuity message
CPG	Call Progress message
CSF	Call Service Function
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
MTP	Message Transfer Part
PDU	Protocol Data Unit
REL	Release message
RLC	Release Complete message
RSC	Reset CIC message
SACF	Single Association Control Function
SAM	Subsequent Address Message
SAO	Single Association Object
SN	Serving Node
STC	Signalling Transport Converter
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*".

6 General

6.1 Introduction to Recommendation structure

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

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

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

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

The structure of the following clauses is:

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

6.2 Messages, parameters and information elements

The BICC signalling information (messages and parameters) referred to in the following clauses are described in ITU-T Q.1902.2 and Q.1902.3. Additionally BICC signalling entities use information elements transferred via an APM (ITU-T Q.765) application. These information elements are defined in ITU-T Q.765.5.

6.3 Use of Application Transport Mechanism

6.3.1 Introduction

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

The BICC procedures require transfer of information between peer BICC signalling entities (CSFs). The Bearer Association Transport (BAT), APM-user 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 1/Q.1902.4 – BAT primitive interface

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

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

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

6.3.2 Application Transport Instruction Indicators

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

The ATII shall be set as follows:

> Bit
>
> A   Release call indicator
>
> 1   release call
>
> Bit
>
> B   Send notification indicator
>
> 0   do not send notification

6.3.3 Handling of Addressing Information

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

6.3.4 BAT ASE at a CMN

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

6.4 Bearer control tunnelling

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

6.4.1 Bearer control tunnelling procedure

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

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

The BICC_Data request primitive is issued, either:

1) as a part of CSF procedures specified elsewhere in this Recommendation, e.g. bearer set-up procedures (7.4, 7.5), or;

2) independent of other specified CSF procedures – on demand, as determined by BCF procedures.

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

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

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

7 Successful basic call set-up

7.1 Introduction

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

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

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

1) A bearer connection is set up and released for each call set-up and release. The bearer set-up is initiated in the forward direction.

2) A bearer connection is set up and released for each call set-up and release. The bearer set-up is initiated in the backward direction.

3) The bearer connection is not released at the end of the call, but is maintained, and can be reused for a subsequent call (reuse of idle bearers is a network option, see Annex B).

7.2 Forward address signalling – *En bloc* operation

7.2.1 Actions required at the originating SN

7.2.1.1 Outgoing selection

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

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

The connection types allowed are:

– speech;

– 3.1 kHz audio;

– 64 kbit/s unrestricted;

- 64 kbit/s unrestricted preferred;
- 2 × 64 kbit/s unrestricted;
- 384 kbit/s unrestricted;
- 1536 kbit/s unrestricted;
- 1920 kbit/s unrestricted;
- N × 64 kbit/s unrestricted (N = 2-30).

The network signalling capabilities allowed are:

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

7.2.1.2 Outgoing signalling procedure

7.2.1.2.1 Initial Address Message

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

a) The information used to determine the routing of the call by the CSF will be included in the IAM (as Called Party Number, Transmission Medium Requirement and Forward Call Indicators parameters), to enable correct routing at intermediate CSFs.

b) Called Party Number parameter

The sending sequence of address information on international calls will be the country code followed by the national (significant) number. On national connections, the address information may be the subscriber number or the national (significant) number as required by the Administration concerned. For calls to international operator positions (Code 11 and Code 12) refer to ITU-T Q.107.

The ST Address Signal will be used whenever the CSF is in a position to know by digit analysis that the final digit has been sent.

c) Transmission Medium Requirement parameter

The information received from the access interface is used to set the value of the Transmission Medium Requirement parameter, see the relevant interworking Recommendation, e.g. ITU-T Q.1912.2.

d) Forward Call Indicators parameter

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

i) "*no end-to-end method available*";

ii) "*no interworking encountered*";

iii) "*ISDN-User Part/BICC used all the way*";

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

See also the relevant interworking Recommendation, e.g. ITU-T Q.1912.2.

e)   The Nature of Connection Indicators parameter.

     i)   The Satellite Indicator is set appropriately based on the characteristics of the selected outgoing network connection.

     ii)   The Continuity Indicator is set to "*no COT to be expected*" if the incoming bearer is established, or may be set to "*COT to be expected*" if the incoming bearer is not established yet (see relevant interworking Recommendation).

     iii) The Echo Control Indicator is set according to Echo Control procedures, see 8.4.

f)   The CSF will include BAT ASE data as required by 7.4.

g)   The CSF may also include other parameters required by procedures specified in clause 8 or the relevant interworking Recommendation, e.g. ITU-T Q.1912.2.

The IAM may be subject to Simple Segmentation; see 12.2.

7.2.1.2.2   Internal through connection of the bearer path

Internal through connection of the bearer path will be completed in the backward direction at the originating SN when the Outgoing bearer set-up procedure (7.4) is successfully completed (Note). (It is also acceptable that on speech or 3.1 kHz audio calls, through connection of the bearer path will be completed in both directions.)

In addition, if the Outgoing bearer set-up procedure is performing "Per-call bearer set-up in the forward direction", with Connect Type "*notification not required*", the bearer path shall be connected in the backward direction when the Bearer Set-up request has been sent by the Outgoing bearer set-up procedure. (It is also acceptable that on speech or 3.1 kHz audio calls, through connection of the bearer path will be completed in both directions.)

The internal bearer path is completed in the forward direction on receipt of a CON or ANM.

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

7.2.1.2.3   Network protection timer

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

7.2.2   Actions required at an intermediate SN

This clause describes the CSF actions to be performed at an intermediate SN. This may be an intermediate SN within one national network, or an intermediate SN in the international network.

7.2.2.1   Common procedures

This clause defines procedures common to national and international node types.

7.2.2.1.1   Incoming signalling procedure and outgoing selection

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

If the call can be routed using the connection type specified in the Transmission Medium Requirement parameter a BIWF may be selected and the Outgoing signalling procedure (7.2.2.1.2), is started. The BIWF selected, at this time, or later in the set-up procedure, shall be able to support the bearer set-up direction indicated by the Action indicator, support the received BNC characteristics, as included in the BICC_Data indication primitive associated with the IAM, and

support bearer control tunnelling if required. Other information elements, if received, shall be taken into account. The Incoming bearer set-up procedure (7.5) is started when a BIWF has been selected.

7.2.2.1.2 Outgoing signalling procedure

7.2.2.1.2.1 Initial Address Message

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

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

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

b) The Continuity Indicator in the Nature of Connection indicators parameter shall be set to indicate "*COT to be expected*".

c) The Echo Control Indicator in the Nature of Connection indicators parameter shall be set according to Echo Control procedures, see 8.4.

d) Signalling procedures in clause 8 may modify parameters.

e) 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.

Signalling procedures in clause 8 may add parameters.

The IAM may be subject to Simple Segmentation; see 12.2.

7.2.2.1.2.2 Internal through connection of the bearer path

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

• the Incoming bearer set-up procedure is successfully completed; and

• the Outgoing bearer set-up procedure is successfully completed.

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

• the Incoming bearer set-up procedure has been successfully completed; and

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

7.2.2.2 Actions required at an intermediate national SN

Clause 7.2.2.1 applies.

7.2.2.3 Actions required at an intermediate international SN

Clause 7.2.2.1 applies with the following exceptions:

a) Outgoing signalling procedure:

    i) The most significant digits in the called party number may be amended or omitted. (Country code is removed at the last CSF before the incoming international gateway.)

    ii) The network protection timer, as described in 7.2.1.2.3, shall be applied.

7.2.3 Actions required at an intermediate CMN

This clause describes the CSF actions to be performed at an intermediate CMN. This may be an intermediate CMN within one national network, or an intermediate CMN in the international network.

7.2.3.1 Common procedures

This clause defines procedures common to national and international node types.

7.2.3.1.1 Incoming signalling procedure and outgoing selection

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

If the call can be routed using the connection type specified in the Transmission Medium Requirement parameter the Outgoing signalling procedure (7.2.3.1.2), is started.

7.2.3.1.2 Outgoing signalling procedure

7.2.3.1.2.1 Initial Address Message

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

When constructing the IAM the CSF may modify signalling information received from the preceding CSF. Clause 7.2.2.1.2.1 applies with the following exceptions:

a)　The Satellite Indicator in the Nature of Connection Indicators parameter should be passed on unchanged.

b)　The Continuity Indicator in the Nature of Connection indicators parameter shall be passed on unchanged.

7.2.3.2 Actions required at an intermediate national CMN

Clause 7.2.3.1 applies.

7.2.3.3 Actions required at an intermediate international CMN

Clause 7.2.3.1 applies with the following exceptions:

a)　Outgoing signalling procedure:

　　i)　The most significant digits in the Called Party Number may be amended or omitted. (Country code is removed at the last CSF before the incoming international gateway.)

　　ii)　The network protection timer, as described in 7.2.1.2.3, shall be applied.

7.2.4 Actions required at an outgoing gateway SN

This clause describes the CSF actions to be performed at an outgoing gateway SN. This may be an outgoing gateway at a point of interconnection between two national networks, or an outgoing international gateway.

7.2.4.1 Common procedures

This clause defines procedures common to national and international node types.

7.2.4.1.1 Incoming signalling procedure and outgoing selection

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

The CSF may route the call using the connection type specified in the Transmission Medium Requirement parameter. If the CSF cannot trust that the Transmission Medium Requirement value received from the previous network reflects the minimum value of the information transfer susceptance, then the Transmission Medium Requirement value may be modified according to the contents of the Information Transfer Capability and Information Transfer Rate fields of the User Service Information parameter (if available).

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

7.2.4.1.2   Outgoing signalling procedure

7.2.4.1.2.1   Initial Address Message

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

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

a)   The most significant digits in the called party number may be amended or omitted.

b)   If an outgoing gateway SN belongs to a network using μ-law PCM encoding and the Transmission Medium Requirement parameter indicates "*speech*" or "*3.1 kHz audio*" then the User Information Layer 1 Protocol Identification field of the User Service Information parameter must be checked, if it indicates "*Recommendation G.711 μ-law*" this must be changed to "*Recommendation G.711 A-law*" and a μ-law to A-law converter must be enabled.

c)   If a new connection type is provided as a result of the outgoing selection procedure (7.2.4.1.1) the Transmission Medium Requirement parameter is modified to the new connection type.

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

e)   The Continuity Indicator in the Nature of Connection indicators parameter shall be set to indicate "*COT to be expected*".

f)   The end-of-pulsing (ST) signal will be used whenever the outgoing CSF is in a position to know by digit analysis that the final digit has been sent.

g)   Signalling procedures in clause 8 may modify parameters.

h)   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.

Signalling procedures in clause 8 may add parameters.

The IAM may be subject to Simple Segmentation; see 12.2.

7.2.4.1.2.2   Internal through connection of the bearer path

Clause 7.2.2.1.2.2 applies.

7.2.4.1.2.3 Network protection timer

Clause 7.2.1.2.3 applies.

7.2.4.2 Actions required at an outgoing national gateway SN

Clause 7.2.4.1 applies.

7.2.4.3 Actions required at an outgoing international gateway SN

Clause 7.2.4.1 applies with the following exceptions:

a) Outgoing selection:

The CSF at an outgoing international gateway SN must ensure that the Transmission Medium Requirement parameter is set according to the service requested by the customer (see ITU-T E.172).

b) Outgoing signalling procedure:

i) The country code is removed at the last CSF before the incoming international gateway.

ii) If a Location Number parameter is received, the Nature of Address Indicator is checked. If the Nature of Address Indicator is set to "*international number*" then the parameter is passed unchanged, otherwise the number is modified to the international number format and the Nature of Address Indicator is set to "*international number*" before being passed.

7.2.5 Actions required at an outgoing gateway CMN

This clause describes the CSF actions to be performed at an outgoing gateway CMN. This may be an outgoing gateway at a point of interconnection between two national networks, or an outgoing international gateway.

7.2.5.1 Common procedures

This clause defines procedures common to national and international node types.

7.2.5.1.1 Incoming signalling procedure and outgoing selection

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

If the call can be routed using the connection type specified in the Transmission Medium Requirement parameter the Outgoing signalling procedure (7.2.5.1.2) is started.

7.2.5.1.2 Outgoing signalling procedure

7.2.5.1.2.1 Initial Address Message

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

When constructing the IAM the CSF may modify signalling information received from the preceding CSF. Clause 7.2.4.1.2.1 applies with the following exceptions:

a) Enabling of μ-law to A-law converters is not applicable.

NOTE – The relation between call processing at a gateway CMN and the need for μ-law to A-law conversion is for further study.

b) The Transmission Medium Requirement parameter shall be passed on unchanged.

c) The Satellite Indicator in the Nature of Connection Indicators parameter should be passed on unchanged.

d) The Continuity Indicator in the Nature of Connection indicators parameter shall be passed on unchanged.

7.2.5.2 Actions required at an outgoing national gateway CMN

Clause 7.2.5.1 applies.

7.2.5.3 Actions required at an outgoing international gateway CMN

Clause 7.2.5.1 applies with the following exceptions:

a) Outgoing signalling procedure:

   i)   The country code is removed at the last CSF before the incoming international gateway.

   ii) If a Location Number parameter is received, the Nature of Address Indicator is checked. If the Nature of Address Indicator is set to "*international number*" then the parameter is passed unchanged, otherwise the number is modified to the international number format and the Nature of Address Indicator is set to "*international number*" before being passed.

7.2.6 Actions required at an incoming gateway SN

This clause describes the CSF actions to be performed at an incoming gateway SN. This may be an incoming gateway SN at a point of interconnection between two national networks, or an incoming international gateway SN.

7.2.6.1 Common procedures

This clause defines procedures common to national and international node types.

7.2.6.1.1 Incoming signalling procedure and outgoing selection

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

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

7.2.6.1.2 Outgoing signalling procedure

7.2.6.1.2.1 Initial Address Message

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

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

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

b) The Continuity Indicator in the Nature of Connection Indicators parameter shall be set to indicate "*COT to be expected*".

c) If an incoming gateway SN belongs to a network using μ-law PCM encoding and the Transmission Medium Requirement parameter indicates "*speech*" or "*3.1 kHz audio*" then the User Information Layer 1 Protocol Identification field of the User Service Information parameter must be checked, if it indicates "*Recommendation G.711 A-law*" this must be changed to "*Recommendation G.711 μ-law*" and a μ-law to A-law converter must be enabled.

d) Signalling procedures in clause 8 may modify parameters.

e) 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.

Signalling procedures in clause 8 may add parameters.

The IAM may be subject to Simple Segmentation; see 12.2.

7.2.6.1.2.2 Internal through connection of the bearer path

Clause 7.2.2.1.2.2 applies.

7.2.6.1.2.3 Network protection timer

Clause 7.2.1.2.3 applies.

7.2.6.2 Actions required at an incoming national gateway SN

Clause 7.2.6.1 applies.

7.2.6.3 Actions required at an incoming international gateway SN

Clause 7.2.6.1 applies with the following exception:

The CSF should delete the Origination ISC Point Code parameter from the IAM, if present. This information is used for statistical purposes, e.g. accumulation of the number of incoming calls on an originating international switching centre basis.

NOTE – This parameter can only be generated at an outgoing international gateway where the outgoing signalling is ISUP.

7.2.7 Actions required at an incoming gateway CMN

This clause describes the CSF actions to be performed at an incoming gateway CMN. This may be an incoming gateway at a point of interconnection between two national networks, or an incoming international gateway.

7.2.7.1 Common procedures

This clause defines procedures common to national and international node types.

7.2.7.1.1 Incoming signalling procedure and outgoing selection

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

If the call can be routed using the connection type specified in the Transmission Medium Requirement parameter the Outgoing signalling procedure (7.2.7.1.2), is started.

7.2.7.1.2 Outgoing signalling procedure

7.2.7.1.2.1 Initial Address Message

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

When constructing the IAM the CSF may modify signalling information received from the preceding CSF. Clause 7.2.6.1.2.1 applies with the following exceptions:

a)   The Satellite Indicator in the Nature of Connection Indicators parameter should be passed on unchanged.

b)   The Continuity Indicator in the Nature of Connection indicators parameter shall be passed on unchanged.

c)   Enabling of μ-law to A-law converters is not applicable.

NOTE – The relation between call processing at a gateway CMN and the need for μ-law to A-law conversion is for further study.

7.2.7.2   Actions required at an incoming national gateway CMN

Clause 7.2.7.1 applies.

7.2.7.3   Actions required at an incoming international gateway CMN

Clause 7.2.7.1 applies with the following exceptions:

The CSF should delete the Origination ISC Point Code parameter from the IAM, if present. This information is used for statistical purposes, e.g. accumulation of the number of incoming calls on an originating international switching centre basis.

NOTE – This parameter can only be generated at an outgoing international gateway where the outgoing signalling is ISUP.

7.2.8   Actions required at the destination SN

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

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

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

•   the incoming bearer set-up procedure is successfully completed; and

•   if the incoming IAM indicated "*COT to be expected*", a Continuity message, with the Continuity Indicators parameter set to "*continuity*" is received.

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

See also the relevant interworking Recommendation, e.g. ITU-T Q.1912.2.

7.2.9   Called party number for operator calls

International gateways should support access to operators equipment as specified in ITU-T Q.101.

The sending sequence of specific forward address information to be sent for calls to operators (incoming, delay or particular delay operator) is shown below. The other parameters of the IAM are coded as the ones for an automatic call IAM (e.g. Nature of Connection Indicators, Transmission Medium Requirement, etc.).

7.2.9.1 International transit operator call

i) Called party number:
- Nature of Address indicator: 0000100 "*international number*".
- Address:
  - country code: I1, I1I2, I1I2I3;
  - extra digit designating the incoming international gateway N1 (Note 1);
  - access to operator's position: Code 11 or Code 12 or special number (Note 2);
  - number of a particular position: x1(x2x3...);
  - sending finished: ST.

NOTE 1 − The extra digit (N1) designating the incoming international gateway is used in cases where more than one incoming international gateway can be reached in the country of destination. The insertion of the extra digit is not mandatory (see ITU-T Q.107).

NOTE 2 − The incoming operator or the delay operator may be obtained by using a special number (see ITU-T Q.101).

ii) Calling party category:

00000001 "*operator, language French*";

00000010 "*operator, language English*";

00000011 "*operator, language German*";

00000100 "*operator, language Russian*";

00000101 "*operator, language Spanish*".

7.2.9.2 International terminal operator call

i) Called party number:
- Nature of Address indicator: 0000011 "*national (significant) number*".
- Address:
  - extra digit designating the incoming international gateway N1 (Note 1 in 7.2.9.1);
  - access to operator's position: Code 11 or Code 12 or special number (Note 2 in 7.2.9.1);
  - number of a particular position: x1(x2x3...);
  - sending finished: ST.

ii) Calling party category:

00000001 "*operator, language French*";

00000010 "*operator, language English*";

00000011 "*operator, language German*";

00000100 "*operator, language Russian*";

00000101 "*operator, language Spanish*".

7.2.10 Called number for calls to testing and measuring devices

This clause only describes the standard sending sequence of forward address information in the case of calls to testing and measuring devices.

i) Called party number:
- Nature of Address indicator: 0000011 "*national (significant) number*".

- Address:
  - access code for particular testing or measuring device: XY (as given in ITU-T Q.107);
  - sending finished: ST.

ii) Calling party category:

00001101 "*test call*".

NOTE – The principles in ITU-T Q.107 are not always applicable to the international network.

7.3 Forward address signalling – *overlap* operation

When using overlap address signalling the procedures of 7.2 apply with the following exceptions.

7.3.1 Actions required at the originating SN

7.3.1.1 Outgoing selection

The routing of the call to another CSF is initiated when sufficient digits have been received from the calling party.

7.3.1.2 Outgoing signalling procedure

7.3.1.2.1 Initial Address and Subsequent Address messages

The IAM and SAM messages in principle contain all of the information that is required to route the call to the CSF at the destination SN and connect the call to the called party. The contents of the IAM is the same as described in 7.2.1.2.1. The only purpose of the SAM is to carry further digits.

Within national networks the address information contained within the IAM may vary depending on the routing requirement within the network.

The remaining digits of the number may be sent in SAMs containing one or several digits as they are received. Efficiency can be gained by grouping together as many digits as possible. However, to prevent an increase in post sending delay in those cases where overlap operation with subscribers' dialling is used, it may be desirable to send the last few digits individually.

The end-of-pulsing (ST) signal is always sent in the following situations:

i) semi-automatic calls;

ii) test calls; and

iii) when the end-of-pulsing (ST) signal is received.

In automatic working, the end-of-pulsing (ST) signal will be sent whenever the CSF is in a position to know, e.g. by digit analysis, that the final digit has been sent. Digit analysis may consist of an examination of the country code and counting the maximum (or fixed) number of digits of the national number. In other cases, the end-of-pulsing signal is not sent and the end-of-address information is determined by the receipt of the ACM or CON message.

7.3.1.2.2 Internal through connection of the bearer path

Internal through connection of the bearer path in the backward direction will be completed either as described in 7.2.1.2.2 or delayed until both the following conditions are satisfied (it is also acceptable that on speech or 3.1 kHz audio calls, through connection of the bearer path will be completed in both directions):

- the relevant bearer set-up conditions specified in 7.2.1.2.2 are satisfied; and

- the CSF determines that all digits have been received – by digit analysis, Timer T10 expiry (see ITU-T Q.1912.2), or by receipt of ACM or CON.

The internal bearer path is completed in the forward direction on receipt of a CON or ANM.

7.3.1.2.3 Network protection timer

The awaiting address complete timer (T7) is started each time the CSF sends an address message. If Timer T7 expires the call is released and an indication given to the calling subscriber.

7.3.2 Actions required at an intermediate SN/CMN

7.3.2.1 Common procedures

This clause defines procedures common to national and international node types.

7.3.2.1.1 Incoming signalling procedure and outgoing selection

If the CSF can route the call using the digits received in the Called Party Number parameter and the other routing information (see 7.2.1.1) the CSF shall act according to the relevant "Incoming signalling procedure and outgoing selection", clause 7.2.2.1.1, with the relevant Outgoing signalling procedure (in 7.2) amended by 7.3.2.1.2.

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 CSF has received additional digits in SAM(s).

7.3.2.1.2 Outgoing signalling procedure

7.3.2.1.2.1 Initial Address and Subsequent Address messages

Any address digits received in SAMs during the outgoing selection process may be included in the IAM. Any SAMs received after the IAM has been sent shall be forwarded to the succeeding CSF as SAMs.

7.3.2.2 Actions required at an intermediate international SN/CMN and at an incoming gateway SN/CMN

Clause 7.3.2.1 applies with the following addition:

The awaiting address complete timer (T7) is started each time the CSF sends an address message. If Timer T7 expires the call is released and an indication given to the calling subscriber.

7.3.2.3 Actions required at an outgoing international gateway SN/CMN

Clause 7.3.2.1 applies with the following addition:

All digits required for routing the call through the international network shall be sent in the IAM. On calls with a country code in the number (except in the case of calls to special operators), the IAM shall contain a minimum of four digits and should contain as many digits as are available.

In automatic working, the end-of-pulsing (ST) signal will be sent whenever the CSF is in a position to know, e.g. by digit analysis, that the final digit has been sent. In other cases, the end-of-pulsing signal is not sent and the end-of-address information is determined by the receipt of the ACM or CON.

The awaiting address complete timer (T7) is started each time the CSF sends an address message. If Timer T7 expires the call is released and an indication given to the calling subscriber.

7.3.3 Actions required at the destination SN

Upon the receipt of sufficient called party number information the CSF at the destination SN will analyse the called party number to determine to which party the call should be connected.

7.4 Outgoing bearer set-up procedure

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

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

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

- "Fast set-up" − in which bearer control information is carried in the IAM and subsequent APM(s). This variation is supported for both the forward and backward bearer set-up cases.

- "Delayed Forward set-up" − in which bearer control information is carried in APM messages following the first backward APM.

- "Delayed Backward set-up" − in which bearer control information is carried in the first backward APM and a subsequent APM(s).

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

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

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

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

If a BIWF has been selected when outgoing set-up is initiated:

- The choice between forward and backward bearer set-up is provisioned at the CSF, as an originating BIWF or outgoing call route characteristic.

- The choice of tunnelled or non-tunnelled operation is made by the originating BCF and is indicated in the initial response from the BCF. (The CSF may indicate in the initial request to the BCF what tunnelling option(s) it may choose.)

- The choice between Fast (Forward or Backward) and Delayed Forward/Backward set-up, respectively, is made by the originating BCF and is indicated in the initial response from this BCF. (The CSF may indicate in the initial request to the BCF what option(s) it may choose.)

If no BIWF has been selected when outgoing set-up is initiated:

- Forward set-up is used.

- The first backward APM indicates whether non-tunnelled or tunnelled operation is to be used. (The choice of tunnelled or non-tunnelled operation is made by the destination BCF, considering the tunnelling option(s) allowed by the destination CSF.)

- For the tunnelled case Delayed Forward set-up is used.

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

7.4.1 Per-call bearer set-up in forward direction

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

1) Initial actions depend on whether a BIWF has been selected at the initiation of outgoing bearer set-up.

    1.1) If a BIWF has been selected: in the response to the BNC Information request primitive the BCF returns the BNC characteristics, and may include the BIWF Address. The response also indicates that bearer control tunnelling is not being used.

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

    1.2) If no BIWF has been selected BNC Characteristics is set to a value determined by the CSF application logic.

    1.3) An IAM is sent including in the BICC_Data request primitive:

       • Action indicator set to "*Connect forward*".

       • BNC characteristics.

       • BIWF Address, if received from the BCF.

       • Bearer Control Tunnelling set to "*no indication*", if the BIWF has not been selected, providing that bearer control tunnelling is allowed.

2) Subsequently BICC_Data indication primitive (corresponding to an APM message), should be received:

    2.1) If the received Action indicator is "*Connect forward, plus notification*" the Connect Type[1] is set to "*notification required*", else it is set to "*notification not required*".

    2.2) If the BICC_Data indication primitive includes the Bearer Control Tunnelling information element set to "*tunnelling to be used*" the procedure continues at 7.4.4 item 2.2).

    2.3) A BIWF is selected, if one was not selected earlier.

    2.4) A Bearer Set-up request is sent to the selected BCF. This request includes:

       • BNC-ID (as received in the BICC_Data indication primitive).

       • BIWF Address (as received in the BICC_Data indication primitive).

       • Bearer Characteristics, i.e. Transmission Medium Requirements (as sent in the IAM) and User Service Information (if sent in the IAM).

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

    3.1) If the Connect Type is "*notification required*" a BICC_Data request primitive (corresponding to an APM message), is sent containing:

       • Action indicator set to "*Connected*".

4) If ACM or CON are received, and Bearer Set-up Connect indication has not yet been received the ACM/CON shall be handled according to 7.7, and Bearer Set-up Connect or Bearer Set-up Failure indication is awaited.

7.4.2 Per-call bearer set-up in backward direction

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

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[1] 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.

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

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

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

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

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

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

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

   The outgoing set-up procedure is now successfully completed.

7.4.3 Per-call bearer set-up using bearer control tunnelling – fast set-up

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

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

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

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

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

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

   2.1) If the IAM indicated "*Connect forward*": if an Action indicator is received set to "*Connect forward, plus notification*" the Connect Type[1] is set to "*notification required*", else it is set to "*notification not required*".

   2.2) If the IAM indicated "*Connect backward*": the Connect Type[1] is set to "*notification required*".

   This primitive should include the Bearer Control Information information element. This information element, and any subsequently received Bearer Control Information information element(s) are handled according to the bearer control tunnelling procedure (6.4).

3)   Receipt of a primitive from the BCF, indicating "*BNC set-up success*"*,* indicates successful completion of the outgoing set-up procedure.

    3.1)   If the Connect Type is "*notification required*" a BICC_Data request primitive (corresponding to an APM message), is sent containing:

        • Action indicator set to "*Connected*".

7.4.4   Per-call bearer set-up using bearer control tunnelling – delayed forward

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

1)   Initial actions depend on whether a BIWF has been selected at the initiation of outgoing bearer set-up.

    1.1)   If a BIWF has been selected: in the response to the BNC Information request primitive the BCF returns the BNC characteristics. The response primitive also may include the BIWF-Address. The response also indicates that bearer control tunnelling is being used and that the delayed forward set-up procedure is to be used.

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

    1.2)   If no BIWF has been selected see 7.4.1.

    1.3)   An IAM is sent including in the BICC_Data request primitive:

        • Action indicator set to "*Connect forward*".

        • Bearer Control Tunnelling, set to "*tunnelling to be used*".

        • BNC characteristics.

        • BIWF Address, if received from the BCF.

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

    2.1)   If the received Action indicator is "*Connect forward, plus notification*" the Connect Type[1] is set to "*notification required*", else it is set to "*notification not required*".

    2.2)   A BIWF is selected, if one was not selected earlier.

    2.3)   A Bearer Set-up request primitive is then sent to the selected BCF containing:

        • BNC-ID (if received in the BICC_Data indication primitive).

        • BIWF Address (if received in the BICC_Data indication primitive).

        • Bearer Characteristics, i.e. Transmission Medium Requirements (as sent in the IAM) and User Service Information (if sent in the IAM).

        • An indication that bearer control tunnelling shall be used (if this request was received in the BICC_Data indication primitive).

3)   Bearer control tunnelling (6.4) is then used to exchange bearer set-up information between BCFs.

4)   Receipt of a primitive from the BCF, indicating "*BNC set-up success*" indicates successful completion of the outgoing set-up procedure.

    4.1)   If the Connect Type is "*notification required*", a BICC_Data request primitive (corresponding to an APM message) is sent containing:

        • Action indicator set to "*Connected*".

7.4.5   Per-call bearer set-up using bearer control tunnelling – delayed backward

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

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

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

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

        • Action indicator set to "*Connect backward*".

        • Bearer Control Tunnelling, set to "*tunnelling to be used*".

        • BNC characteristics.

        • BNC-ID, if received from the BCF.

        • BIWF Address, if received from the BCF.

2)   Bearer control tunnelling (6.4) is then used to exchange bearer set-up information between BCFs.

3)   Receipt of a primitive from the BCF, indicating "*BNC set-up success*" indicates successful completion of the outgoing set-up procedure.

7.5   Incoming bearer set-up procedure

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

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

7.5.1   Per-call bearer set-up in forward direction

This procedure is invoked if the received Action indicator is set to "*Connect forward*"*,* and the Bearer Control Tunnelling information element indicating "*tunnelling to be used*" is not present.

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

1)   If Codec negotiation (8.3) is applicable, the following steps are delayed until indicated by that procedure.

2)   A BNC Information Request primitive is sent to the BCF. This request includes:

    • BNC Characteristics (as received via BICC_Data indication primitive associated with the IAM).

    • Bearer Characteristics, i.e. Transmission Medium Requirements (as received in the IAM) and User Service Information (if received in the IAM).

    • BIWF-Address, if received in the BICC_Data indication primitive.

- An indication that bearer control tunnelling can be used if the Bearer Control Tunneling information element set to "*no indication*" was received in the BICC_Data indication primitive.

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

2.1)   The Connect Type[2] is set to "*Notification not required*".

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

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

- Action indicator set to: "*Connect forward, plus notification*" if the Connect Type is "*Notification required*", else it is set to "*Connect forward, no notification*".

- BNC-ID.

- BIWF Address.

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

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

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

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

3.4)   If the Connect Type is "*notification required*" the incoming set-up procedure awaits a BICC_Data indication primitive (corresponding to an APM message) containing Action indicator set to "*Connected*". The incoming set-up procedure is now successfully completed.

7.5.2   Per-call bearer set-up in backward direction

This procedure is invoked if the received Action indicator is set to "*Connect backward*"*,* and the Bearer Control Tunnelling information element indicating "*tunnelling to be used*" is not present.

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

1)   If Codec negotiation (8.3) is applicable the following steps are delayed until indicated by that procedure.

2)   A Bearer Set-up request is sent to a selected BCF. This request includes:

- BNC-ID (as received via BICC_Data indication primitive associated with the IAM).

- BIWF Address (as received via BICC_Data indication primitive associated with the IAM).

- Bearer Characteristics, i.e. Transmission Medium Requirements (as received in the IAM) and User Service Information (if received in the IAM).

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[2] 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.

3)   When the Bearer Set-up Connect indication is received from the BCF the incoming set-up procedure is now successfully completed.

7.5.3   Per-call bearer set-up using bearer control tunnelling – fast set-up

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

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

1)   If Codec negotiation (8.3) is applicable the following steps are delayed until indicated by that procedure.

2)   A BNC Information request primitive is sent to the selected BCF. This request includes:

- BNC Characteristics (as received via BICC_Data indication primitive associated with the IAM).

- Bearer Characteristics, i.e. Transmission Medium Requirements (as received in the IAM) and User Service Information (if received in the IAM).

- Bearer control PDU (as received in the Bearer Control Information information element in the BICC_Data indication primitive).

- BIWF-Address, if received in the BICC_Data indication primitive.

- BNC-ID, if received in the BICC_Data indication primitive.

The response primitive returns a bearer control PDU.

2.1)   If the Action indicator in the IAM was "*Connect forward*" the Connect Type[2] is set to "*Notification not required*".

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

If the Action indicator in the IAM was "*Connect backward*" the Connect Type[2] is set to "*Notification required*".

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

- If the Action indicator in the IAM was "*connect forward*": Action indicator set to: "Connect forward, plus notification" if the Connect Type is "*notification required*", else it is set to "*connect forward, no notification*".

- If the Action indicator in the IAM was "*connect backward*": no Action indicator is sent.

- Bearer Control Information, containing the bearer control PDU.

3)   Bearer control tunnelling (6.4) may then be used to exchange further bearer set-up information between BCFs.

4)   If the Connect Type is "*notification not required*" receipt of a primitive from the BCF, indicating "*BNC set-up success*" indicates successful completion of the incoming set-up procedure.

5)   If the Connect Type is "*notification required*" the incoming set-up procedure awaits a BICC_Data indication primitive (corresponding to an APM message) containing Action indicator set to "*Connected*". The incoming set-up procedure is now successfully completed.

7.5.4 Per-call bearer set-up using bearer control tunnelling – delayed forward

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

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

1) If Codec negotiation (8.3) is applicable the following steps are delayed until indicated by that procedure.

2) A BNC Information request primitive is sent to the selected BCF. This request includes:

   • BNC Characteristics (as received via BICC_Data indication primitive associated with the IAM).

   • Bearer Characteristics, i.e. Transmission Medium Requirements (as received in the IAM) and User Service Information (if received in the IAM).

   • BIWF-Address, if received in the BICC_Data indication primitive.

   • An indication that bearer control tunnelling shall be used if "*tunnelling to be used*" was received in the Bearer Control Tunnelling information element in the BICC_Data primitive.

   Upon receipt of the response primitive:

   2.1) The Connect Type[2] is set to "*Notification not required*".

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

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

   • Action indicator set to: "*Connect forward, plus notification*" if the Connect Type is "*Notification required*", else it is set to "*Connect forward, no notification*".

   • If "*tunnelling to be used*" indication was not present in the IAM, i.e. bearer control tunnelling has been initiated by the BCF at this SN (see 7.5.1), the Bearer Control Tunnelling information element is included indicating "*tunnelling to be used*".

   • BNC-ID, if received from the BCF.

   • BIWF Address, if received from the BCF.

3) Bearer control tunnelling (6.4) may then be used to exchange bearer set-up information between BCFs.

4) If the Connect Type is "*notification not required*" receipt of a primitive from the BCF, indicating "*BNC set-up success*" indicates successful completion of the incoming set-up procedure.

5) If the Connect Type is "*notification required*" the incoming set-up procedure awaits a BICC_Data indication primitive (corresponding to an APM message) containing Action indicator set to "*Connected*". The incoming set-up procedure is now successfully completed.

7.5.5 Per-call bearer set-up using bearer control tunnelling – delayed backward

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

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

1) If Codec negotiation (8.3) is applicable the following steps are delayed until indicated by that procedure.

2) A Bearer Set-up request primitive is sent to a selected BCF. This request includes:

   • BNC Characteristics (as received via BICC_Data indication primitive associated with the IAM).

   • BIWF-Address (if received in the BICC_Data indication primitive).

   • BNC-ID (if received in the BICC_Data indication primitive).

   • Bearer Characteristics, i.e. Transmission Medium Requirements (as received in the IAM) and User Service Information (if received in the IAM).

   • An indication that bearer control tunnelling shall be used.

3) Bearer control tunnelling (6.4) may then be used to exchange bearer set-up information between BCFs.

4) Receipt of a primitive from the BCF, indicating "*BNC set-up success*", indicates successful completion of the incoming set-up procedure.

7.6 Continuity message

7.6.1 Actions required at the originating SN

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

7.6.2 Actions required at an intermediate SN

7.6.2.1 Outgoing signalling procedure

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

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

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

1) If the incoming IAM indicated "*COT to be expected*", a Continuity message, with the Continuity Indicators parameter set to "*continuity*" shall be received.

2) One of the following events, which indicate successful completion of bearer set-up, shall also be received by the Incoming bearer set-up procedure, depending on the procedure being applied:

   2.1) Bearer Set-up indication − for the forward bearer set-up case where the incoming Connect Type is "*notification not required*".

2.2) BICC_Data indication primitive with Action indicator set to "*Connected*" − for the forward bearer set-up cases (with, or without bearer control tunnelling) where the incoming Connect Type is "*notification required*", and for the fast set-up (backward) case.

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

2.4) BNC set-up success indication for cases using bearer control tunnelling, except as identified in item 2.2) above.

7.6.2.2 Incoming signalling procedure

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

7.6.3 Actions required at a CMN

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

7.6.4 Actions required at the destination SN

7.6.4.1 Incoming signalling procedure

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

7.7 Address complete message or Connect message

The ACM or CON may be subject to Simple Segmentation; see 12.2.

7.7.1 Actions required at the destination SN

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

ACM is sent by the CSF at the destination SN according to the relevant interworking Recommendation, e.g. ITU-T Q.1912.2.

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

i)   "*no end-to-end method available*";

ii)   "*no interworking encountered*";

iii)   "*ISDN-User Part/BICC used all the way*".

See 7.8.6 for generation of CON at the destination SN.

7.7.2 Actions required at an intermediate SN/CMN

This clause describes the CSF actions to be performed at an intermediate SN or CMN. This may be an intermediate SN/CMN within one national network, or an intermediate SN/CMN in the international network.

7.7.2.1 Common procedures

Upon receipt of an ACM the CSF will send the corresponding ACM to the preceding CSF, and if this is the CSF controlling charging, the awaiting answer timer (T9) is started. If Timer T9 expires, the call is released and an indication is sent to the calling subscriber. The call is released in the backward direction with cause value #19, "*no answer from user; user alerted*".

If a CON is received instead of an ACM, a CON will be sent to the preceding CSF.

7.7.2.2 Actions required at an intermediate national SN/CMN

Clause 7.7.2.1 applies.

7.7.2.3 Actions required at an intermediate international SN/CMN

Clause 7.7.2.1 applies with the following exception.

Upon receipt of an ACM or CON, the awaiting address complete timer (T7) is stopped.

7.7.3 Actions required at an outgoing gateway SN/CMN

This clause describes the CSF actions to be performed at an outgoing gateway SN or CMN. This may be an outgoing gateway SN/CMN at a point of interconnection between two national networks, or an outgoing international gateway SN/CMN.

Upon receipt of an ACM, the awaiting address complete timer (T7) is stopped and the awaiting answer timer (T9) is started. If Timer T9 expires, the call is released and an indication is sent to the calling subscriber. The call is released in the backward direction with cause value #19, "*no answer from user; user alerted*".

If the CON is received, then the awaiting address complete timer (T7) is stopped.

See also 7.7.2.

7.7.4 Actions required at an incoming gateway SN/CMN

This clause describes the CSF actions to be performed at an incoming gateway SN or CMN. This may be an incoming gateway SN/CMN at a point of interconnection between two national networks, or an incoming international gateway SN/CMN.

Upon receipt of an ACM or CON, the awaiting address complete timer (T7) is stopped.

See also 7.7.2.

7.7.5 Actions required at the originating SN

a)   On receipt of the ACM the awaiting address complete timer (T7) is stopped and the awaiting answer timer (T9) is started. If Timer T9 expires the connection is released and an indication is sent to the calling subscriber.

b)   If the CON is received, then the awaiting address complete timer (T7) is stopped (see 7.8.6).

See also the relevant interworking Recommendation, e.g. ITU-T Q.1912.2.

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

The sending of the awaiting answer indication (e.g. ring tone) at the destination SN depends on the type of call. On speech, 64 kbit/s unrestricted preferred, 3.1 kHz calls and calls to an analogue called party the awaiting answer indication is applied to the bearer path to the calling party from the destination SN on receipt of an alerting indication from the called party or from information contained within the destination SN that the called party will not or is prohibited from providing in-band tone.

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

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

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

7.8 Answer message

The ANM may be subject to Simple Segmentation; see 12.2.

7.8.1 Actions required at the destination SN

When the called party answers, the destination SN connects through the internal bearer path and the ringing tone is removed if applicable. An ANM is sent to the preceding CSF. If the CSF at the destination SN controls charging, then charging may begin.

See also the relevant interworking Recommendation, e.g. ITU-T Q.1912.2.

7.8.2 Actions required at an intermediate SN/CMN

This clause describes the CSF actions to be performed at an intermediate SN or CMN. This may be an intermediate SN/CMN within one national network, or an intermediate SN/CMN in the international network.

7.8.2.1 Common procedures

Upon receipt of an ANM, the CSF sends the corresponding ANM to the preceding CSF.

7.8.2.2 Actions required at an intermediate national SN/CMN

Clause 7.8.2.1 applies with the following exception:

If this is the CSF controlling charging, charging may begin, and timer (T9) is stopped.

7.8.2.3 Actions required at an intermediate international SN/CMN

Clause 7.8.2.1 applies.

7.8.3 Actions required at an outgoing gateway SN/CMN

This clause describes the CSF actions to be performed at an outgoing gateway SN or CMN. This may be an outgoing gateway SN/CMN at a point of interconnection between two national networks, or an outgoing international gateway SN/CMN.

Upon receipt of an ANM, the CSF sends the corresponding ANM to the preceding CSF and Timer T9 is stopped.

7.8.4 Actions required at an incoming gateway SN/CMN

This clause describes the CSF actions to be performed at an incoming gateway SN or CMN. This may be an incoming gateway SN/CMN at a point of interconnection between two national networks, or an incoming international gateway SN/CMN.

Upon receipt of an ANM, the CSF sends the corresponding ANM to the preceding CSF.

7.8.5 Actions required at the originating SN

When the CSF at the originating SN receives an ANM indicating the required connection has been completed, the internal bearer path is connected through in the forward direction, if not already connected. The awaiting answer timer (T9) is stopped. If the CSF at the originating SN controls charging, charging may begin if applicable.

See also the relevant interworking Recommendation, e.g. ITU-T Q.1912.2.

7.8.6 Return of answer from automatic terminals

When connections are set up to terminals having an automatic answer feature, the alerting indication may not be received from the called party. If the CSF at a destination SN receives an answer indication an ANM is sent provided that an ACM has been sent, otherwise a CON is sent.

7.9 Access Transport Parameter

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

7.10 Storage and release of Initial Address Message information

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

The IAM information can be released from memory:

a)   by the CSF in the originating SN when the ACM or CON has been received and the calling party does not subscribe to a supplementary service which would cause a new call set-up. The release of the information when the calling party does subscribe to a supplementary service that is covered in ITU-T Q.730-series Recommendations;

b)   by the CSF in the intermediate SN or CMN when the ACM or the CON has been received;

c)   by the CSF in the destination SN when the ACM or CON has been sent and the called party does not subscribe to a supplementary service which would cause a new call set-up. The release of the information when the called party does subscribe to a supplementary service is covered in the ITU-T Q.730-series Recommendations,

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

8   Additional set-up procedures

8.1   Introduction

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

8.2   Call Progress

The CPG is sent (only after the ACM) from a CSF in the backward direction indicating that an event has occurred during call set-up which should be relayed to the calling party.

The CPG may be subject to Simple Segmentation; see 12.2.

8.2.1 Actions required at the destination SN

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

– an indication is received that the called party is being alerted, the CPG contains an Event Indicator that is set to "*alerting*";

– a progress indication is received from the called party, the CPG contains an Event Indicator that is set to "*progress*".

See the relevant interworking Recommendation, e.g. ITU-T Q.1912.2.

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

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

8.2.2 Actions required at an intermediate SN/CMN

On receipt of a CPG a CSF will send the corresponding CPG to the preceding CSF.

8.2.3 Actions required at the originating SN

On receipt of a CPG, no state change occurs, and the appropriate indication is sent to the calling user. See the relevant interworking Recommendation, e.g. ITU-T Q.1912.2.

8.3 Codec Negotiation

The support of the codec negotiation procedure is optional. Codec negotiation is not applicable in case of reuse of idle bearers, see Annex B. Codec negotiation procedures are not applicable at a CMN − a CMN shall pass all codec information unchanged.

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

8.3.1 SN initiating codec negotiation

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

1) The Supported Codec List is constructed and contains all the codecs, in priority order, that are offered for use in the call. The preferred codec is placed as the highest priority in the list.

2) The Supported Codec List for the call is sent forward in the BICC_Data request primitive associated with the IAM. It is coded as a Codec List information element and shall not include more than eight Single Codec information elements.

3) The preferred codec identity is indicated to the BCF, if a BIWF has currently been selected.

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

8.3.2 SN transiting codec negotiation

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

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

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

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

• if the incoming side of the call is the network that supports codec negotiation then the CSF shall perform the codec negotiation procedures described in 8.3.3 for SN terminating codec negotiation;

• if the incoming side of the call is the network that does not support codec negotiation, then the CSF shall perform the codec negotiation procedures described in 8.3.1 for an SN initiating codec negotiation.

8.3.3 SN terminating codec negotiation

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

The CSF performs the following procedure to select the appropriate codec to be used for the call (the "Selected Codec"), and to discover the list of codecs available for the call (the "Available Codec List"):

a) It selects the codec with highest priority in the received Supported Codec List that is appropriate for the call.

b) It constructs the Available Codec List for the call by deleting the entries that can not be used for the call. (The selected codec is also included in the list of available codecs.)

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

8.3.4 Outgoing bearer set-up procedure

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

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

8.3.4.1 Per-call bearer set-up in forward direction

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

The Selected Codec and Available Codecs List for the call shall be received in the BICC_Data indication primitive (corresponding to an APM) received at 7.4.1, 7.4.3 or 7.4.4 item 2):

• Action indicator set to "*Connect forward, no notification + Selected Codec*" or "*Connect forward, plus notification + Selected Codec*". (The handling of these Action indicators in the relevant clause in 7.4 shall be as for values "*Connect forward, no notification*" or "*Connect forward, plus notification*", respectively.)

• The Selected Codec is coded as the Single Codec information element.

• The Available Codecs List is coded as the Codec List information element.

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

8.3.4.2 Per-call bearer set-up in backward direction

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

The Selected Codec and Available Codecs List for the call shall be received in a BICC_Data indication primitive (corresponding to an APM message):

- Action indicator set to "*Selected codec*".
- The Selected Codec is coded as the Single Codec information element.
- The Available Codecs List is coded as the Codec List information element.

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

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

8.3.5 Incoming bearer set-up procedure

8.3.5.1 Per-call bearer set-up in forward direction

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

The incoming bearer set-up procedure shall wait, at 7.5.1, 7.5.3 or 7.5.4 item 1), until the Selected Codec and the Available Codecs List for the call become available[3] – the procedure then continues. The Selected Codec and the Available Codecs List shall be included in the BICC_Data request primitive sent at 7.5.1, 7.5.3 or 7.5.4 item 2.2):

- Action indicator set to "*Connect forward, no notification + Selected Codec*" or "*Connect forward, plus notification + Selected Codec*". (Instead of values "*Connect forward, no notification*" or "*Connect forward, plus notification*", respectively.)
- The Selected Codec is coded as the Single Codec information element.
- The Available Codecs List is coded as the Codec List information element.

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

8.3.5.2 Per-call bearer set-up in backward direction

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

The incoming bearer set-up procedure shall wait, at 7.5.2, 7.5.3 or 7.5.5 item 1), until the Selected Codec information and the Available Codecs List for the call become available[3], the procedure shall continue as follows:

1) A BICC_Data request primitive (corresponding to an APM message), shall be issued including:

   - Action indicator set to "*Selected codec*".
   - Selected Codec, coded as the Single Codec information element.
   - Available Codecs List, coded as the Codec List information element.

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

3) The procedures to initiate bearer set-up continue at 7.5.2, 7.5.3 or 7.5.5 item 2).

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

8.3.6 Abnormal cases

8.3.6.1 Codec Unavailability

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

8.3.6.2 SN initiating codec negotiation

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

8.3.6.3 Codec negotiation in an SN transiting codec negotiation

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

8.4 Echo Control

8.4.1 General

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

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

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

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

NOTE 1 − Although the Enhanced Echo Control procedures are not supported by BICC, intermediate CSFs defined in this Recommendation pass the Echo Control Information parameter and the NRM message, if received from ISUP, according to normal basic call procedures and the procedures for handling unreasonable information (see 13.4).

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.

8.4.2 Procedures

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

8.4.2.1 Forward direction

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

8.4.2.1.1 Actions at the originating SN

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

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

8.4.2.1.2 Actions at an intermediate SN

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

a)   When the Nature of Connection Indicators parameter field in the IAM indicates that an echo control device is already included:

–   no change to the Nature of Connection Indicators parameter field in the IAM is made;
–   an incoming echo control device is reserved; and
–   any outgoing echo control device is disabled.

b)   When the Nature of Connection Indicators parameter field in the IAM does not indicate that an echo control device is already included:

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

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

a)   When the Nature of Connection Indicators parameter field in the IAM indicates that an echo control device is already included:

–   no change to the Nature of Connection Indicators parameter field in the IAM is made; and
–   an incoming echo control device is reserved.

b)   When the Nature of Connection Indicators parameter field in the IAM does not indicate that an echo control device is already included:

–   no additional action is required.

8.4.2.1.3 Actions at the destination SN

See 8.4.2.2.1 below.

8.4.2.2 Backward direction

8.4.2.2.1 Actions at the destination SN

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

–   an incoming echo control device is enabled; and

– the Echo Control Device Indicator of the Backward Call Indicators parameter in the ACM or CON is set to "*incoming echo control device included*".

If the CSF at the destination SN is unable to include an incoming echo control device, the information is conveyed to the preceding CSF by the Echo Control Device Indicator in the Backward Call Indicators parameter in the ACM or CON set to "*incoming echo control device not included*".

8.4.2.2.2 Actions at an intermediate SN

Upon receipt of the ACM or CON in response to an IAM with echo control indication, then one of the following actions can occur:

a) When the Backward Call Indicators parameter field indicates that an incoming echo control device is not already included:

– the reserved incoming echo control device is included; and

– the Echo Control Device Indicator in the Backward Call Indicators parameter is set to "*incoming echo control device included*".

b) When the Backward Call Indicators parameter field indicates that an incoming echo control device is already included:

– the reserved incoming echo control is released; and

– no change to the Backward Call Indicators parameter field in the backward message is made.

8.4.2.2.3 Actions at the originating SN

No additional action is required.

8.5 Propagation delay procedure

The procedure provides means to determine the total propagation delay for a connection.

The propagation delay information is accumulated during call set-up in the forward direction. The result is sent in the backward direction as Call History Information before the active phase of a call.

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.

NOTE – ISNs employing the ISUP signalling system with an ability to provide enhanced echo control signalling procedures will use the propagation delay and call history values in echo control logic (see ITU-T Q.764).

8.5.1 Procedure

The procedure starts from the principle that the propagation delay of a connection is detected during call set-up by increasing the Propagation Delay Counter contained in the IAM and that the accumulated result is sent in the backward direction included in the ANM or CON.

8.5.1.1 Actions at the initiating CSF

The initiating CSF is the CSF at the SN or CMN which initiates the procedure, e.g. a typical case is at the originating local SN.

8.5.1.1.1 Actions referring to the propagation delay counter

The initiating CSF shall always include the Propagation Delay Counter into the IAM. Initially the counter is set to 0 ms or if an access delay value is available, it is set to that delay value.

Depending on the chosen route to the succeeding CSF, the CSF increases the counter by a value representing the appropriate delay value prior to sending the IAM.

A value of the delay for each route has to be available in the CSF.

If the chosen route includes a satellite link, also the satellite indicator must be set accordingly.

8.5.1.1.2 Actions referring to the call history information

Upon receipt of the Call History Information parameter in the ANM or CON, the initiating CSF has to store the received delay value until the call is released.

8.5.1.2 Actions at an intermediate CSF

An intermediate CSF can be at a national or international, intermediate or gateway, SN/CMN.

8.5.1.2.1 Actions referring to the propagation delay counter

Upon receipt of the IAM, the CSF analyses the routing information in order to select a suitable route to the succeeding CSF.

After choosing a route, the Propagation Delay Counter shall be increased by the value of the corresponding delay value.

A value of the delay for each route has to be available in the CSF.

The IAM is sent to the succeeding CSF containing the new value of the Propagation Delay Counter.

8.5.1.2.2 Actions referring to the call history information

The CSF shall pass on the received ANM or CON including the Call History Information parameter.

8.5.1.3 Actions at the terminating CSF

The terminating CSF is the CSF at the SN or CMN which terminates the procedure, e.g. a typical case is the local destination SN.

8.5.1.3.1 Actions referring to the propagation delay counter

Upon receipt of the IAM including the Propagation Delay Counter, the CSF shall increase the value by the delay value of the terminating access if available and store the delay value until the call is released.

8.5.1.3.2 Actions referring to the call history information

Prior to sending the ANM or CON to the preceding CSF, the Call History Information parameter shall be included in the message.

The value of the Call History Information parameter is set according to the stored value of the Propagation Delay Counter.

8.5.1.4 Interactions with other signalling systems

There are two basic interworking situations namely:

i)   signalling systems supporting the procedure toward signalling systems not supporting the procedure;

ii)   signalling systems not supporting the procedure toward signalling systems supporting the procedure.

8.5.1.4.1 Interworking from signalling systems supporting the procedure to signalling systems not supporting the procedure

In case of an interworking situation, the CSF at the interworking SN shall store the propagation delay value accumulated up to this point until the call is released. If a delay value referring to the part of the connection where the procedure is not supported is available, this delay value shall be added to the stored one.

The CSF at an interworking SN acts like a terminating CSF according to 8.5.1.3.

Upon receipt of the ANM or CON the interworking SN shall include the Call History Information parameter set to the stored delay value.

The ANM or CON including the Call History Information parameter is sent to the preceding CSF by the CSF at the interworking SN.

8.5.1.4.2 Interworking from signalling systems not supporting the procedure to signalling systems supporting the procedure

Because of the signalling systems which do not support the procedure do not include the Propagation Delay Counter, the CSF at the interworking SN shall insert the Propagation Delay Counter in the IAM resetting it to 0 ms. If a delay value referring to the part of the connection where the procedure is not supported is available, the Propagation Delay Counter shall be set to this delay value.

The CSF at an interworking SN acts like a initiating CSF according to 8.5.1.1.

The calculated delay value shall reflect the delay incurred on the preceding circuit(s)/route(s). This includes delay values corresponding to satellite delays, if applicable.

Prior to sending the IAM to the succeeding CSF, the Propagation Delay Counter shall be increased according to the value of the outgoing route chosen.

8.5.1.5 Abnormal procedures

At any CSF where the incoming signalling system supports the propagation delay determination procedure, the Propagation Delay Counter parameter may be missing from the received IAM. In this case a propagation delay value should be created as in the interworking case described in 8.5.1.4.2. The procedure should then continue as in 8.5.1.2, 8.5.1.3 or 8.5.1.4 as appropriate.

At any CSF where the outgoing signalling system supports the propagation delay determination procedure, the Call History Information parameter may be missing from the ANM or CON received. In this case no special action is required; the ANM or CON is sent backward without this parameter.

At any CSF that supports the propagation delay procedure, a Confusion message may be received referring to the Propagation Delay Counter or the Call History Information parameter. The Confusion message should be discarded. Any stored propagation delay value is also discarded.

8.6 Signalling procedures for connection type allowing fallback

NOTE 1 – The procedure assumes that ITU-T E.172 will, at an appropriate time, include routing rules for the Transmission Medium Requirement parameter value "*64 kbit/s unrestricted preferred*".

NOTE 2 – The question of additional network signalling procedures to support the provision of tones and announcements in the case of 64 kbit/s unrestricted calls without the application of fallback, is for further study.

8.6.1 Actions in the forward direction

8.6.1.1 Actions at the originating SN

In order to set up a connection type allowing fallback, the relevant access interworking Recommendation, e.g. ITU-T Q.1912.2, may require that:

1)   Two bearer capability information elements are mapped into one corresponding User Service Information parameter and one corresponding User Service Information Prime parameter to be carried in the IAM.

     The User Service Information Prime parameter carries the preferred bearer capability and the User Service Information parameter carries the fallback bearer capability.

2)   The Transmission Medium Requirement parameter is coded "*64 kbit/s unrestricted preferred*", and the call is routed according to this Transmission Medium Requirement parameter.

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

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

8.6.1.2   Actions at an intermediate SN/CMN

8.6.1.2.1   Succeeding network does have the capability of performing fallback

The CSF at an intermediate SN or CMN will set up the call on a route according to the Transmission Medium Requirement parameter "*64 kbit/s unrestricted preferred*" whenever available.

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

8.6.1.2.2   Succeeding network does not have the capability of performing fallback

In case there is no route available being capable of satisfying the connection type requirements of "*64 kbit/s unrestricted preferred*", the CSF will continue the call, discard the User Service Information Prime parameter, maintain the User Service Information parameter, change the Transmission Medium Requirement parameter in accordance with the fallback connection type contained in the Transmission Medium Requirement Prime parameter and then discard the Transmission Medium Requirement Prime parameter.

8.6.1.3   Actions at the destination SN

The information carried in the User Service Information parameter and the User Service Information Prime parameter is handled according to the relevant interworking Recommendation, e.g. ITU-T Q.1912.2.

8.6.2   Actions in the backward direction – fallback indicated before answer

8.6.2.1   Actions at the destination SN

Fallback before answer may be indicated according to the relevant access interworking. This will be indicated in the backward direction by including a Transmission Medium Used parameter (which has been set according to the fallback connection type indicated by the Transmission Medium Requirement Prime parameter) in the ACM or CPG.

Appropriate actions to modify network resources will be initiated.

8.6.2.2   Actions at an intermediate SN/CMN

8.6.2.2.1   Succeeding network does have the capability of performing fallback

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

At an SN appropriate actions to modify network resources, e.g. µ-law/A-law conversion, will be initiated.

8.6.2.2.2   Succeeding network does not have the capability of performing fallback

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

At an SN appropriate actions to modify network resources, e.g. µ-law/A-law conversion, will be initiated.

8.6.2.3   Actions at the originating SN

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

Appropriate actions to modify network resources will be initiated.

8.6.3   Actions in the backward direction − fallback indicated at answer

8.6.3.1   Actions at the destination SN

Fallback at answer may be indicated according to the relevant access interworking. This will be indicated by including a Transmission Medium Used parameter (which has been set according to the fallback connection type indicated in the Transmission Medium Requirement Prime parameter) in the ANM or CON.

Appropriate actions to modify network resources will be initiated.

8.6.3.2   Actions at an intermediate SN/CMN

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

At an SN appropriate actions to modify network resources, e.g. µ-law/A-law conversion, will be initiated.

8.6.3.3   Actions at the originating SN

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

Appropriate actions to modify network resources will be initiated.

8.6.4   Actions in the backward direction − fallback does not occur

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

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

8.6.5   Echo control for connection types allowing fallback

The placement of echo control devices on a connection with a Transmission Medium Required value of "*64 kbit/s unrestricted preferred*" is performed by the echo control signalling procedures (see 8.4) in conjunction with echo control logic as defined in ITU-T Q.115. The enabling of the echo control devices shall only be carried out if a Transmission Medium Used parameter is received in the backward direction indicating "*speech*" or "*3.1 kHz audio*".

8.7 Transit network selection (national use)

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

8.8 Support for Temporary Alternative Routing (TAR)

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

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

8.9 Hop counter procedure

The hop counter procedure is used to detect call set-up looping that can be caused by incorrect routing data. Incorrect routing data may be introduced when route provisioning information changes, especially when new routes are added. The problem is temporary and can be corrected by correction of routing data. As such, the hop counter procedure is optional and can be deactivated when determined to be no longer needed. A CSF provisionable option to deactivate the hop counter procedure applies per outgoing route. The default is active.

8.9.1 Actions at the initiating SN/CMN

The CSF at an originating SN or an intermediate SN or CMN shall initiate the hop counter procedure if the hop counter capability is activated. The outgoing IAM shall include the Hop Counter parameter containing the initial count value.

The initial count value shall be provisionable by the network operator on a per CSF basis (31 maximum).

The CSF at an originating SN receiving a Release message with cause #25, "*exchange routing error*" shall notify the management system of the routing error and provide the called party number, identity of the succeeding CSF[4], and if available, the calling party number.

8.9.2 Actions at an intermediate SN/CMN

Intermediate CSF actions are dependent upon whether a Hop Counter parameter is received from the preceding CSF and, if received, the result of decrementing the Hop Counter value.

If the Hop Counter parameter is received, the CSF shall decrement the Hop Counter value by 1. Subsequent actions are based on the result as described below:

a) If the result equals 0, the CSF shall release the call by returning a REL with cause value #25, "*exchange routing error*", to the preceding CSF. In addition, the management system shall be informed of the Hop Counter exhaust (value = 0), associated called party number, identity of the preceding CSF[4], and if available, the calling party number.

b) If the result is greater than 0, the CSF shall include the Hop Counter parameter in the outgoing IAM.

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[4] The method of identifying the succeeding/preceding CSF is for further study.

8.9.3 Actions at the destination SN

None. The CSF shall ignore the Hop Counter if received.

NOTE – Interaction with supplementary services and IN is for further study.

8.10 Charging

Charging indicators are basically defined for national use. Therefore, unless there is bilateral agreement, the decision to charge a call or not, or to start international accounting will not be decided upon reception of these indicators.

8.11 Access delivery indication

In case the destination SN delivered any call set-up information at the ISDN access, this will be indicated in the Access Delivery Indicator in the ACM, CON or REL.

Only the CSF at the destination SN can generate the Access Delivery Indicator.

An intermediate CSF is required to recognize the Access Delivery Indicator when it is received, and pass it on if possible.

When a CSF does not receive the Access Delivery Indicator, no action is required. This would be the case when the CSF at the destination SN or the network between the destination SN and the receiving CSF does not support the Access Delivery Indicator.

The procedure for use of the indication is for further study.

8.12 Information messages

8.12.1 Requesting information (national use)

An Information Request message may be sent to any CSF in the forward (backward) call establishment direction after sending (receiving) an IAM until when routing is complete i.e. when the ACM or CON is generated by the CSF at the destination SN or when it is received by the CSF at an intermediate SN/CMN or originating SN.

8.12.2 Sending solicited information (national use)

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

i)   if all the information requested is available locally, then an Information message containing all the required information is sent in response;

ii)   if all the information is not available locally, but may be available remotely, then an Information Request message may be sent to a subsequent CSF in the call in an attempt to extract the information not locally available. (This Information Request message may be delayed if one has already been sent and the response not yet received.) On receipt of a response, all the information necessary to respond to the original Information Request message is sent in an Information message;

iii)   if all the information is not available locally or remotely, then an Information message containing only the available information is sent and the requested but not delivered information is indicated as "*not available*", using either the indication in the information indicator or an appropriate coding in the requested parameter.

8.12.3 Receiving a solicited information message (national use)

Upon receipt of an Information message Timer T33 is stopped.

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

8.13 Call collect request procedure

As described in ITU-T E.141, a calling party may, during call set-up, invoke an operator service to request that a call be charged to a called party.

For such calls, IAM sent beyond the CSF at the SN providing the operator service, shall include the Collect Call Request parameter coded to indicate "*collect call requested*".

On receipt of a "*collect call requested*" indication in an incoming IAM, a terminating network may take such actions as it may consider appropriate in order to avoid the problem of uncollectable charges.

8.14 Calling party number

a)   International network

The calling party number can only be included in the IAM.

b)   National networks

The calling party number can either be included in the IAM or requested by the CSF at the destination SN (see 8.12). If the calling party number is required at the destination but is not included in the IAM, the CSF may request the calling party number. The CSF will investigate the presence/absence of the calling party number parameter to determine whether a request is useful or not. Further, it may be necessary to withhold the sending of the ACM until the calling party number has been successfully delivered.

The calling party number could contain Code 11 or 12 if the call is from an international operator.

8.15 Calling Geodetic location procedure

8.15.1 Introduction

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

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

How geodetic location information is transformed into other forms is outside the scope of this Recommendation.

Possible applications of the transport of calling geodetic location information include:
- Emergency services.
- Location dependent routing.
- Location number portability.
- Location mobility services.

8.15.2 Transfer of Geodetic information

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

8.16 Inter-nodal traffic group identification

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

8.16.1 Sending Inter-nodal traffic group identification

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

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

8.16.2 Receiving Inter-nodal traffic group identification

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

8.17 Carrier selection information (national use)

8.17.1 Action required at the originating SN

If a Carrier Selection is invoked by the user (reception of carrier selection information from the access) or by the network operator, the CSF shall send the Carrier Selection Information (CSI) parameter in the IAM.

NOTE 1 – The carrier selection information received from the access can be provided by a short prefix conveyed in the called party number or by other means, depending on the access signalling system.

The CSI parameter shall be set as follows:

- If call per call Carrier Selection is not invoked and there is a preselected carrier then the CSI parameter is set to "*selected carrier identification pre-subscribed, and no input by calling party*" (value 1).
- If a carrier is call per call selected then the CSI parameter is set to "*Carrier selected by input of calling party*" (value 10) (Note 2).
- If a carrier is selected by the network operator to which belongs the SN then the CSI parameter is set to "*carrier selected by a network operator*" (value 11).

If no Carrier Selection is invoked, the CSI parameter shall not be sent.

NOTE 2 – A coding giving more accurate information could possibly be used ("Selected Carrier identification pre-subscribed and input by calling party" (value 2) or "Selected Carrier identification not pre-subscribed, and input by calling party" (value 4)). The reason for using a generic coding (value 10) comes from regulation in some countries which protects privacy of the calling party.

8.17.2 Action required at an intermediate SN/CMN within the originating network

The CSF at an intermediate SN/CMN shall pass unchanged the CSI parameter to the subsequent CSF.

8.17.3 Action required at an outgoing national gateway SN/CMN

The CSF at an outgoing national gateway SN/CMN will pass on the parameter transparently.

8.17.4 Action required at an incoming national gateway SN/CMN

a)   In case the network to which belongs the gateway SN/CMN is explicitly selected:

The handling of the content of the CSI parameter is a network matter. However, the parameter shall not be sent to any subsequent network.

b)   In case the network to which belongs the gateway SN/CMN is not explicitly selected:

The call is routed through the network with the CSI parameter unchanged.

8.17.5 Action required at the destination SN

No special action required.

8.17.6 Action required at an international gateway SN/CMN

The CSF at an international gateway SN/CMN shall discard the CSI parameter.

8.18 Global Call Reference

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

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

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

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

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

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

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

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

8.19 Bearer Control Unit Identifier (BCU-ID)

8.19.1 General

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

8.19.2 Actions at an SN

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

•   If the BIWF address is absent in the BICC signalling.

•   If a topology is used with a physical separation between CSF and BIWF.

•   If a topology is used with a BIWF being controlled by multiple CSFs.

•   Limited interconnectivity between the BIWFs.

•   Optimal placement of the BIWF used for the call.

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

8.19.3 Actions at a CMN

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

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

8.19.4 Selection of BCU-ID

When selecting a BCU (Note 1) a number of criteria may be considered, e.g.:
• BIWF capabilities including types of accesses required for the call.
• Minimization preferences regarding equipment and transmission costs.
• Connectivity to peer BCUs.
• Point of interconnect restrictions.

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

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

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

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

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

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

8.19.5 Forward/Backward Bearer Establishment

8.19.5.1 BCU-ID sending node

8.19.5.1.1 Forward direction

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

8.19.5.1.2 Backward direction

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

8.19.5.2 BCU-ID receiving node

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

8.20 Out-of-band transport of DTMF and Tone information

8.20.1 Introduction

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

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

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

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

8.20.2 Procedures

8.20.2.1 No Signal Insertion in Bearer

If information is received by the CSF, either via incoming call control signalling or from the BCF indicating that a signal is switched on/off and no insertion of signals in the bearer has to be performed, a BICC_Data request primitive (corresponding to an APM message) is issued with the Action indicator set to either "*START Signal (no) notify*" or "*STOP Signal (no) notify*" depending on the received information.

NOTE 1 − Notification may be required, e.g. depending on interworking scenarios.

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

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

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

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

NOTE 2 – This description covers also the relay case where a BICC SN receives a BICC_Data indication primitive (corresponding to an APM message) containing a signal and no signal insertion in the bearer is required.

8.20.2.2 Signal Insertion in Bearer

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

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

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

1)   "*START Signal ACKNOWLEDGE*" for successful signal insertion, or

2)   "*START Signal REJECT*" if signal insertion was not possible, or

3)   "*STOP Signal ACKNOWLEDGE*" for successful disconnection of the signal.

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

9   Unsuccessful call set-up

9.1   Introduction

If at any time the call set-up cannot be completed successfully, the CSF will (if applicable):

a)   return an indication (in-band or out-band) to the calling party (see 9.5); or

b)   attempt to re-route the call set-up; or

c)   initiate release procedures to the preceding and/or succeeding CSF (see 9.2).

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

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

The call-failure indication (cause value #31, "*normal, unspecified*") is sent in a REL whenever a call attempt fails and other specific cause values do not apply.

9.2   Actions at a CSF initiating a release message

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

9.3   Actions at an intermediate SN/CMN

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

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

9.4.1 Actions at a controlling SN

On receipt of a REL from the preceding or succeeding CSF, the CSF at a controlling SN requests the BCF to disconnect the internal through-connection of the bearer path.

In addition, the controlling CSF will (if applicable):

a)   return an indication (in-band or out-band) to the calling party (see 9.5); or

b)   attempt to re-route the call set-up; or

c)   initiate release procedures to the preceding or succeeding CSF (see 11.5).

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

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

9.4.2 Actions at a controlling CMN

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

a)   attempt to re-route the call set-up; or

b)   pass the REL to the preceding or succeeding CSF (see 11.6).

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

9.5 Tones and announcements

9.5.1 Tones and announcements at an SN

The applicability of tones and announcements is decided based on the Transmission Medium Requirements. Tones and announcements are applicable for the following Transmission Medium Requirements:

–   speech;

–   3.1 kHz audio; and

–   64 kbit/s unrestricted preferred.

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

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

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

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

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

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

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

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

9.5.2   Tones and announcements at a CMN

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

9.6   Address incomplete

The determination that the proper number of digits has not been received can be made at once if the end of pulsing signal is received.

When overlap working is used and the end of pulsing has not been received, the REL with cause #28, "*invalid number format (address incomplete)*", will be sent 15-20 seconds (T35) after receipt of the latest address message and before receipt of the minimum or fixed number of digits for forward routing of the call.

10   Mid-call procedures

10.1   Introduction

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

10.2   Suspend and resume

10.2.1 Suspend

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

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

a) *Action at the destination SN or an interworking SN*

On receipt of an on-hook condition in the destination SN or a clearback signal at the interworking SN, the CSF may send a SUS (network) message to the preceding CSF.

b) *Action at the intermediate SN/CMN*

On receipt of a SUS message the CSF will send a SUS message to the preceding CSF.

c) *Action at the controlling CSF (i.e. the CSF at the SN or CMN controlling the call)*

On receipt of the on-hook condition or clearback indication or SUS message, the CSF starts timer T6 to ensure that an off-hook condition, a re-answer indication, a RES (network) message or a REL is received and, if applicable, sends a SUS (network) message to the preceding CSF. The value of this timer (T6) is covered in ITU-T Q.118[5]. If timer T6 expires, the procedures in 10.2.3 apply.

d) *Actions at the incoming gateway SN/CMN*

On receipt of the on-hook condition or clearback indication or SUS (network) message, the CSF sends to the preceding CSF a SUS (network) message and starts timer T38, to ensure that a REL is received. The value of this timer is covered in ITU-T Q.118[5]. If timer T38 expires, the procedure in 10.2.3 applies. The procedure described above may not be applied in the incoming gateway if a similar arrangement is already made in the incoming network.

10.2.2 Resume

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

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

a) *Action at the destination SN or interworking SN*

On receipt of a re-answer indication at the interworking SN or an off-hook condition in the destination SN, the CSF may send a RES (network) message to the preceding CSF if a SUS (network) message had previously been sent.

b) *Actions at the intermediate SN/CMN*

On receipt of a RES message the CSF will send a RES message to the preceding CSF.

c) *Action at the controlling CSF (i.e. CSF at the SN or CMN controlling the call)*

On receipt of the off-hook condition, re-answer signal, or RES (network) message the CSF stops timer T6 (started in 10.2.1 c)) and, if applicable, sends a RES (network) message to the preceding CSF. On receipt of a REL the CSF stops timer T6 and releases the call according to the procedure in 11.4.

d) *Actions at the incoming gateway SN/CMN*

On receipt of the off-hook condition, re-answer signal, or RES (network) message from the succeeding CSF, the CSF stops timer T38 (started in 10.2.1 d)) and sends a RES (network) message to the preceding CSF. On receipt of a REL the CSF stops timer T38 and releases the call according to the procedure in 11.4.

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[5] ITU-T Q.118 defines timer values for use at international gateways – application of this Recommendation within a national network is a network option.

10.2.3 Expiration of timer T6 or timer T38

If a request for reconnection or a RES (network) message is not received within timer T6 or timer T38, both covered in ITU-T Q.118, then the CSF where the timer has been started will initiate the release procedure on both sides. Cause value #16, "*normal call clearing*", is used in the REL on expiry of T6; cause value #102, "*recovery on timer expiry*", is used in the REL on expiry of T38.

10.3 Forward Transfer message

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

a)   following a call switched automatically to a subscriber, or following a call established via a special operator, the controlling operator wishes to call in an assistance operator. On receipt of the FOT message by the CSF at the incoming international gateway SN, an assistance operator is called in;

b)   following a call via codes 11 and 12, the controlling operator wishes to recall the incoming international gateway SN. Receipt of the FOT message by the CSF at the incoming international gateway SN recalls the incoming operator on calls completed via the operator positions at the SN.

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

10.4 Codec modification/mid-call codec negotiation procedures

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

When the codec modification/mid-call codec negotiation option is supported, the codec selected for a call can be modified in any direction and at any time during the active phase of the call. Codec modification can only occur once the bearer connection has been fully established, a codec has been selected for the call and an Available Codec List for the call has been stored in all the CSFs intervening in the codec negotiation procedures (8.3). Mid-call codec negotiation can only occur once the bearer connection has been fully established. The procedure to be followed for codec modification/mid-call codec negotiation depends on whether the SN is to act as a SN initiating, transiting or terminating codec modification/mid-call codec negotiation.

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

NOTE 1 – The terms "preceding" and "succeeding" SN in the following clauses refer to the direction of the modification/mid-call codec negotiation flow, not of the direction of the call set-up flow. To illustrate this, a successful codec modification and a successful mid-call codec negotiation procedure between two CSFs are as follows:
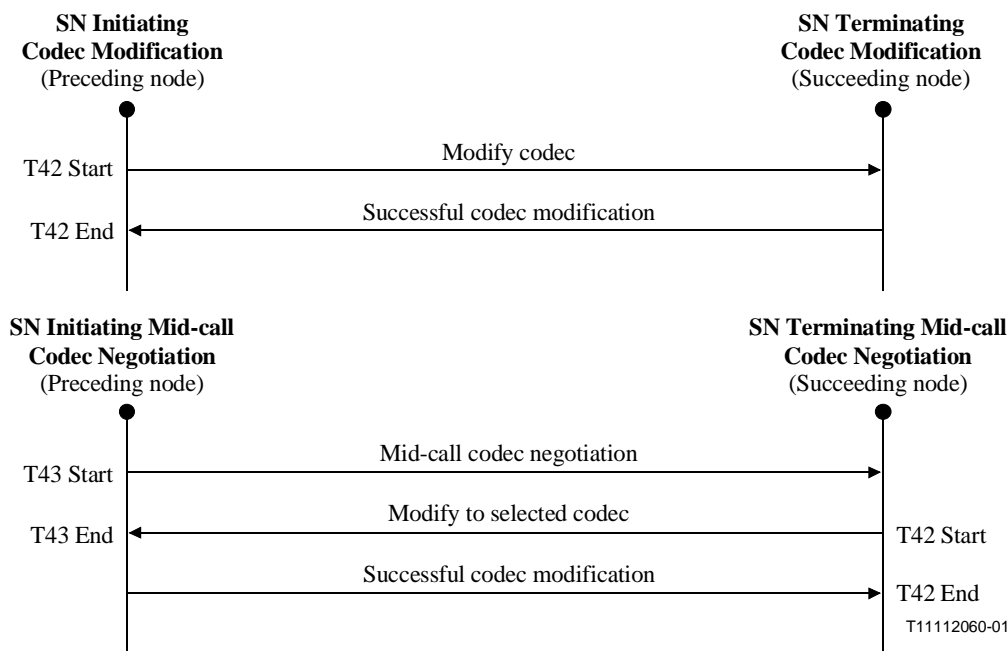
**Figure 1/Q.1902.4 – Overview of codec modification
and mid-call negotiation**

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

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

10.4.1 SN initiating codec modification

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

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

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

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

1) If the selected codec is to be modified, the CSF shall request the BCF to allocate the new codec resources required for the connection towards the succeeding BIWF. Upon reception of the result of the allocation request, the following actions are taken by the CSF:

- if the result of the allocation request is successful, the CSF proceeds according to step 2) below,

- if the result of the allocation request is unsuccessful, the modification is considered to have been rejected, the nodal functions are notified and no further action is taken.

2)   Issue a BICC_Data request primitive, (corresponding to an APM message), containing:

   •   An Action indicator set to "*modify codec*".

   •   A Single Codec information element indicating the newly selected codec for the call if the selected codec is to be modified. The newly selected codec must be among the ones in the currently stored Available Codec List.

   •   A Codec List information element indicating the new Available Codec List for the call if the stored Available Codec List is to be modified.

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

3)   A BICC_Data indication primitive will be received in response, including an Action indicator:

   •   If the received Action indicator is set to "*successful codec modification*", then the codec modification has been successful. Codec modification timer (T42) is stopped, the nodal functions are notified and the new Available Codec List is stored for future use, if modification of the stored Available Codec List was requested.

   •   If the received Action indicator is set to "*codec modification failure*", then the codec modification has been rejected. Codec modification timer (T42) is stopped and the nodal functions are notified. If modification of the selected codec was originally requested, the CSF shall request the BCF to revert to the original codec resources required for the connection towards the succeeding BIWF.

10.4.2   SN terminating codec modification

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

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

•   An Action indicator set to "*modify codec*".

•   A Single Codec information element if the currently selected codec for the call is to be modified.

•   A Codec List information element if the stored Available codec List for the call is to be modified.

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

•   If either the Single Codec or the Codec List are not valid, i.e. the Single Codec is not among the ones offered in the stored, or received, Available Codec List or the Codec List is not a subset of the stored Available Codec List, then the modification is rejected.

•   If the Codec Information is valid, and the selected codec is not required to be modified, then the modification is considered to have been accepted.

•   If the codec information is valid, and the selected codec is to be modified, the CSF shall issue a request to the BCF containing the following information:

   a)   to allocate the selected codec resources required for the connection to the preceding BIWF,

   b)   to initiate bearer modification procedures towards the preceding BIWF to prepare the bearer connection to support the selected codec type and to secure additional bandwidth (if necessary),

   c)   to notify the CSF when the bearer connection to the preceding BIWF has been successfully modified to support the selected codec type. This notification contains an indication that the modification has been either rejected or accepted.

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

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

- If the nodal functions indicate that the modification cannot be accepted, then a BICC_Data request primitive with an Action indicator set to "*codec modification failure*" is issued towards the preceding CSF. If modification of the selected codec was originally requested, the CSF requests the BCF to initiate bearer modification procedures to revert to the original codec resources and to free any unused bandwidth for the connection towards the preceding BIWF. Additionally, the CSF requests the BCF to notify the CSF when the bearer connection to the preceding BIWF has been successfully modified to support the original codec type.

- If the nodal functions indicate that the modification can be accepted, then a BICC_Data request primitive with an Action indicator set to "*successful codec modification*" is sent to the preceding CSF. If modification of the selected codec was originally requested, the CSF indicates to the BCF to confirm that the modification has been successful and to initiate bearer modification procedures towards the preceding BIWF to free any unused bandwidth when it is no longer required for the connection. If the stored Available Codec List is modified, then the new Available Codec List is stored for future use.

10.4.3 SN transiting codec modification

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

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

- an Action indicator set to "*modify codec*",

- a Single Codec information element if the currently selected codec for the call is to be modified,

- a Codec List information element if the stored Available Codec List is to be modified.

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

1) If either the Single Codec or the Codec List is not valid (i.e. the Single Codec is not among the ones offered in the stored, or received Available Codec List for the call, or the Codec List is not a subset of the stored Available Codec List), then the codec modification is rejected. The CSF issues a BICC_Data request primitive towards the preceding CSF containing an Action indicator set to "*codec modification failure*" and no further action is taken.

2) If the codec information is valid, and the selected codec is not required to be modified, the CSF proceeds according to step 4) below. If the codec information is valid and the selected codec is to be modified, the CSF shall issue a request to the BCF containing the following information:

  - to allocate the selected codec resources required for the connection to the preceding BIWF,

  - to initiate bearer modification procedures towards the preceding BIWF to prepare the bearer connection to support the selected codec type and to secure additional bandwidth (if necessary),

  - to notify the CSF when the bearer connection to the preceding BIWF has been successfully modified to support the selected codec type.

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

3) If the above notification indicates a successful modification, the CSF shall request the BCF to allocate the new codec resources required for the connection towards the succeeding BIWF. Upon reception of the result of the allocation request, the following actions are taken by the CSF:

- if the result of the allocation request is successful, the CSF proceeds according to step 4) below,

- if the result of the allocation request is unsuccessful, the modification is considered to have been rejected, the CSF issues a BICC_Data request primitive towards the preceding CSF containing an Action indicator set to "*codec modification failure*". The CSF requests the BCF to initiate bearer modification procedures to revert to the original codec resources, and free any unused bandwidth, for the connection towards the preceding BIWF. The CSF also requests the BCF to notify the CSF when the bearer connection to the preceding BIWF has been successfully modified to support the original codec type, and no further action is taken.

4) The received codec information is forwarded by the CSF in a BICC_Data request primitive towards the succeeding CSF.

5) Upon reception of a BICC_Data indication primitive from the succeeding CSF that contains an Action indicator set to "*successful codec modification*" or "*codec modification failure*" it shall forward the received information in a BICC_Data request primitive towards the preceding SN. The following additional actions are taken by the CSF according to the Action indicator:

- If the received Action indicator was set to "*successful codec modification*" and if modification of the selected codec was originally requested, the CSF indicates to the BCF to confirm that the modification has been successful and to initiate bearer modification procedures towards the preceding BIWF to free any unused bandwidth when it is no longer required for the connection. If the stored Available Codec List has been modified, then the new Available Codec List is stored for future use.

- If the received Action indicator was set to "*codec modification failure*" and if modification of the selected codec was originally requested, the CSF takes the following further actions:

  a) The CSF shall request the BCF to revert to the original codec resources required for the connection towards the succeeding BIWF.

  b) The CSF requests the BCF to initiate bearer modification procedures to revert to the original codec resources and to free any unused bandwidth for the connection towards the preceding BIWF. The CSF also requests the BCF to notify the CSF when the bearer connection to the preceding BIWF has been successfully modified to support the original codec type.

10.4.4 SN initiating mid-call codec negotiation

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

- the negotiation of the stored Available Codec List for the call. The new Available Codec List for the call may contain different codecs to those in the stored Available Codec List (if one exists) and/or,

- the selection of a codec amongst the codecs present in the Supported Codec List.

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

1)   Construct a Supported Codec List including all the codecs, in priority order, that are offered for the call.

2)   Issue a BICC_Data request primitive (corresponding to an APM message) to the succeeding CSF, containing:

- an Action indicator set to "*mid-call codec negotiation*",

- a Supported Codec List coded as a Codec List information element.

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

3)   A BICC_Data indication primitive will be received from the succeeding CSF in response. Mid-call codec negotiation timer (T43) is stopped, and the Action indicator examined:

- If the received Action indicator is set to "*mid-call codec negotiation failure*", then the mid-call codec negotiation has been rejected, the nodal functions are notified and no further action is taken.

- If the received Action indicator is set to "*modify to selected codec information*", and the selected codec is not required to be modified, the nodal functions are informed of the request to modify to the codec information and a response is awaited. The CSF proceeds according to step 4) below.

- If the received Action indicator is set to "*modify to selected codec information*", and the selected codec is required to be modified, the CSF shall issue a request to the BCF containing the following information:

  a) to allocate the selected codec resources required for the connection to the succeeding BIWF,

  b) to initiate bearer modification procedures towards the succeeding BIWF to prepare the bearer connection to support the selected codec type and to secure additional bandwidth (if necessary),

  c) to notify the CSF when the bearer connection to the succeeding BIWF has been successfully modified to support the selected codec type. This notification contains an indication that the modification has been either accepted or rejected:

    - If the modification is accepted, the nodal functions are informed of request to modify to the selected codec information and a response is awaited. The CSF proceeds according to step 4) below.

    - If the modification is rejected, then a BICC_Data request primitive with an Action indicator set to "*codec modification failure*" is issued towards the succeeding CSF. The nodal functions are notified of the unsuccessful mid-call codec negotiation, and no further action is taken.

4)   Upon reception of a response from the nodal functions, the following actions are taken by the CSF:

- If the nodal functions indicate that the mid-call codec negotiation cannot be accepted, then a BICC_Data request primitive with an Action indicator set to "*codec modification failure*" is issued towards the succeeding CSF. If modification of the selected codec was originally requested, the CSF requests the BCF to initiate bearer modification

procedures to revert to the original codec resources and to free any unused bandwidth for the connection towards the succeeding BIWF. Additionally, the CSF requests the BCF to notify the CSF when the bearer connection to the succeeding BIWF has been successfully modified to support the original codec type.

- If the nodal functions indicate that the mid-call codec negotiation can be accepted, then a BICC_Data request primitive with an Action indicator set to "*successful codec modification*" is sent to the succeeding CSF. If modification of the selected codec was originally requested, the CSF indicates to the BCF to confirm that the modification has been successful and to initiate bearer modification procedures towards the succeeding BIWF to free any unused bandwidth when it is no longer required for the connection. If the stored Available Codec List has been modified, then the new Available Codec List is stored for future use.

10.4.5 SN terminating mid-call codec negotiation

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

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

- an Action indicator set to "*mid-call codec negotiation*",
- a Supported Codec List coded as a Codec List information element.

The following procedure shall be followed by the CSF:

1) The CSF performs the following procedure to select the appropriate codec to be used for the call (the "Selected Codec"), and to discover the list of codecs available for the call (the "Available Codec List"):

   - It constructs the Available Codec List for the call by deleting the entries that cannot be used for the call.

   - It selects the codec with the highest priority in the received Supported Codec List that may be used for the call.

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

2) The CSF shall inform the nodal functions of the mid-call codec negotiation request and a response is awaited. Upon reception of a response from the nodal functions, the following actions are taken by the CSF:

   - If the nodal functions indicate that the mid-call codec negotiation request cannot be accepted, a BICC_Data request primitive with an Action indicator set to "*mid-call codec negotiation failure*" is issued towards the preceding CSF and no further action is taken.

   - If the nodal functions indicate that the mid-call codec negotiation request can be accepted, and the selected codec is not required to be modified, the CSF proceeds according to step 3) below.

   - If the nodal functions indicate that the mid-call codec negotiation request can be accepted, and the selected codec is required to be modified, the CSF shall request the BCF to allocate the new codec resources required for the connection towards the preceding BIWF. Upon reception of the result of the allocation request, the following actions are taken by the CSF:

     a) if the result of the allocation request is successful, the CSF proceeds according to step 3) below,

b) if the result of the allocation request is unsuccessful, the mid-call codec negotiation is considered to have been rejected. A BICC_Data request primitive with an Action indicator set to "*mid-call codec negotiation failure*" is issued towards the preceding CSF, the nodal functions are notified and no further action is taken.

3) Issue a BICC_Data request primitive (corresponding to an APM message) towards the preceding CSF, containing:

- An Action indicator set to "modify to selected codec information".
- A Single Codec information element indicating the newly selected codec for the call.
- A Codec List information element indicating the new Available Codec List for the call.

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

4) A BICC_Data indication primitive will be received from the preceding CSF in response, codec modification timer (T42) is stopped and the Action indicator examined:

- If the received Action indicator is set to "*successful codec modification*", then the mid-call codec negotiation has been successful. The nodal functions are notified and if the stored Available Codec List has been modified, then the new Available Codec List is stored for future use.
- If the received Action indicator is set to "*codec modification failure*", then the mid-call codec negotiation has been rejected and the nodal functions are notified. If modification of the selected codec was originally requested, the CSF shall request the BCF to revert to the original codec resources required for the connection towards the preceding BIWF.

10.4.6 SN transiting mid-call codec negotiation

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

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

- an Action indicator set to "*mid-call codec negotiation*",
- a Supported Codec List coded as a Codec List information element.

The CSF derives the Supported Codec List by deleting the codecs inside the received Supported Codec List that cannot be used for the call. If it is determined that there are no available codecs in the received Supported Codec List, the CSF issues a BICC_Data request primitive with an Action indicator set to "*mid-call codec negotiation failure*" towards the preceding CSF and no further action is taken.

2) The CSF then sends a BICC_Data request primitive towards the succeeding CSF that includes:

- an Action indicator set to "*mid-call codec negotiation*" and
- the Supported Codec List coded as a Codec List information element.

3) A BICC_Data indication primitive will be received from the succeeding CSF in response, including an Action indicator:

- If the received Action indicator is set to "*mid-call codec negotiation failure*", then the mid-call codec negotiation has been rejected. A BICC_Data request primitive with an Action indicator set to "*mid-call codec negotiation failure*" is issued towards the preceding CSF and no further action is taken.
- If the received Action indicator is set to "*modify to selected codec information*", and the selected codec is not required to be modified, the CSF proceeds according to step 5) below.

- If the received Action indicator is set to "*modify to selected codec information*", and the selected codec is required to be modified, the CSF shall issue a request to the BCF containing the following information:

  a) to allocate the selected codec resources required for the connection to the succeeding BIWF,

  b) to initiate bearer modification procedures towards the succeeding BIWF to prepare the bearer connection to support the selected codec type and to secure additional bandwidth (if necessary),

  c) to notify the CSF when the bearer connection to the succeeding BIWF has been successfully modified to support the selected codec type. This notification contains an indication that the modification has been either accepted or rejected:

     - If the modification is accepted, the CSF proceeds according to step 4) below.

     - If the modification is rejected, then a BICC_Data request primitive with an Action indicator set to "*mid-call codec negotiation failure*" is issued towards the preceding CSF, and a BICC_Data request primitive with an Action indicator set to "*codec modification failure*" is issued towards the succeeding CSF. No further action is taken.

4) The CSF shall request the BCF to allocate the new codec resources required for the connection towards the preceding BIWF. Upon reception of the result of the allocation request, the following actions are taken by the CSF:

   - if the result of the allocation request is successful, the CSF proceeds according to step 5) below,

   - if the result of the allocation request is unsuccessful, the mid-call codec negotiation is considered to have been rejected. The CSF shall take the following actions:

     a) A BICC_Data request primitive with an Action indicator set to "*mid-call codec negotiation failure*" is issued towards the preceding CSF.

     b) A BICC_Data request primitive with an Action indicator set to "*codec modification failure*" is issued towards the succeeding CSF. The CSF requests the BCF to initiate bearer modification procedures to revert to the original codec resources and to free any unused bandwidth for the connection towards the succeeding BIWF. Additionally, the CSF requests the BCF to notify the CSF when the bearer connection to the succeeding BIWF has been successfully modified to support the original codec type. No further actions are taken.

5) Issue a BICC_Data request primitive (corresponding to an APM message) towards the preceding CSF, containing:

   - An Action indicator set to "*modify to selected codec information*".

   - A Single Codec information element indicating the newly selected codec for the call.

   - A Codec List information element indicating the new Available Codec List for the call.

6) A BICC_Data indication primitive will be received from the preceding CSF in response, including an Action indicator:

   - If the received Action indicator is set to "*successful codec modification*", then the mid-call codec negotiation has been successful. The CSF shall issue a BICC_Data request primitive with an Action indicator set to "*successful codec modification*" towards the succeeding CSF. If modification of the selected codec was originally requested, the CSF indicates to the BCF confirming that the modification has been successful and to initiate bearer modification procedures towards the succeeding BIWF to free any unused bandwidth when it is no longer required for the connection. If the

stored Available Codec List has been modified, then the new Available Codec List is stored for future use.

- If the received Action indicator is set to "*codec modification failure*", then the mid-call codec negotiation has been rejected. The CSF shall issue a BICC_Data request primitive with an Action indicator set to "*codec modification failure*" towards the succeeding CSF. If modification of the selected codec was originally requested, the CSF takes the following further actions:

  a) The CSF shall request the BCF to revert to the original codec resources required for the connection towards the preceding BIWF.

  b) The CSF shall request the BCF to initiate bearer modification procedures to revert to the original codec resources, and to free any unused bandwidth, for the connection towards the succeeding BIWF. The CSF also requests the BCF to notify the CSF when the bearer connection to the succeeding BIWF has been successfully modified to support the original codec type.

10.4.7 Abnormal codec modification/mid-call codec negotiation cases

10.4.7.1 Failed modification/mid-call codec negotiation

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

10.4.7.2 Expiry of codec modification timer (T42)

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

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

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

10.4.7.4 Procedure incompatibility

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

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

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

1) Mid-call codec negotiation procedures take precedence over codec modification procedures:

   a) If a CSF receives a request for codec modification when it has already sent a request for mid-call codec negotiation, it shall discard the codec modification request and continue processing the mid-call codec negotiation.

   b) If a CSF receives a request for mid-call codec negotiation when it has already sent a request for a codec modification, it shall cease processing the codec modification and process the mid-call codec negotiation.

2)   Codec modification/mid-call codec negotiation requests initiated in the direction towards the called party shall take precedence over codec modification/mid-call codec negotiation requests initiated in the direction towards the calling party. The codec modification/mid-call codec negotiation request which takes precedence continues according to normal procedures while the other codec modification/mid-call codec negotiation request is discarded.

3)   If a codec modification/mid-call codec negotiation collision has been detected by the CSF and resolved according to the above rules, and subsequently either an error in the received codec information or a resource unavailability is detected, then both of the codec modification/mid-call codec negotiation requests involved in the collision shall be rejected according to the relevant procedures in 10.4.1 to 10.4.6.

11   Normal call release

11.1   Introduction

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

NOTE − At an SN an indication of call release is issued to the BCF, but the subsequent decision to initiate bearer release protocol is the responsibility of BCF logic, and is not specified in this Recommendation. See Appendix I and Appendix II.

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

11.2   Release initiated by a calling party

a)   *Actions at the originating SN*

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

b)   *Actions at an intermediate SN*

On receipt of a REL from the preceding CSF, the CSF invokes the Release reception procedure (11.6), and initiates call release on the outgoing side by invoking the Release sending procedure (see 11.5) towards the succeeding CSF.

c)   *Actions at a CMN*

On receipt of a REL from the preceding CSF, the CSF invokes the Release reception procedure (see 11.6) to pass the message on, or respond, as appropriate.

d)   *Actions at the destination SN*

On receipt of a REL from the preceding CSF, the CSF invokes the Release reception procedure (see 11.6).

11.3   Release initiated by a called party

a)   *Actions at the destination SN*

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

b) *Actions at an intermediate SN*

On receipt of a REL from the succeeding CSF, the CSF invokes the Release reception procedure (see 11.6), and initiates call release on the incoming side by invoking the Release sending procedure (see 11.5) towards the preceding CSF.

c) *Actions at a CMN*

On receipt of a REL from the succeeding CSF, the CSF invokes the Release reception procedure (see 11.6) to pass the message on, or respond, as appropriate.

d) *Actions at the originating SN*

On receipt of a REL from the succeeding CSF, the CSF invokes the Release reception procedure (see 11.6).

11.4 Release initiated by the network

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

a) *Actions at an SN*

If the CSF needs to initiate call release it requests the BCF to disconnect the internal through-connection of the bearer path, and invokes the Release sending procedure (see 11.5) towards the adjacent CSF(s).

b) *Actions at a CMN*

If the CSF needs to initiate call release it invokes the Release sending procedure (see 11.5) towards the adjacent CSF(s).

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

11.5 Release sending procedure

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

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

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

11.6 Release reception procedure

a) *Actions at an SN*

On receipt of a REL the CSF requests the BCF to disconnect the internal through-connection of the bearer path. The received Cause parameter is passed to the BCF and call release at the incoming/outgoing (as applicable) side is indicated. When the BCF acknowledges successful disconnection of the internal bearer path a RLC is returned to the preceding/succeeding CSF (as applicable).

b) *Actions at a CMN*

On receipt of a REL when there is a BICC signalling association set-up through the CMN, the REL message and the subsequent RLC message shall be passed through unchanged[6]. The CMN shall not start timers T1 and T5. If a REL is received when there is no BICC signalling association set-up through the CMN an RLC shall be sent. CIC values shall be released at the CMN when the RLC is sent/received.

11.7 Collision of Release messages

a) *Actions at an SN*

In the case when two points both initiate the release of a call, a REL may be received at a CSF from a succeeding or preceding CSF after the disconnection of the internal bearer path is initiated and after sending a REL to the adjacent CSF. In this case, the CSF will return a RLC to the CSF from which the concerned REL was received. The RLC will be sent only after the BCF acknowledges successful disconnection of the internal bearer path. The CSF will make the CIC value available for new calls when both a RLC is received (corresponding to the sent REL) and a RLC is sent (corresponding to the received REL).

b) *Actions at a CMN*

If a REL is received from an adjacent CSF after REL has been sent to that adjacent CSF the actions depend on whether this CSF initiated the call release, or whether the CSF is passing through a REL received from a subsequent CSF:

- If this CSF has passed through a REL received from another CSF (see 11.6), but it has not yet received the corresponding RLC when it receives a REL, then this REL shall also be passed through to the subsequent CSF. RLC messages will subsequently be passed through in both directions. i.e. the procedure in 11.6 is applied to both RELs. The CIC value shall be made available for new calls when RLC has been both sent and received.

- If this CSF initiated call release (11.5) but it has not yet received the corresponding RLC when it receives a REL, the CSF will return a RLC to the CSF from which the REL was received. The CIC value shall be made available for new calls when RLC has been both sent and received.

11.8 Charging (national use)

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

12 Network features

12.1 Introduction

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

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

12.2 Simple segmentation

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

If the START-INFO.indication primitive received from the STC, see ITU-T Q.2150.0, indicates that the underlying message transport mechanism can transport greater than 272 octets the CSF shall not invoke Simple Segmentation. However, a CSF may receive a segmented message, even if the transport mechanism supports messages greater than 272 octets, (due to ISUP being used on a preceding/succeeding call segment), in this case the following procedures for reception of the Segmentation message apply.

The procedure is as follows:

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

NOTE 1 − The threshold for the initiation of the simple segmentation procedure may alternatively depend on network characteristics. The value of this threshold may vary per traffic relation depending on the typical network configuration and interconnection arrangements.

b)   The parameters that may be sent in the second segment using the Segmentation message are: the User-to-User Information, Generic Digit, Generic Notification, Generic Number and Access Transport parameters. If the User-to-User Information and Access Transport parameters cannot be carried in the original message and the two together do not fit in the Segmentation message, the User-to-User Information parameter is discarded.

c)   The sending CSF sets the Simple Segmentation Indicator in the Optional Forward or Backward Call Indicators parameter to indicate that additional information is available.

d)   When a message is received, by a CSF at a local SN, with the Simple Segmentation Indicator set to indicate additional information is available, the CSF starts timer T34 to await the Segmentation message. This action may also take place at incoming or outgoing gateway CSFs if policing of information is required.

e)   When the Segmentation message is received timer T34 is stopped, and the call continues.

f)   In case any other message except the ones listed below is received before the Segmentation message containing the second segment the CSF should react as if the second segment is lost, i.e. the timer T34 is stopped and the call continues.

The messages are:
–   Continuity.
–   CIC Group Blocking.
–   CIC Group Blocking Acknowledgement.
–   CIC Group Unblocking.
–   CIC Group Unblocking Acknowledgement.
–   CIC Group Query.
–   CIC Group Query Response.

g)   After expiry of timer T34 the call shall proceed and a received Segmentation message containing the second segment of a segmented message is discarded.

h)   At an incoming or outgoing gateway SN or CMN, when following the simple segmentation procedure it is possible that the CSF has to reassemble an incoming message and subsequently re-segment it for onward transmission. In this case it has to be ensured that any unrecognized parameters received in the first, or second segment are transmitted in the first, or second, segment respectively, when the passing of the parameter is required by the compatibility procedure.

i)   In case a Segmentation message is received when not expected, see 13.4.

NOTE 2 − Based on the set of services supported (e.g. ISDN end-to-end information, Call Diversion, User-to-user, etc.) and the set of APM applications (VPN, BICC, GAT, etc.), the CSF performing the segmentation is able to calculate the maximum length of the first segment, to leave enough space in a message for use by any subsequent. This maximum length may vary per traffic relation depending on the typical network configuration and interconnection arrangements.

12.3   Pre-release information transport

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

A CSF receiving a PRI message shall determine whether to store the received information and process it upon release of the call or pass-on the PRI without awaiting REL, depending on the parameters received and the application present for the call at that CSF. In the case that an intermediate CSF receives a PRI containing one, (or more), parameters that should be passed on without awaiting REL, and one, (or more), parameters that should be processed upon receipt of REL the procedures are for further study.

12.4   Automatic repeat attempt

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

i)   on detection of dual seizure (at the non-control CSF) (see 13.2);

ii)   on receipt of the CIC Group Blocking message, including the relevant status bit for this CIC set to "*1*", after sending an address message and before any backward message has been received (see 12.5);

iii) on receipt of a Reset CIC message after sending an address message and before a backward message has been received (see 13.3.1 e));

iv)   on receipt of an unreasonable message during call set-up (see 13.4).

12.5   Blocking and unblocking of CIC values

12.5.1   Introduction

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

The CIC Group Blocking message can be originated by either CSF. The receipt of a CIC Group Blocking message will have the effect of prohibiting non-test calls using the relevant CIC value(s) outgoing from the CSF until an appropriate CIC Group Unblocking message is received, but will not prohibit test calls incoming to that CSF. Test calls generated in the outgoing direction from the CSF that sent the CIC Group Blocking message will also be processed. Non-test IAMs will result in an abnormal case (see 12.5.4 x)).

12.5.2 CIC group blocking procedures

CIC values are removed from (returned to) service using the CIC Group Blocking (Unblocking) messages. The range of CIC values to be blocked (unblocked) is indicated in the Range field. Those CIC values within the range that have to be blocked (unblocked) are indicated in the Status field. The same rule applies to the acknowledgements.

The number of CIC values to be blocked (unblocked) with one CIC Group Blocking (Unblocking) message is in the range 1 to 32.

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

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

A received CIC Group Blocking (Unblocking) Acknowledgement message has to match in the parameter value of the CIC, the CIC Group Supervision Message Type, and the Range field (see ITU-T Q.1902.3) with the previously sent Group Blocking (Unblocking) message in order to be considered a valid acknowledgement.

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

The REL message should not override a blocking condition and return CIC value(s) to service. The blocked CIC value(s) will be returned to service on transmission of the CIC Group Unblocking Acknowledgement message at one CSF and on receipt of the CIC Group Unblocking Acknowledgement message at the other CSF.

For all instances of CIC Group Blocking the maintenance system should be notified at both ends of the signalling association.

12.5.3 Interactions between CIC blocking and call set-up procedures

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

If the CIC Group Blocking message is received:

– after an IAM has been sent for the indicated CIC value, in the opposite direction, and after at least one backward message relating to that call has been received; or

– after an IAM has been received for that CIC value beforehand,

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

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

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

–	for calls other than test calls, the CIC Group Blocking message, including the relevant status bit for this CIC set to "1", shall be returned and the IAM discarded.

12.5.4 Abnormal CIC group blocking procedures

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

i)	If a CIC Group Blocking message is received relating to remotely blocked CIC values, then blocking acknowledgement indications for those CIC values are given in the Status field of the corresponding CIC Group Blocking Acknowledgement message which will be sent in response.

ii)	If a CIC Group Unblocking message is received relating to CIC values which are not in the state remotely blocked, then unblocking acknowledgement indications for those CIC values are given in the Status field of the corresponding CIC Group Unblocking Acknowledgement message which will be sent in response.

iii)	When a CSF, upon receipt of a CIC Group Blocking (Unblocking) message, is not able to give an appropriate blocking (unblocking) acknowledgement indication for each CIC value (e.g. because that/those CIC value(s) is(are) not provisioned at the receiving CSF) for which a blocking (unblocking) indication is given in the Status field, then no blocking (unblocking) acknowledgement indication relating to that/those CIC value(s) will be given in the Status field of the corresponding CIC Group Blocking (Unblocking) Acknowledgement message which will be sent in response.

iv)	If a CIC Group Blocking acknowledgement message in response to a CIC Group Blocking message is received containing in the Status field the indications no blocking acknowledgement for the CIC values which are to be blocked due to the previously sent CIC Group Blocking message, then the maintenance system should be notified for the concerned CIC values. The same rule applies to the unblocking procedures.

v)	If a CIC Group Blocking Acknowledgement message in response to a CIC Group Blocking message is received containing in the Status field blocking acknowledgement indications for the CIC values which are not to be blocked due to the previously sent CIC Group Blocking message and are not marked locally blocked, then the maintenance system should be notified for the CIC values concerned.

vi)	If a CIC Group Unblocking Acknowledgement message in response to a CIC Group Unblocking message is received containing in the Status field unblocking acknowledgement indications for CIC values which are not to be unblocked due to the previously sent CIC Group Unblocking message and have to remain marked locally blocked, then the maintenance system should be notified for the CIC values concerned.

vii)	If a CIC Group Blocking acknowledgement message which is not expected as an acknowledgement for any CIC Group Blocking message is received:

–	relating to CIC values which all are in the status locally blocked the received CIC Group Blocking Acknowledgement will be discarded;

–	relating to CIC values part or all of which are not in the status locally blocked then the maintenance system should be notified for the relevant CIC values.

viii)	If a CIC Group Unblocking Acknowledgement message which is not expected as an acknowledgement for any CIC Group Unblocking message is received:

–	relating to CIC values none of which is in the status locally blocked then the CIC Group Unblocking Acknowledgement message will be discarded;

–	relating to CIC values part or all of which are locally blocked then the maintenance system should be notified for the relevant CIC values.

ix)   If a CIC Group Blocking (unblocking) message or a CIC Group Blocking (Unblocking) Acknowledgement message refers to status changes for more than 32 CIC values, the receiving CSF shall discard that message.

x)   If a non-test IAM is received with a remotely blocked CIC value, the remotely blocked state of the CIC value is removed and the IAM is processed normally unless the CIC value is also locally blocked in which case the IAM is discarded. This should not be the preferred method of unblocking a CIC value.

xi)   When a CSF receives a CIC Group Blocking (Unblocking) Acknowledgement message which indicates CIC values that are not provisioned (except for the CIC in the label of the message), these CIC values will be ignored.

12.6   CIC group query (national use)

12.6.1   General

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

The value N of the Range field of the CIC Group Query message, including N = 0 for a single CIC, indicates the range to be tested. The maximum value of N is 31. If that value is exceeded the CIC Group Query message is discarded.

12.6.2   Interpretation of CIC states

For the purposes of CIC query procedures, there are states which are classified into four major categories, as follows:

1)   unequipped and transient conditions;

2)   call processing states;

3)   maintenance blocking states.

The two states "unequipped" and "transient" do not overlap with other states.

Call processing states include:

1)   idle;

2)   CIC incoming busy;

3)   CIC outgoing busy.

Maintenance blocking states include:

1)   unblocked;

2)   remotely blocked;

3)   locally blocked;

4)   locally and remotely blocked.

A CIC value is "unequipped" if the CIC value is not provisioned. This is a unique state and will not overlap with any other state.

The "transient" state refers to any transient call processing or maintenance states.

Call processing is in a transient state:

a)   after having sent an IAM and waiting for the ACM or CON (whether a suspended call is in a transient state in the context of CIC group query is for further consideration); or

b)   after having sent a REL and waiting for the RLC.

Transient maintenance states are those where the CSF after having sent a CIC Group (Un)Blocking message is awaiting the proper CIC Group (Un)Blocking Acknowledgement message from the remote CSF.

The CIC state is also considered transient as long as a CIC (Group) Reset message has not been acknowledged.

The "idle" state is a call-processing state of a provisioned, non-busy CIC. The "CIC incoming busy" or "CIC outgoing busy" refers to a stable call processing state.

The maintenance "remotely blocked" state refers to the state marked by the CSF when the far-end CSF initiates blocking. The maintenance blocking state can coexist with "idle", "CIC incoming busy", or "CIC outgoing busy" state.

The maintenance "locally blocked" state refers to the state marked by the CSF when it initiated blocking to the far-end CSF and the proper acknowledgement was received. The maintenance blocking state can co-exist with "idle", "CIC incoming busy", or "CIC outgoing busy" state.

To initiate the CIC group query procedure, the sending CSF sends a CIC Group Query message indicating in the Range field those CICs to be audited. If no response to the CIC Group Query message is received before timer T28 expires, maintenance systems should be informed.

The receiving CSF will process the CIC Group Query message, and return a CIC Group Query Response message setting the CIC state indicators to the state of the CICs being audited.

If this CIC group procedure uncovers discrepancies in the state of a CIC as perceived at the two CSFs, the action to be taken in order to align the two views is for further study.

12.7   Support for Hard To Reach Network Management functions

The network management Hard To Reach (HTR) process is defined in ITU-T E.412. It enables more efficient usage of network resources during periods of congestion.

NOTE − The current E.412 procedures do not necessarily optimise network operation in network configurations where alternate routes exist to a hard to reach destination, e.g. via multiple transit networks, and this may result in unnecessary call failures. The E.412 procedures also do not currently support the Transit Network Selection procedure.

The network management process maintains a list of Hard To Reach destination codes. The destination codes contained in the list can be complete destination addresses or any substring of a complete destination address that includes at least the most significant digit(s), e.g. country code.

The exchange of HTR information requires agreement between all network operators involved.

12.7.1   SN/CMN initiating HTR indication

During the set-up of a call the CSF network management function compares the called party number with the Hard To Reach destination codes. If CSF is at an incoming international gateway it shall delete it's own country code, if present, before attempting this comparison.

If a match is found between a Hard To Reach destination code and the most significant digits of the called party number, then the HTR Information parameter shall be included in the ACM/CON or the REL, (if the call fails without sending an ACM/CON). The HTR Information parameter shall contain the Hard To Reach destination code as provided by the network management function.

If the CSF is at an incoming or intermediate international SN it shall ensure that the digits included in the HTR Information parameter constitute an internationally significant number.

12.7.2   SN receiving HTR indication

A CSF receiving the HTR Information parameter in the ACM, CON or REL messages shall pass the HTR information to the CSF's routing/network management control function, see ITU-T E.412.

The HTR actions may be applicable only at CSFs adjacent to the CSF determining the HTR condition, or the network management function may determine that the HTR information should be passed back through the network. Therefore, a CSF that receives a HTR information parameter

should discard that parameter after notifying the routing/network management control function, unless the network management function requests the passing of the information to the previous CSF.

CSFs that change the called party number, e.g. as a result of an Intelligent Network service or when Call Forwarding is invoked, shall not pass back the received HTR information, as this would result in incorrect HTR information being passed to the network management function at previous CSFs, and this may result in unnecessary call failures.

NOTE – Not passing the HTR information in these cases is only a temporary solution and a long term solution is for further study.

12.8 Automatic congestion control

Automatic Congestion Control (ACC) is used when a CSF is in an overload condition (see also ITU-T Q.542). Two levels of congestion are distinguished, a less severe congestion threshold (congestion level 1) and a more severe congestion threshold (congestion level 2).

If either of the two congestion thresholds are reached, an Automatic Congestion Level parameter is added to all REL messages generated by the CSF. This parameter indicates the level of congestion (congestion level 1 or 2) to the adjacent CSFs. The adjacent CSFs, when receiving a REL containing an Automatic Congestion Level parameter should reduce their traffic to the overload affected CSF.

If the overloaded CSF returns to a normal traffic load it will cease including Automatic Congestion Level parameters in RELs.

The adjacent CSFs then, after a predetermined time, automatically return to their normal status.

12.8.1 Receipt of a release message containing an automatic congestion level parameter

When a CSF receives a REL containing an Automatic Congestion Level parameter, the appropriate information should be passed to the signalling system-independent network management/overload control function within the CSF. This information consists of the received congestion level information and the route identification to which the REL applies.

If the automatic congestion level procedure is not implemented, the Automatic Congestion Level parameter is not acted upon and discarded as normal.

Automatic congestion level actions are applicable only at CSFs adjacent to the congested CSF. Therefore, a CSF that receives a REL containing an Automatic Congestion Level parameter should discard that parameter after notifying the network management/overload control function.

12.8.2 Actions taken during overload

Whenever a CSF is in an overload state (congestion level 1 or 2), the signalling system independent-network management/overload control function will indicate that the CSF should include an Automatic Congestion Level parameter in every REL transmitted.

The network management/overload control function will indicate which congestion level (1 or 2) to code in the Automatic Congestion Level parameter.

When the overload condition has ended the network management/overload control function will indicate that the CSF should cease including Automatic Congestion Level parameters in the transmitted RELs.

12.9 Signalling transport out-of-service and in-service indications

The OUT-OF-SERVICE.indication and IN-SERVICE.indication primitives may be received from the STC, see ITU-T Q.2150.0.

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

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

12.10 Signalling transport congestion indications

The CONGESTION.indication primitive may be received from the STC, see ITU-T Q.2150.0. The traffic load for the associated signalling relation should be adjusted according to the value of the Level parameter received in the primitive.

13 Abnormal conditions

13.1 Introduction

This clause includes procedures for the handling of events not expected during normal operation.

13.2 Dual seizure

CIC values for use across a signalling association may be allocated in two different ways:

1)   The provisioned set of CIC values may be divided into two parts: one set selectable by one CSF and the remainder selectable by the other CSF. This scheme avoids the possibility of dual seizure of a CIC value, or,

2)   a common set of CIC values may be provisioned, i.e. either CSF can select any provisioned value. In this case it is possible that the two CSFs will attempt to seize the same CIC value at approximately the same time.

Clauses 13.2.1 to 13.2.4 apply only when the second method of CIC provisioning is used.

13.2.1 Unguarded interval

The CSF must detect dual seizure and take action as defined in 13.2.4.

13.2.2 Detection of dual seizure

A dual seizure is detected by a CSF from the fact that it receives an IAM for a CIC value for which it has sent an IAM, but before it receives a valid backward message.

13.2.3 Preventive action

Different methods for CIC selection can be envisaged to minimize/remove the occurrence of dual seizure. The following method is defined:

An opposite order of CIC value selection is used at each CSF.

(Other methods for CIC value selection may also be used provided that they give the same degree of protection against dual seizure also when the method specified above is used at the other end.)

13.2.4 Action to be taken on detection of dual seizures

In the event of dual seizure, one CSF will be the control CSF and the other the non-control CSF. On detection of a dual seizure, the call being processed by the control CSF will be completed and the received IAM will be disregarded. If the IAM has been segmented using a Segmentation message, then this second segment will also be disregarded. Any following SAM(s) will also be disregarded.

Under these conditions, the call being processed by the control CSF will be allowed to mature. The call being processed by the non-control CSF will be backed off and the internal bearer path disconnected (if applicable). A REL will not be sent. The non-control CSF will make an automatic repeat attempt on the same or on an alternative route.

The control CSF will be determined as follows:

Each CSF will control one half of the CIC values. One CSF will control all even-numbered CICs and the other CSF the odd-numbered CICs. Each CSF will examine the CIC_control parameter in the START-INFO.indication primitive from the STC, see ITU-T Q.2150.0 to determine whether it controls odd or even CIC values per signalling association.

13.3 Reset of CICs

In systems which maintain call status in memory, there may be occasions when the memory becomes mutilated. In such a case the CIC values and associated resources must be reset to the idle condition at both CSFs to make them available for new traffic. Since the CSF with the mutilated memory does not know whether the CIC values are idle, busy outgoing, busy incoming, blocked, etc., Reset CIC messages or a CIC Group Reset message should be sent as appropriate for the affected CIC values.

13.3.1 Reset CIC procedure

If only a few CIC values are concerned, a Reset CIC message should be sent for each affected CIC value. Reception of the Reset CIC acknowledgement message (RLC) is guarded by timers T16 and T17. Expiry of these timers is covered in 13.7.1.

On receipt of a Reset CIC message the receiving (unaffected) CSF will:

a) if it is the incoming or outgoing CSF on a call in any state of call set-up or during a call, accept the message as a REL message and respond by sending a RLC message, after the CIC value has been made idle;

b) if the CIC value is in the idle condition, accept the message as a REL message and respond by sending a RLC message;

c) if it has previously sent a CIC Group Blocking message with the Status bit for this CIC value set to "1", or if it is unable to release the CIC value as described above, respond by the CIC Group Blocking message. If an incoming or outgoing call is in progress, this call should be released and the CIC value returned to the "idle, blocked" state. A RLC message is sent following the CIC Group Blocking message. The CIC Group Blocking message should be acknowledged by the affected CSF. If the acknowledgement is not received, the repetition procedure specified in 13.7 should be followed;

d) if it has previously received a CIC Group Blocking message with the Status bit for this CIC value set to "1", respond by releasing a possible outgoing call or call attempt using the CIC value, remove the blocked condition, restore the CIC value to the idle state, and respond with a RLC message;

e) if the message is received after the sending of an IAM, but before receipt of a backward message relating to that call, make an automatic repeat attempt using another CIC value if appropriate;

f)   if the message is received after having sent a Reset CIC message, respond by a RLC message. After receipt of the appropriate acknowledgement message, the CIC value should be made available for service;

g)   clear any interconnected call segments by the appropriate method:

  •   at an SN: any interconnected call segments shall be released (see 11.4);

  •   at a CMN: a Reset CIC shall be sent for any interconnected call segments[7];

h)   at an SN: issue a request to the BCF to reset any allocated bearer resources, associated with this CIC value.

The affected CSF will then reconstruct its memory according to the received response(s) to the Reset CIC and respond to the message(s) in the normal way, i.e. CIC Group Blocking Acknowledgement message in response to a CIC Group Blocking message.

13.3.2   Group reset procedure

If a considerable number of CIC values or all CIC values are affected by a memory mutilation, (a) CIC Group Reset message(s) should be used to make them available for new traffic.

Reception of the CIC Group Reset Acknowledgement message is guarded by timers T22 and T23. Expiry of these timers is covered in 13.7.2.

The maximum number of CIC values to be reset with a CIC Group Reset message is limited to 32.

On receipt of a CIC Group Reset message the receiving (unaffected) CSF will:

a)   restore the CIC values to the idle state;

b)   respond by a CIC Group Reset Acknowledgement message in which the Status indicator bits of the CIC values available for service are coded "0" and the status indicator bits of all CIC values blocked for maintenance reasons are set to "1";

c)   if it had previously received (a) CIC Group Blocking message(s) for one or more of the CIC value(s) involved, remove the blocked condition and make the CIC values available for service;

d)   if a CIC Group Reset message is received concerning CIC values for which a CIC Group Reset message or Reset CIC message(s) have been sent, make the CIC values concerned available for service after receipt of the appropriate acknowledgement message;

e)   clear any interconnected call segments by the appropriate method:

  •   at an SN: any interconnected call segments shall be released (see 11.4);

  •   at a CMN: a Reset CIC, or CIC Group Reset shall be sent for any interconnected call segments[7];

f)   at an SN: issue (a) request(s) to the BCF to reset any allocated bearer resources, associated with the reset CIC values.

The affected CSF will then reconstruct its memory according to the possibly received CIC Group Blocking messages and the received CIC Group Reset Acknowledgement message. It will respond to the possibly received CIC Group Blocking messages in the normal way.

A correct acknowledgement should match the original CIC Group Reset message in range and CIC value. The CIC value of both CIC Group Reset messages and CIC Group Reset Acknowledgement messages should be provisioned for BICC.

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[7] The reset request needs to be relayed through a CMN to ensure that bearer resources are released at the peer SN. The CSF sending reset may not be able to release the bearer resources, depending on the error causing the reset, and the sending of REL would not ensure that a receiving SN will release the bearer.

All CIC values in the range of a CIC Group Reset and CIC Group Reset Acknowledgement message must be provisioned for BICC.

13.3.3 Abnormal group reset procedures

i)   If a CIC Group Reset message is received indicating reset of more CIC values than allowed by the receiving CSF, it is discarded.

ii)   If a CIC Group Reset Acknowledgement message is received which is not a correct response to a sent CIC Group Reset message, it is discarded.

iii)   If a CIC Group Reset message is received requesting reset of CIC values that are not provisioned, or a CIC Group Reset Acknowledgement message that contains CIC values that are not provisioned, the message is discarded.

13.4   Receipt of unreasonable signalling information

The message transport service provided by the STC and its lower layers avoids mis-sequencing, or double delivery, of messages with a high reliability (e.g. see ITU-T Q.706). However, undetected errors at the lower message transport layers and CSF malfunctions may produce signalling information messages that are either ambiguous or inappropriate.

Unreasonable or unexpected signalling information may also be received at a CSF due to differing levels of signalling protocol enhancements at different CSFs within a network: a CSF using a more enhanced version of the protocol may send information to a less enhanced CSF which is outside the protocol definition supported at that CSF.

The degree of applicability of the procedures below at CSFs where there are differences between the capabilities of the incoming and outgoing signalling systems, e.g. between the national and international sides of a gateway, is for further study.

The procedures listed below do not include the procedures for group blocking and group reset, these are covered in 12.5 and 13.3 respectively.

13.4.1 Handling of message format errors

The following are considered message format errors:

a)   The message length is less than the number of octets required for the fixed mandatory part, the mandatory variable pointers and the start of optional parameters pointer.

b)   A mandatory variable or start of optional parameter's pointer points beyond the message length.

c)   A mandatory variable or optional parameter's length indicator causes the overall message length to be exceeded.

When a message format error is detected the message shall be discarded.

NOTE – A format error can only be detected when the message is recognized.

For the purposes of format error detection, the message length may be interpreted as either:

i)   received message length; or

ii)   maximum message length as indicated by the STC in the START-INFO.indication primitive (e.g. 272 octets).

Interpretation i) is preferred as it will detect errors which may not be found by interpretation ii). However, the STC TRANSFER.indication does not contain the received message length.

13.4.2 Handling of unexpected messages

An unexpected message is one which contains a message type code that is within the set supported at this CSF, but is not expected to be received in the current state of the call.

In order to resolve possible ambiguities in the state of a CIC when unexpected messages are received the following will apply:

a)   if a REL is received relating to an idle CIC value it will be acknowledged with a RLC;

b)   if a RLC is received relating to an idle CIC value it will be discarded;

c)   if a RLC is received relating to a CIC value that is in use for a call, and a REL has not been sent, the call will be released and a REL will be sent;

d)   if a Segmentation message is received with a CIC value that is in use for a call, in case the segmentation has not been announced in the Simple Segmentation Indicator the Segmentation message shall be discarded;

e)   if other unexpected signalling messages are received, the following actions will be undertaken:

–   if the CIC value is idle, the Reset CIC message is sent;

–   if the CIC value is in use for a call, after receipt of a backward message required for the call set-up, the unexpected signalling message is discarded, except in certain cases, see item c);

–   if the CIC value is in use for a call, before receipt of a backward message required for the call set-up, the Reset CIC message is sent. If the CIC is in use for an incoming call, any interconnected call segment will be released. If the CIC is in use for an outgoing call, an automatic repeat attempt is provided using another CIC value.

f)   If a message is received with a CIC value that is not provisioned within the CSF it shall be discarded, however if the CSF supports the national option using the Unequipped CIC message (13.5), that procedure shall be performed instead.

13.4.3   General requirements on receipt of unrecognized messages and parameters

It may happen that a CSF receives unrecognized. messages, parameter types or parameter values. This can typically be caused by the upgrading of the signalling system used by other CSFs in the network. In these cases, the following compatibility procedures are invoked to ensure the predictable network behaviour.

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

a)   compatibility information received in the same message as the unrecognized information;

b)   the Confusion message;

c)   the Release message;

d)   the Release Complete message;

e)   the Facility Reject message; or

f)   the Cause Indicators parameter; the following cause values are used:

–   #97 "*message type non-existent or not implemented, discarded*";

–   #99 "*information element/parameter non-existent or not implemented, discarded*";

–   #103 "*parameter non-existent or not implemented, passed on*" (Note 1);

–   #110 "*message with unrecognized parameter, discarded*".

NOTE 1 – This Cause value may be received from a *Blue Book* (1988) ISDN User Part, but will not be generated from later versions of the ISDN User Part or from BICC.

For all the above cause values a Diagnostic field is included containing, dependent on the Cause value, either the unrecognized parameter name(s), the message type code, or the message type code and the unrecognized parameter name(s).

The procedures are based on the following assumptions:

i) The forward compatibility information contains different instructions for different CSFs. There are two types of CSFs, type A and type B CSFs. The classification of type A and B CSFs to the functional type a CSF may perform is listed below. It is determined on a per call basis. The classification of a CSF to the functional type can change during a call due to, for example, supplementary services.

Type A

– The CSF at an originating SN, i.e. the CSF in which the call is generated from a national public network point of view.

– The CSF at a destination SN, i.e. the CSF to which the call is destined from a national public network point of view.

– The CSF at an interworking SN, i.e. the CSF in which interworking is performed between BICC and other signalling systems.

  NOTE 2 – An ISN where BICC interworks to ISUP is not considered an interworking SN in this context.

– The CSF at an incoming or outgoing gateway SN or CMN (Note 3).

  NOTE 3 – In an incoming or outgoing gateway SN/CMN, the instruction to pass on a message or a parameter does not preclude the normal policing functions of these SNs.

– The CSF at a gateway ISN where ISUP interworks with BICC.

Type B

– The CSF at a national or international intermediate SN or CMN, i.e. an SN/CMN that acts just as a transit node.

– The CSF at a national or international intermediate ISN where ISUP interworks with BICC.

ii) Since type A and type B CSFs can be both national and international CSFs, the compatibility mechanism is applicable to the national and international network.

iii) If a CSF receives a Confusion, a REL, a RLC or Facility Reject message indicating an unrecognized message or parameter received, it assumes interaction with a CSF at a different functional level. See 13.4.5 for more details on this.

iv) All unrecognized messages that can be received only contain parameters coded as optional parameters, no "new" messages will contain mandatory fixed or mandatory variable parameters.

If messages are received without compatibility information and are not recognized, they are discarded and the Confusion message is sent.

When an unrecognized parameter or message is received, the CSF should find some corresponding instructions contained in the Parameter Compatibility Information or Message Compatibility Information parameters respectively. The Parameter Compatibility Information parameter may contain compatibility instructions for more than one parameter. The Message Compatibility Information parameter contains the instructions specific for the handling of the complete message.

If the CSF does not find instructions in an appropriate compatibility parameter or if the compatibility parameter is not found in the message, the actions default to a basic action. Details of this are found in 13.4.4.

The instruction indicators are a set of Boolean indicators. The following general rules apply to the examination of these instruction indicators:

i) Depending on the role of the CSF in the call, i.e. type A or type B, and the settings of the indicators only a subset of the indicators are examined, some being ignored.

Only type B CSFs examine the Transit at Intermediate Exchange Indicator. If it is set to "*Transit Interpretation*", the other indicators are ignored. If it is set to "*End Node Interpretation*", the actions in accordance with the setting of the remaining indicators are performed.

Type A CSFs always interpret the remaining indicators, i.e. all indicators except the Transit at Intermediate Exchange indicator.

Consequently, "*End Node Interpretation*" means that all kinds of CSFs, i.e. type A and type B, have to interpret the instruction indicators.

ii) Instruction indicators marked as "*spare*" are not examined. They may be used by future versions of BICC; in this case the future version of BICC will set the currently defined instruction indicators to a reasonable value for the current version. This rule ensures that more types of instructions can be defined in the future without creating a backward compatibility problem.

iii) A CSF must decide what CSF type it is for the call before performing compatibility actions.

iv) At a type B CSF the unrecognized information should be passed on unchanged, if the Transit at Intermediate exchange Indicator is set to "*Transit Interpretation*".

v) At a type B CSF that has not been instructed to pass on the unrecognized information, if the Release Call Indicator is set to "*Release Call*", the call is released.

At a type A CSF, the call is released if the Release Call Indicator is set to "*Release Call*".

vi) At a type B CSF that has not been instructed to pass on the unrecognized information or at a type A CSF, in any case the following is applicable if the Release Call Indicator is set to "*Do Not Release Call*":

– if the Discard Message Indicator, or the Discard Parameter Indicator is set to "*Discard Message/Discard Parameter*", the message or parameter is discarded, as instructed,

– and then, if the Send Notification Indicator is set to "*Send Notification*", a Confusion message is sent towards the CSF that sent the unrecognized information.

vii) For the case of an unrecognized parameter it is possible for the instruction to require that either the unrecognized parameter or the whole message is discarded. This provides for the case where the sending CSF determines that it is not acceptable for the message to continue being processed without this parameter.

viii) In case a parameter is included more than once in the same message, the instruction indicator of the Parameter Compatibility Information parameter is set according to the most stringent combination of the possible codings (i.e. the coding "1" of a bit in the instruction indicator is dominant).

ix) In case a message is used for more than one procedure related to the same call, and the codings of the instruction indicator of the Message Compatibility Information parameter described in the corresponding texts are different, the instruction indicator is set according to the most stringent combination of the possible codings (i.e. the coding "1" of a bit in the instruction indicator is dominant).

x) At a type A CSF where "pass on" has been specified for a message or parameter and "pass on" is not possible, then the Pass On Not Possible Indicator and Send Notification Indicator are checked.

xi) In case of, for example, a repeat attempt if a Confusion message is sent or passed on with the indication that a parameter of an IAM is discarded, this parameter shall not be sent in a new IAM.

xii) If a CSF applies the instruction "discard message" according to the Parameter Compatibility Information parameter, it should discard the first segment and its possible associated Segmentation message whenever timer T34 has been started.

xiii)   If unrecognized information is received when interworking with B-ISUP, the Broadband/narrow-band Interworking Indicator is checked.

xiv)   Tables 2 and 3 clarify the handling of the received compatibility information:

Table 2/Q.1902.4 – On receipt of Message Compatibility Information parameter

Instruction indicator			Required action
B	**C**	**D**	
0	X	0	Pass on message (Notes 1, 2 and 3)
0	0	1	Discard message
0	1	1	Discard message and send notification
1	X	X	Release call (Note 1)

Bit
<u>B</u>   *Release call indicator*
0   Do not release call
1   Release call

<u>C</u>   *Send notification indicator*
0   Do not send notification
1   Send notification

<u>D</u>   *Discard message indicator*
0   Do not discard message (pass on)
1   Discard message

If pass on is set (bit D = 0) but not possible then bits C and E are checked.

Bit
<u>E</u>   *Pass on not possible indicator*
0   Release call
1   Discard information

Bits
<u>GF</u>   *Broadband/narrow-band interworking indicator*
00   Pass on
01   Discard message
10   Release call
11   Reserved, assume "00"

NOTE 1 – "x" = don't care.

NOTE 2 – Applicable to type B CSFs and CSFs at incoming or outgoing international gateway SN/CMNs. Other CSFs (e.g. originating, terminating, interworking) check bit E to determine the required action.

NOTE 3 – In case of passing on a message, no notification is sent, bit C is ignored.

Table 3/Q.1902.4 – On receipt of parameter compatibility information parameter

Instruction indicator				Required action
B	**C**	**D**	**E**	
0	X	0	0	Pass on parameter (Notes 1 and 2)
0	0	0	1	Discard parameter
0	0	1	0	Discard message
0	0	1	1	Discard message
0	1	0	1	Discard parameter and send notification
0	1	1	0	Discard message and send notification
0	1	1	1	Discard message and send notification
1	X	X	X	Release call (Note 1)

Bit
<u>B</u>   *Release call indicator*
0   Do not release call
1   Release call

<u>C</u>   *Send notification indicator*
0   Do not send notification
1   Send notification

<u>D</u>   *Discard message indicator*
0   Do not discard message (pass on)
1   Discard message

<u>E</u>   *Discard parameter indicator*
0   Do not discard parameter (pass on)
1   Discard parameter

If pass on is set (bit D = 0 and bit E = 0) but not possible, bits C, F and G are checked.

Bits
<u>GF</u>   *Pass on not possible indicator*
00   Release call
01   Discard message
10   Discard parameter
11   Reserved in 1993 version, assume "00"

<u>JI</u>   *Broadband/narrow-band interworking indicator*
00   Pass on
01   Discard message
10   Release call
11   Discard parameter

NOTE 1 − "x" = don't care.

NOTE 2 − Applicable to type B CSFs and CSFs at incoming or outgoing international gateway SN/CMNs. Other CSFs (i.e. originating, terminating, interworking) shall check Bits G and F to determine the required action.

13.4.4   Procedures for the handling of the unrecognized messages or parameters

Messages and parameters that are indicated as "ISUP only" in ITU-T Q.1902.3 shall be treated as unrecognized.

A Confusion message must not be sent in response to a received Confusion, Facility Reject, REL or RLC message. Any unrecognized parameters received in a Confusion, Facility Reject or RLC message are discarded. Any unrecognized mandatory parameter value received in a Confusion or Facility Reject message will result in the message being discarded.

13.4.4.1 Unrecognized messages

1) *Actions at type A CSFs*

   a) Compatibility parameter received

   Depending on the instructions received in the Message Compatibility Information parameter, a type A CSF receiving an unrecognized message will either:

   – transfer the message transparently (Note);

   – discard the message;

   – discard the message and send Confusion; or

   – release the call.

   NOTE – The transparent passing of a message is only applicable when the signalling is ISUP'92 or a later version, or BICC.

   A REL and a Confusion message shall include the cause value #97, "*message type non-existent or not implemented-discarded*", followed by a Diagnostic field containing the message type code.

   b) Compatibility parameter not received

   If an unrecognized message is received without Message Compatibility Information parameter at a CSF, the message is discarded and a Confusion message is returned. A Confusion message shall include the cause value #97, "*message type non-existent or not implemented – discarded*", followed by a Diagnostic field containing the message type code.

2) *Actions at type B CSF*

   a) Compatibility parameter received

   Depending on the instructions received in the Message Compatibility Information parameter, a type B CSF receiving an unrecognized message will either:

   – transfer the message transparently;

   – discard the message;

   – discard the message and send Confusion; or

   – release the call.

   A Confusion message shall include the cause value #97, "*message type non-existent or not implemented-discarded*", followed by a Diagnostic field containing the message type code.

   A REL message shall include the cause value #97, "*message type non-existent or not implemented – discarded*", followed by a Diagnostic field containing the message type code.

   b) Compatibility parameter not received

   If an unrecognized message is received without Message Compatibility Information parameter at a CSF, the message is discarded and a Confusion message is returned. A Confusion message shall include the cause value #97, "*message type non-existent or not implemented-discarded*", followed by a Diagnostic field containing the message type code.

13.4.4.2 Unrecognized parameters

Receipt of unrecognized parameters can only refer to optional parameters, since mandatory parameters will always be recognized by their location in a message.

Unexpected parameters (a parameter in the "wrong" message) are handled like unrecognized parameters.

i) *Actions at type A CSF*

   a) Compatibility parameter received

     Depending on the instructions received in the Parameter Compatibility Information parameter, a type A CSF receiving an unrecognized parameter will either:

     – transfer the parameter transparently;

     – discard the parameter;

     – discard the message;

     – discard the parameter and send Confusion;

     – discard the message and send Confusion; or

     – release the call.

     NOTE – The transparent passing of a parameter is only applicable when the signalling is ISUP'92 or a later version, or BICC.

     A Confusion message shall include the cause value #99, "*information element/parameter non-existent or not implemented-discarded*", followed by a Diagnostic field containing the parameter name, or #110, "*message with unrecognized parameter-discarded*", followed by a Diagnostic field containing the message name and the name of the first detected unrecognized parameter which caused the message to be discarded. A Confusion message may refer to multiple unrecognized parameters.

     A REL message shall include the cause value #99, "*information element/parameter non-existent or not implemented-discarded*", followed by a Diagnostic field containing the parameter name.

     If an unrecognized parameter is received in a Facility Request message, the parameter is handled like unrecognized parameters in other messages.

     If a REL message is received containing an unrecognized parameter, depending on the instructions received in the compatibility information parameter, a type A CSF will either:

     – discard the parameter; or

     – discard the parameter and send a cause #99, "*information element/parameter non-existent or not implemented-discarded*", in the RLC message.

   b) Compatibility parameter not received

     If a CSF receives and detects an unrecognized parameter without a Parameter Compatibility Information parameter, the actions taken will be dependent on whether the unrecognized parameter is passed on or discarded. If the unrecognized parameter is discarded, a Confusion message is sent to the CSF from which the unrecognized parameter was received. The Confusion message contains the cause value #99, "*information element/parameter non-existent or not implemented-discarded*", followed by a Diagnostic field containing the parameter name. A Confusion message may refer to multiple unrecognized parameters. If the unrecognized parameter is passed on unmodified, no subsequent actions are necessary.

     If a Facility Request message is received with unrecognized parameters, the message is discarded and a Facility Reject message is returned including the cause value #99, "*information element/parameter non-existent or not implemented-discarded*", followed by the parameter name code in the Diagnostic field.

If a REL message containing an unrecognized parameter is received at a type A CSF, a RLC message is returned including the cause value #99, "*information element/parameter non-existent or not implemented-discarded*".

ii) *Actions at type B CSF*

   a) Compatibility parameter received

   Depending on the instructions received in the Parameter Compatibility Information parameter, a type B CSF receiving an unrecognized parameter will either:

   – transfer the parameter transparently;

   – discard the parameter;

   – discard the message;

   – discard the parameter and send Confusion;

   – discard the message and send Confusion; or

   – release the call.

   A Confusion message shall include the cause value #99, "*information element/parameter non-existent or not implemented-discarded*", followed by a Diagnostic field containing the parameter name, or #110, "*message with unrecognized parameter-discarded*", followed by a Diagnostic field containing the message name and the name of the first detected unrecognized parameter which caused the message to be discarded. A Confusion message may refer to multiple unrecognized parameters. If the unrecognized parameter is passed on unmodified, no subsequent actions are necessary.

   A REL message shall include the cause value #99, "*information element/parameter non-existent or not implemented-discarded*", followed by a Diagnostic field containing the parameter name.

   If an unrecognized parameter is received in a Facility Request message, the parameter is handled like unrecognized parameters in other messages.

   Depending on the instructions received in the Parameter Compatibility Information parameter, a CSF receiving an unrecognized parameter in a REL message will either:

   – transfer the parameter transparently;

   – discard the parameter; or

   – discard the parameter and send a cause #99, "*information element/parameter non-existent or not implemented − discarded*", in the RLC message.

   b) Compatibility parameter not received

   If a CSF receives and detects an unrecognized parameter without a Parameter Compatibility Information parameter, the actions taken will be dependent on whether the unrecognized parameter is passed on or discarded. If the unrecognized parameter is discarded, a Confusion message is sent to the CSF from which the unrecognized parameter was received. The Confusion message contains the cause value #99, "*information element/parameter non-existent or not implemented-discarded*", followed by a Diagnostic field containing the parameter name. A Confusion message may refer to multiple unrecognized parameters. If the unrecognized parameter is passed on unmodified, no subsequent actions are necessary.

   If a Facility Request message is received with unrecognized parameters, the message is discarded and a Facility Reject message is returned including the cause value #99, "*information element/parameter non-existent or not implemented-discarded*", followed by the parameter name code in the Diagnostic field.

If a REL message containing an unrecognized parameter that cannot be passed on is received at a type B CSF, a RLC message is returned including the cause value #99, "*information element/parameter non-existent or not implemented-discarded*".

13.4.4.3 Unrecognized parameter values

Any parameter values marked as "spare", "reserved" or "national use" in ITU-T Q.1902.3 may be regarded as unrecognized.

If a CSF receives and detects a recognized parameter, but the contents are unrecognized, then the actions are as defined as below:

a)   *Unrecognized mandatory parameter values*

Unrecognized mandatory parameter values can only occur for parameters defined in messages of the *Blue Book* 1988 ISDN User Part. BICC does not contain any mandatory parameters in new messages.

If a CSF receives and detects an unrecognized mandatory parameter value, the actions taken in the different types of CSFs will be dependent on Tables A.1 and A.2/Q.1902.3.

If a Facility Request message is received with unrecognized mandatory parameter value(s) the actions to be taken are described in the above mentioned tables, i.e. the message is discarded and a Facility Reject message is returned including the cause value #99, "*information element/parameter non-existent or not implemented − discarded*", followed by the parameter name code in the Diagnostic field indicating the first detected unrecognized parameter.

If a REL message is received with unrecognized mandatory parameter value(s) the actions to be taken are described in the above mentioned tables.

b)   *Unrecognized optional parameter values*

The procedures as stated for unrecognized parameters apply. There is no specific compatibility information field for each parameter value. For all parameter values contained in a parameter, the compatibility information of the parameter applies.

If unrecognized parameter values are received and detected in optional parameters which are already defined in *Blue Book* ITU-T Q.763, the actions taken will be dependent on the tables contained in ITU-T Q.1902.3.

13.4.5 Procedures for the handling of responses indicating unrecognized information has been sent

13.4.5.1 Type A CSFs

CSF action taken on receipt of these messages at an originating or terminating SN will depend on the call state and the affected service.

The definition of any procedure that is outside the basic call set-up protocol, as defined in this Recommendation, should include procedures for handling responses that indicate that another CSF has received, but not recognized, information belonging to that procedure. The procedure receiving this response should take the appropriate actions.

The default action taken on receipt of a Confusion message is to discard the message without disrupting normal call processing.

13.4.5.2 Type B CSFs

i)   *Confusion (message type non-existent or not implemented-discarded)*

A CSF receiving Confusion (message type non-existent or not implemented-discarded) has to determine the appropriate subsequent actions as described for type A CSFs in the above clause.

ii)   *Confusion (parameter non-existent or not implemented-discarded, or passed on)*

The actions taken at a type B CSF, on receipt of a Confusion message will depend on whether the CSF has the functionality to generate the parameter identified in the diagnostic field:

a) If the CSF does not have the functionality to generate the parameter, the decision on what action should be taken is deferred to a CSF that does contain this functionality. This is achieved by passing the Confusion message transparently through the type B CSF.

b) If this CSF does have the functionality to generate the parameter, the procedural element that created or modified the information should determine any subsequent actions, as described for type A CSFs above.

iii)   *Facility Reject*

If a type B CSF does not have the capability to take action on receipt of Facility Reject, it should pass the message transparently to the preceding or succeeding CSF.

iv)   *Release and Release Complete*

Action taken on receipt of a REL or a RLC message with cause indicating unrecognized information is as for the normal procedures for these messages.

The above actions are summarized in Table 4.

Table 4A/Q.1902.4 – Handling of responses indicating unrecognized information has been sent

	CSF has the functionality to generate the information			
	Cause			
Message	Parameter discarded	Parameter passed on	Message discarded	Message passed on
Confusion	(Procedure dependent action)			
Facility reject	Normal procedures	Procedure depend. Action	Not applicable	Not applicable
Release	Normal procedures	Not applicable	Not applicable	Not applicable
Release complete	Normal procedures	Normal procedures	Not applicable	Not applicable

Table 4B/Q.1902.4 – Handling of responses indicating unrecognized information has been sent

	CSF does not have the functionality to generate the information			
	Cause			
Message	Parameter discarded	Parameter passed on	Message discarded	Message passed on
Confusion	Defer action (transit Confusion)			
Facility reject	Defer action (transit)			
Release	Normal procedures	Not applicable	Not applicable	Not applicable
Release complete	Normal procedures	Normal procedures	Not applicable	Not applicable

13.4.6 Procedures for handling unreasonable parameters

If a message is received that

a)   is of valid type, i.e. it is not unexpected or unrecognized as described in 13.4.2 and 13.4.4.1; and

b)   it contains parameters of recognized type and value, i.e. the procedures in 13.4.4.2 do not apply,

it is still possible that the contents of the message are unreasonable. This can be as a result of conflicting information within the message. This situation should be handled by assuming the lower network capability for the affected parameter.

13.4.7 Handling of the BICC_Error indication primitive

On reception of a BICC_Error indication primitive containing an error notification indicating "*unidentified context/addressing error*", the call shall be released with cause value #79, "*service or option not implemented, unspecified*", and the maintenance system shall be notified.

On reception of a BICC_Error indication primitive containing an error notification indicating "*reassembly error*", the call shall be released with cause value #111, "*protocol error, unspecified*", and the maintenance system shall be notified.

On reception of a BICC_Error indication primitive containing an error notification indicating "*unrecognized information*", the Compatibility procedure in 13.4.8 applies.

13.4.8 Compatibility for the BICC APM user application

13.4.8.1 General requirements on receipt of unrecognized information elements

It may happen that a node receives unrecognized information element types or subfield values. This can typically be caused by the upgrading of the 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.

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 can not be passed on. The following general rules apply to the interpretation of these instruction indicators:

a) "Reserved" subfields of the compatibility field are not examined. They may be used by future capability sets of this 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 CSF for this call. If the ability to "*pass-on*" is not possible at a CSF, then the instruction indicators "*pass-on not possible*" are examined.

   NOTE – Examples of where "pass-on" might not be possible are: At ISNs, or in GSN between different operators, where "pass-on" might depend on bilateral agreements.

e) For the case of an unrecognized information element, it is possible for the instruction to require that either the unrecognized information element or all the information elements relating to received APP parameter containing the information element is discarded. This provides for the case where the sending node determines that it is not acceptable for the APP parameter to continue being processed without this information element.

13.4.8.2 Procedures for the handling of unrecognized information elements

13.4.8.2.1 Unrecognized information elements

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

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

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

a) release the call;

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

c) discard all the associated information elements;

d) discard the information element and send notification;

e) discard the information element; or

f) transfer the information element transparently.

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

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

The Index subfield shall be coded as follows:

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

1)   For a "Simple" information element, see 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 PRI message) towards the node that sent the unrecognized information element, including the Report Reason "*information element non-existent or not implemented*" followed by a Diagnostic field containing the Information Element Identifier (of the first detected unrecognized information element which caused the call to be released) and the Index subfield.

If a BICC_Error indication primitive indicating "*unrecognized information*" is received relating to a PRI message, depending on the instructions received in the Information Element Compatibility field the node will either:

a)   discard all the associated information elements;

b)   discard the information element; or

c)   transfer the information element transparently.

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

No BAT Compatibility Report information element is sent for unrecognized information inside a PRI message or for unrecognized information inside a BAT Compatibility Report information element inside a BICC_Data indication primitive.

13.4.8.2.2 Unrecognized fields

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

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

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

a) If the CSF does not have the functionality to generate the information element, the decision on what action should be taken is deferred to a CSF that does contain this functionality. This is achieved by passing the BAT Compatibility Report information element transparently through the CSF.

b) If this CSF does have the functionality to generate the information element, the procedural element that created or modified the information should determine any subsequent actions.

The default action taken on receipt of a BAT Compatibility Report information element is to discard the primitive containing the BAT Compatibility Report without disrupting normal call processing.

13.4.8.4 Handling of unexpected values

If a BICC_Data indication primitive is received with an Action indicator value that is not expected the following actions shall be taken:

− If the set-up procedure, (incoming or outgoing, as appropriate), has not been completed the Reset procedure, 13.3, shall be invoked. Any associated call segment shall be released with cause #111, "*Protocol error, unspecified*".

− If the set-up procedure, (incoming or outgoing, as appropriate), has been completed the Action indicator is treated as unrecognized, see 13.4.8.2.

13.5 Unequipped CIC message (national use)

An Unequipped CIC message is sent by a CSF in response to either the reception of an IAM, a CIC supervision message, or a CIC group supervision message on which it is unable to act as a consequence of its inability to perform a CIC translation.

If an Unequipped CIC message is received for a CIC value for which an IAM has been transmitted, the receiving CSF shall:

1) remove the indicated CIC value from the service and report the CIC value to the maintenance system for maintenance action;

2) re-attempt the call using another CIC value providing the rejected attempt was a first attempt. If the rejected attempt was a second attempt, either a REL message should be returned, or a recorded announcement connected.

If an Unequipped CIC message is received in response to the transmission of a CIC supervision message the CIC value should be removed from the service and the CIC value reported to the maintenance system for maintenance action.

A CSF, receiving a CIC group supervision message whose CIC value is not provisioned, should respond with a Unequipped CIC message for the CIC value received. This in effect is the acknowledgement to the initial message. A CSF receiving a CIC group message where the CIC is provisioned but one or more of the CIC values indicated by the range field is not provisioned merely responds in the manner that it would have if the CIC were equipped. The unequipped state of the CIC(s) will be recovered when an IAM, or CIC Group Query message is received for the affected CIC(s).

A CSF, receiving an Unequipped CIC message after having transmitted a CIC group supervision message removes the indicated CIC value from service, assumes the regular acknowledgement message will not be received and treats the other CIC values as though the responding CSF had not taken the action on the affected CIC values indicated in the initial message.

13.6 Overlength messages

If a sending CSF detects that a message to be sent exceeds the octet limit of the underlying message transport mechanism as indicated by the START-INFO.indication primitive received from the STC, see ITU-T Q.2150.0, and the message is not able to be segmented or segmentation has already been applied, then the User-to-User Information parameter (if present) should first be discarded followed by all unrecognized optional parameters to bring the message to within the indicated octet limit.

13.7 Timer expiries

13.7.1 Failure in the Reset CIC procedure

If no RLC message is received in acknowledgement to the Reset CIC message before 15-60 seconds (T16) the Reset CIC message should be repeated. If an acknowledgement for the message is not received within 5-15 minutes (T17) after the initial Reset CIC message, the maintenance system should be notified. However, the sending of the Reset CIC message should continue at 5-15 minutes (T17) intervals until maintenance intervention occurs.

13.7.2 Failure in the Group Reset procedure

If no acknowledgement to a CIC Group Reset message is received before 15-60 seconds (T22) the CIC Group Reset message should be repeated. If an acknowledgement for the CIC Group Reset message is not received within 5-15 minutes (T23) after sending the initial CIC Group Reset message the maintenance system should be notified. However, the sending of the CIC Group Reset message should continue at 5-15 minutes (T23) intervals until maintenance intervention occurs.

13.7.3 Failure in the blocking/unblocking sequence

A CSF will repeat the CIC Group Blocking (Unblocking) message on failure to receive the appropriate acknowledgement in response to one of these messages before 15-60 seconds (T18, T20 appropriately). (See 12.5.)

If the appropriate acknowledgement is not received within a period of 5-15 minutes (T19, T21 appropriately) after sending the initial CIC Group Blocking (Unblocking) message, the maintenance system should be alerted, the repetition of the CIC Group Blocking (Unblocking) message should be continued at the intervals specified by T19 and T21, respectively, until maintenance intervention occurs and the CIC value(s) taken out of (returned to) service as appropriate.

13.7.4 Failure to receive a Release Complete message – Timer T1 and T5

If a RLC is not received in response to a REL before expiry of timer (T1) the CSF will retransmit the REL message, and indicate call release to the BCF, see 11.5 b).

On transmitting the initial REL message, a 5-15 minute timer (T5) is started. If no RLC is received on the expiry of this timer (T5), the CSF shall:

i)   send a Reset CIC message;

ii)   alert the maintenance system;

iii)   remove the CIC value from service;

iv)   continue the sending of the Reset CIC message at 5-15 minute intervals until maintenance action occurs.

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

If a response is not received in response to an Information Request message before timer T33 expires, the CSF will release the call and the maintenance system may be informed.

ANNEX A

Timers

Table A.1/Q.1902.4 – Timers in the BICC basic call protocol

Symbol	Time-out value	Cause for initiation	Normal termination	At expiry	Reference
T1	15-60 seconds	When REL is sent	At receipt of RLC	Retransmit REL and start timer T1	11 13.7.4
T5	5-15 minutes	When initial REL is sent	At receipt of RLC	Send RSC, alert maintenance personnel and remove the CIC value from service, stop T1, start T17. Procedure continues until maintenance intervention occurs	11 13.7.4
T6	Covered in ITU-T Q.118	When controlling CSF receives SUS (network)	At receipt of RES (network) or REL	Initiate release procedure (cause #16)	10.2
T7	20-30 seconds	When the latest address message is sent	When the condition for normal release of address and routing information is met (receipt of ACM or CON)	Initiate release procedure	7.2 7.3 7.7
T8	10-15 seconds	When the CSF at an SN receives IAM indicating that COT is to be expected	At receipt of Continuity message	Initiate release procedure (cause #41)	7.6
T9	Interval specified in ITU-T Q.118	When national controlling or outgoing gateway CSF receives ACM	At the receipt of ANM	Initiate release procedure (cause #19)	7.7 7.8
T16	15-60 seconds	When RSC is sent, not due to expiry of T5	At the receipt of the acknowledgement (RLC)	Retransmit RSC and start T16	13.7.1
T17	5-15 minutes	When initial RSC is sent	At the receipt of the acknowledgement	Alert maintenance personnel, retransmit RSC, start T17, stop T16. Procedure continues until maintenance intervention occurs	13.7.1
T18	15-60 seconds	When Group Blocking message is sent	At receipt of Group Blocking Acknowledgement	Retransmit Group Blocking message and start T18	13.7.3

Table A.1/Q.1902.4 – Timers in the BICC basic call protocol

Symbol	Time-out value	Cause for initiation	Normal termination	At expiry	Reference
T19	5-15 minutes	When initial Group Blocking message is sent	At receipt of Group Blocking Acknowledgement	Retransmit Group Blocking message, alert maintenance personnel, start T19, stop T18. Procedure continues until maintenance intervention occurs	13.7.3
T20	15-60 seconds	When Group Unblocking message is sent	At receipt of Group Unblocking Acknowledgement	Retransmit Group Unblocking message and start T20	13.7.3
T21	5-15 minutes	When initial Group Unblocking message is sent	At receipt of Group Unblocking Acknowledgement	Retransmit Group Unblocking message, alert maintenance personnel, start T21, stop T20. Procedure continues until maintenance intervention occurs	13.7.3
T22	15-60 seconds	When Group Reset message is sent	At receipt of Group Reset acknowledgement	Retransmit Group Reset message and start T22	13.7.2
T23	5-15 minutes	When initial Group Reset message is sent	At the receipt of Group Reset acknowledgement	Alert maintenance personnel and start T23, retransmit Group Reset message, stop T22. Procedure continues until maintenance intervention occurs	13.7.2
T28	10 seconds	When send CQM	At receipt of CQR	Alert maintenance	12.6
T33	12-15 seconds	When send INR	On receipt of INF	Initiate release procedure, alert maintenance personnel	13.7.5
T34	2-4 seconds	When indication of a segmented message is received on an IAM, ACM, CPG, ANM or CON	At receipt of a Segmentation message	Proceed with call	12.2
T35	15-20 seconds	At receipt of the latest digit ($< >$ST) and before the minimum or fixed number of digits have been received	At receipt of ST or when the minimum or fixed number of digits have been received	Initiate release procedure (cause #28)	9.6

Table A.1/Q.1902.4 – Timers in the BICC basic call protocol

Symbol	Time-out value	Cause for initiation	Normal termination	At expiry	Reference
T38	Interval specified in ITU-T Q.118	When the incoming gateway CSF sends to the preceding CSF a SUS (network)	At receipt of RES (network) or REL	Initiate release procedure (cause #102)	10.2
T40	10 seconds	When out-of-band start signal (DTMF or tone) is sent and notification is requested	At receipt of positive or negative notification	Send notification to requesting side	8.20.2.1
T41	10 seconds	When out-of-band stop signal (DTMF or tone) is sent and notification is requested	At receipt of notification	"No action"	8.20.2.1
T42	5-30 seconds	When a modification is initiated during codec modification or mid-call codec negotiation procedures	At receipt of indication of successful or failed codec modification	Initiate release procedure	10.4
T43	5-30 seconds	When a mid-call codec negotiation is initiated	At receipt of successful or failed mid-call codec negotiation	Notify mid-call codec negotiation nodal functions	10.4

ANNEX B

Procedures for reuse of idle bearers (network option)

B.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 SN which originally set them up. The management of a set of idle bearers is therefore a local issue in the BCF which has established them.

•   This specification does not define the procedures used at the node which owns a network connection to determine whether and when network connections should be retained (left idle) and released.

•   To protect against the error case in which the node owning a network connection neglects to release it when it has not been 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 specification.

•   Reuse of idle bearers may not be applicable to all bearer technologies.

B.2   Procedures

The following procedures are applied, as increments to the BICC protocol, as described in the main body of this Recommendation.

B.2.1   Outgoing bearer set-up procedures

B.2.1.1   Reuse of forward idle bearer

During the forward bearer set-up procedure, 7.4.1, in response to the Bearer Set-up request, (item 2.3)), the BCF may indicate that an existing bearer is to be used for this call. In this case a BICC_Data request primitive is issued (corresponding to an APM message), with the following information:

•   BNC-ID (the value provided by the BCF indicating the connection to reuse);

•   Action indicator set to "*Use idle*".

The outgoing bearer set-up procedure awaits a BICC_Data indication primitive (corresponding to an APM message), with Action indicator set to "*Switched*".

The outgoing bearer set-up procedure is now successfully completed.

B.2.1.2   Reuse of backward idle bearer

During the backward bearer set-up procedure, 7.4.2, whilst awaiting a Bearer Set-up indication from the BCF (item 2)), reception of a BICC_Data indication primitive (corresponding to an APM message), including Action indicator set to "*Use idle*" indicates that an existing bearer is to be used for this call. In this case a request to 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 bearer set-up procedure.

2) If the BCF fails to accept this request the call instance is reset according to 13.3. (Use of reset causes the re-alignment of system resources.)

B.2.2 Incoming bearer set-up procedures

B.2.2.1 Reuse of forward idle bearer

During the forward bearer set-up procedure, 7.5.1, whilst awaiting a Bearer Set-up indication from the BCF (item 3)), reception of a BICC_Data indication primitive (corresponding to an APM message), containing Action indicator set to "*Use idle*", indicates that an existing idle bearer is to be used for this call. In this case a request to 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 bearer set-up procedure is now successfully completed.

2) If the BCF fails to accept this request the call instance is reset according to 13.3. (Use of reset causes the re-alignment of system resources.)

B.2.2.2 Reuse of backward idle bearer

During the backward bearer set-up procedure, 7.5.2, in response to the Bearer Set-up request, (item 2)), the BCF may indicate that an existing idle bearer is to be used for this call. In this case:

1) The response from the BCF indicates the BNC-ID to be used for the connection.

2) A BICC_Data request primitive is issued (corresponding to an APM message), including the following information:

   • BNC-ID (the value provided by the BCF indicating the connection to reuse).

   • Action indicator set to "*Use idle*".

3) When a BICC_Data indication primitive is received with Action indicator set to "*Switched*" incoming bearer set-up procedure is now successfully completed.

B.2.3 Continuity message

The procedure in 7.6 applies except that the completion of set-up of the bearer path is indicated by completion of the incoming bearer set-up procedure described in this annex, instead of the various bearer events listed in that clause.

B.2.4 Codec negotiation

Codec negotiation is not applicable when reusing idle bearers.

B.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 C

Test calls

C.1   Called number for test calls

This clause only describes the sending sequence of forward address information in the case of test calls based on bilateral agreements.

i)   Called party number:

- Nature of address indicator: 0000011 "*national significant number*".
- address:
    – access code N1 ... Nn based on bilateral agreements.
    – sending finished: ST.

ii)   Calling party's category:

00001101 "*test call*".

ANNEX D

Start-up procedures

D.1   Introduction

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

The purpose of the start-up procedure is to ensure that two CSFs have the same values of the CICs provisioned between them. A method of verifying this is the sending of (Group) Reset messages in both directions between the two CSFs. The CSFs have the same perception of their CIC connectivity if the proper acknowledgements are received.

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

The CIC start-up procedure is executed between two CSFs and consists of sending (Group) Reset messages in both directions. As an operational option, a test to verify that a bothway bearer path exists to the intended destination may be performed on selected CICs after the (Group) Reset messages have been acknowledged.

Abbreviations used in messages sequences:

ACM   Address Complete

ANM   Answer

GRA   Group Reset Acknowledgement

GRS   Group Reset message

IAM   Initial Address

RLC   Release Complete

## D.2 Procedure for putting CICs into service

CSF X ◄─────────────────────► CSF Y

and

```
        ───────GRS──────►        ◄──────GRS───────
        ◄──────GRA───────        ───────GRA──────►
```

or

```
        ◄──────GRS───────        ───────GRS──────►
```

and

```
        ───────GRA──────►        ◄──────GRA───────        T11112070-01
```
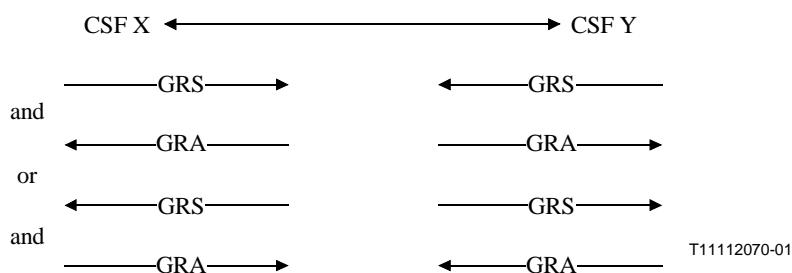
NOTE – It is also possible to have individual Reset CIC messages. The diagrams do not intend to cover all possible exchange of messages (see 13.3).

D.3 Test procedures

This clause describes a test procedure which may be used after the start-up of the CICs. As a minimum, it is required that an SN can actively perform the test procedure.

Procedure using a test to verify that a bothway bearer path exists to the intended destination:

```
        ───────IAM (test)───────►

        ◄──────ACM──────

        ◄──────ANM──────
```

Test to verify that a bothway bearer
path exists to the intended destination

```
        ───────REL───────►

        ◄──────RLC───────        T11112080-01
```
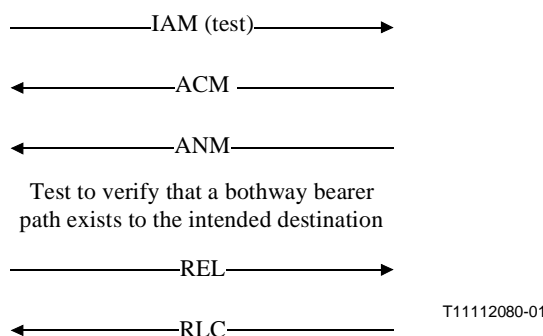
ANNEX E

(Network Option)

Procedures for use of Structured AAL1 bearers

E.1 Introduction

This annex describes the procedures to be performed for the use of Structured AAL1 bearers. A Structured AAL1 bearer carries multiple independent channels within one network bearer connection, see ITU-T I.363.1, *B-ISDN ATM Adaptation Layer (AAL) specification: Type 1 AAL.* When this option is supported, a new structured AAL1 bearer is set up only if no such bearer exists or if there are no idle channels on an existing structured AAL1 bearer. If there is an idle channel on an existing structured AAL1 bearer, a new bearer is not set up for the call, instead an idle channel on a pre-existing bearer is associated with the call during the set-up procedure.

NOTE – Structured AAL1 bearers and the channels associated with them are 'owned' by the SN which originally set them up. The management of a set of idle bearers is therefore a local issue in the BCF that has established them.

• This Recommendation does not define the procedures used at the node that owns a structured AAL1 bearer to determine whether and when the bearer should be released after all of the channels within the bearer have become idle.

- To protect against the error case in which the node owning a structured AAL1 bearer neglects to release it when it has not been reused for a long period, it is recommended that the BCF at the node which does not own the bearer nevertheless should have a protection timer. This timer is started upon release of the call that is using the last active channel within a particular structured AAL1 bearer and stopped on reuse of any of the channels within the structured AAL1 bearer or upon release of that structured AAL1 bearer. On timer expiry the structured AAL1 bearer is released with cause value #31 "*Normal unspecified*". The value of the timer is a local matter and is not covered in further detail in this specification.

E.2   Procedures

If a new structured AAL1 bearer needs to be established for the setup of a call, BICC protocol procedures in clause 7 are applicable. The BNC characteristics shall be coded "structured AAL1". At the bearer level based on the coding of BNC-ID, a structured AAL1 bearer consisting of a set of bearer network connections shall be established and the call shall be associated with the BNC-ID carried in BICC. The remaining bearer network connections (channels within the structured AAL1 bearer) shall be marked idle by the concerned BCFs to be used for other calls. From the viewpoint of BICC procedures, the set of channels associated with a structured AAL1 bearer shall be treated as a pool of idle bearer connections each with an associated BNC-ID (see Appendix II).

If an idle bearer network connection associated with a structured AAL1 bearer can be used for the set-up of a call, the procedures for reuse of idle bearers, B.2.1 to B.2.3, shall be used.

E.2.1   Codec negotiation

Codec negotiation is not applicable to the use of Structured AAL1 bearers.

E.2.2   Release procedure

NOTE − In support of this procedure the BCFs may decide not to release the structured AAL1 bearer even though all of the channels associated with it are idle.

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.)

- All ISNs are shown interworking to ISUP. Interworking, at the ISN, to other signalling systems is also possible according to the relevant interworking Recommendation.

- The flows mention for each message the minimum set of BICC information elements that are specific to this flow example. Other parameters and information elements may also be included according to the relevant protocol procedures.

- If no TSN is used the flows between ISN-A and ISN-B would be as shown for ISN-A to TSN.

- Between each SN two SWNs are shown. The number of such nodes depends on network configuration.

- Message sequences in the case of a GSN to GSN connection would be as shown in between ISN and TSN, except that no SWNs would exist.
- The 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 BICC 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.

I.2   Contents

1)   Call set-up:

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

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

   1.3)   Backward establishment of backbone network connection.

   1.4)   Per-call bearer set-up using bearer control tunnelling – fast forward.

   1.5)   Per-call bearer set-up using bearer control tunnelling – delayed forward.

   1.6)   Per-call bearer set-up using bearer control tunnelling – backward.

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

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

   1.9)   Multinetwork example.

2)   Codec negotiation and modification:

   2.1)   Forward establishment of backbone network connection with codec negotiation.

   2.2)   Backward establishment of backbone network connection with codec negotiation.

   2.3)   Codec modification.

   2.4)   Mid-call codec negotiation.

   2.5)   Codec modification collision.

   2.6)   Mid-call codec negotiation collision.

   2.7)   Collision between mid-call codec negotiation and codec modification.

   2.8)   Collision between mid-call codec negotiation and codec modification (error following collision resolution).

3)   Release:

   3.1)   Forward call and bearer release. Forward bearer set-up.

   3.2)   Forward call and bearer release. Backward bearer set-up.

   3.3)   Forward call release. Bearers not released.

   3.4)   Forward call and bearer release. Gateway interworking between forward and backward bearer set-up.

The following note applies to all the call set-up flows.

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

Case	Message AAA	Message BBB
Continuity is supported:	IAM indicating "*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*"
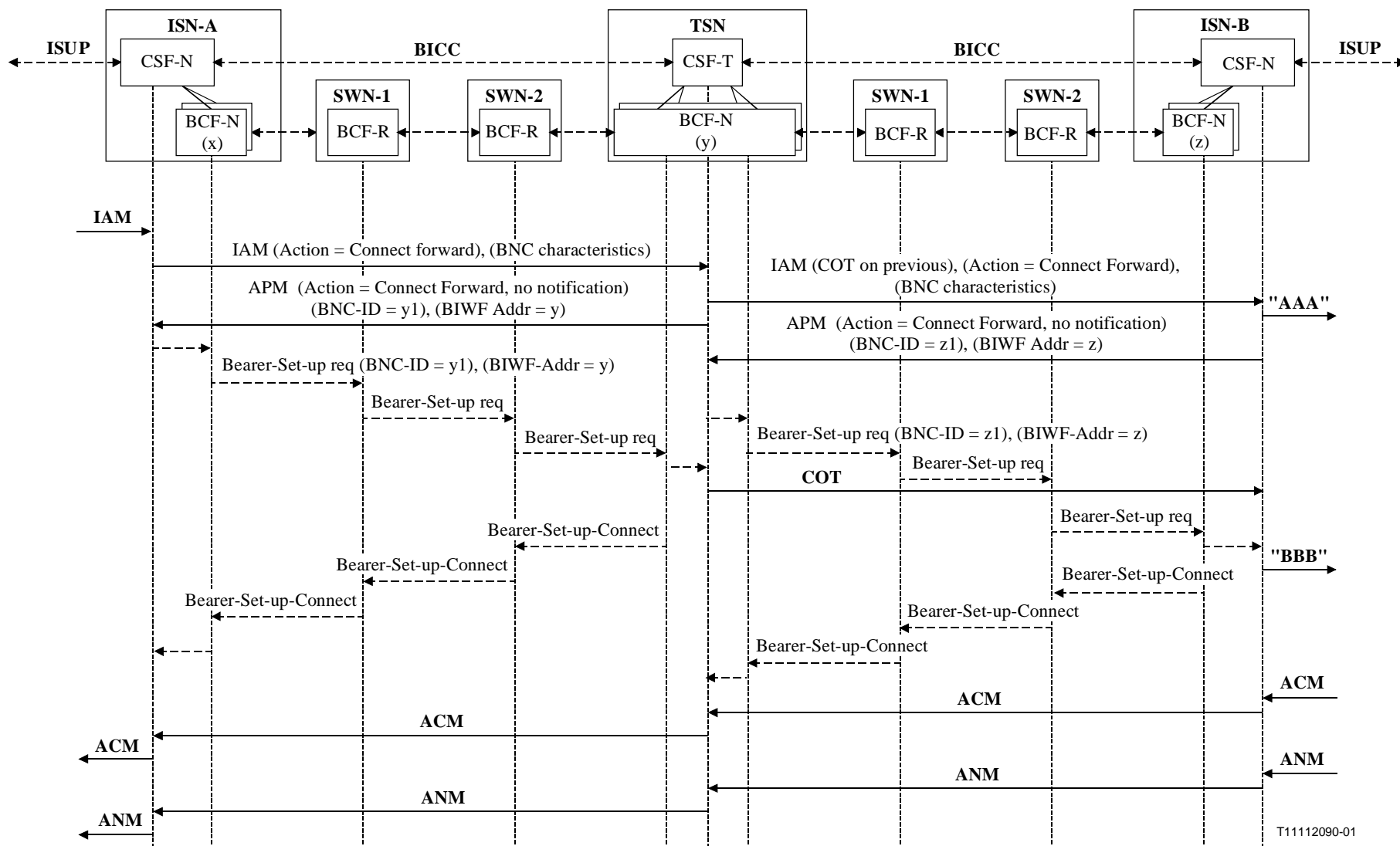
**Figure I.1/Q.1902.4 – Forward establishment of backbone network connection,
no notification of bearer connect required**
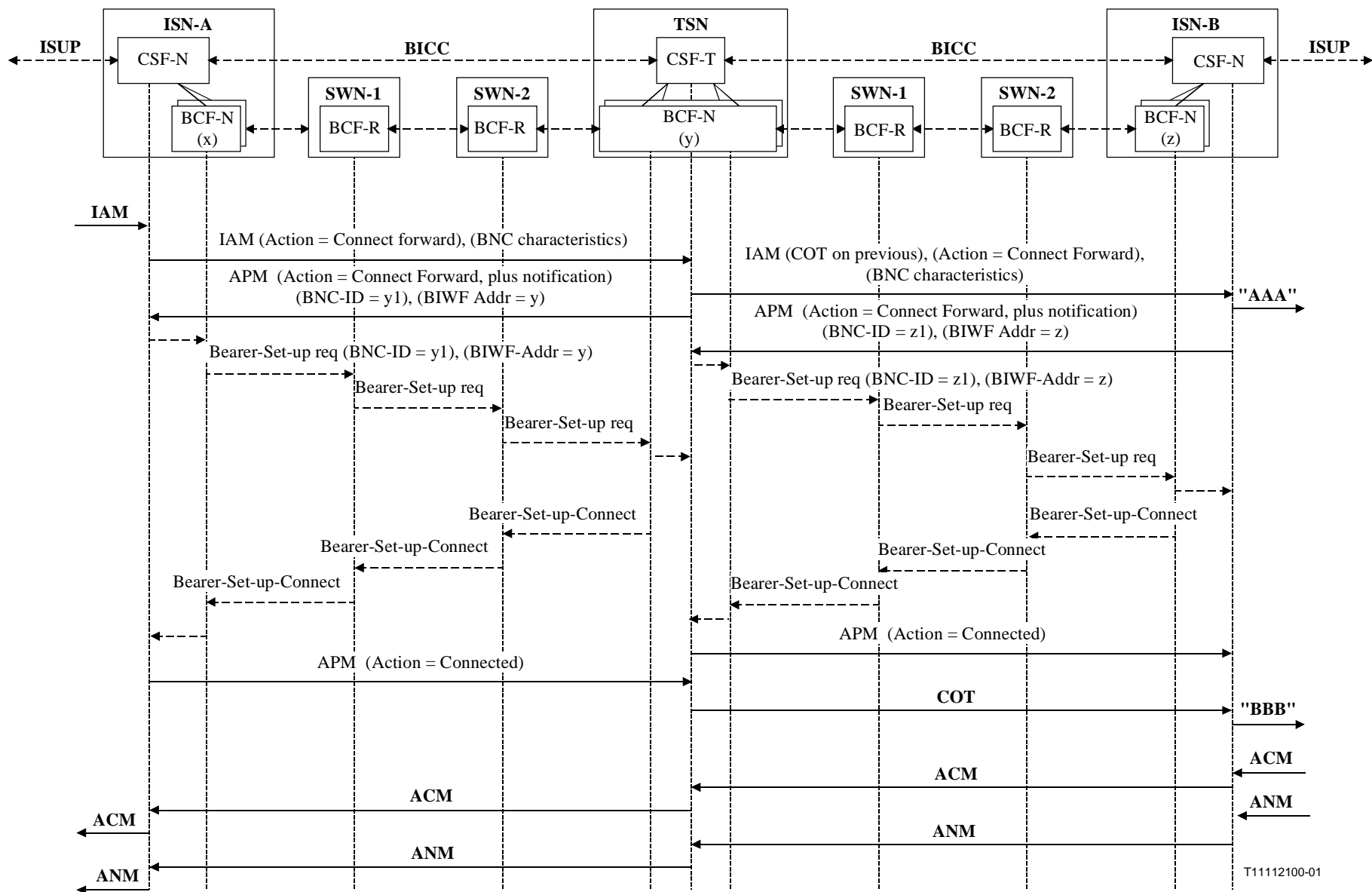
Figure I.2/Q.1902.4 – Forward establishment of backbone network connection, notification of bearer connect is required
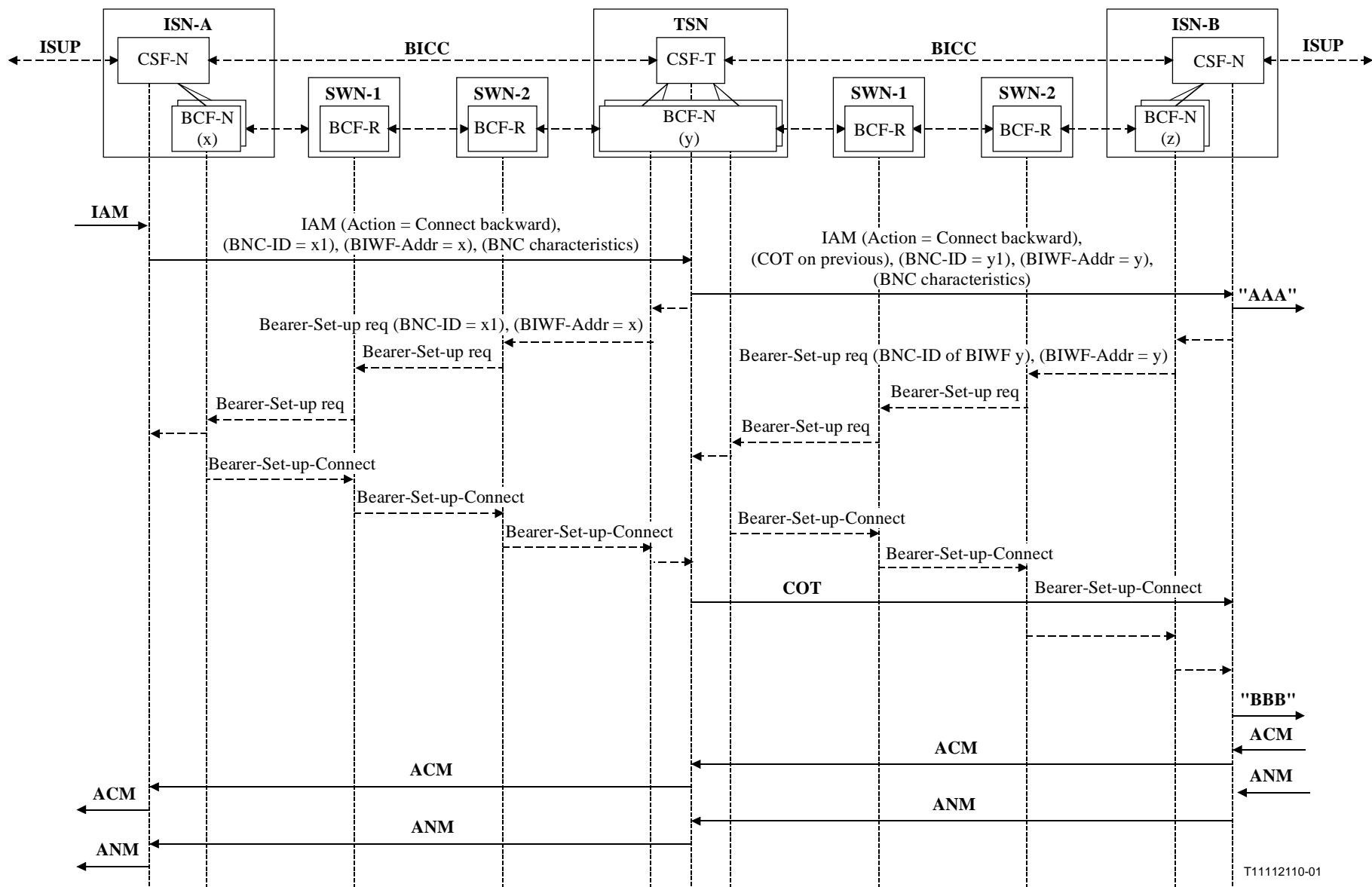
Figure I.3/Q.1902.4 – Backward establishment of backbone network connection
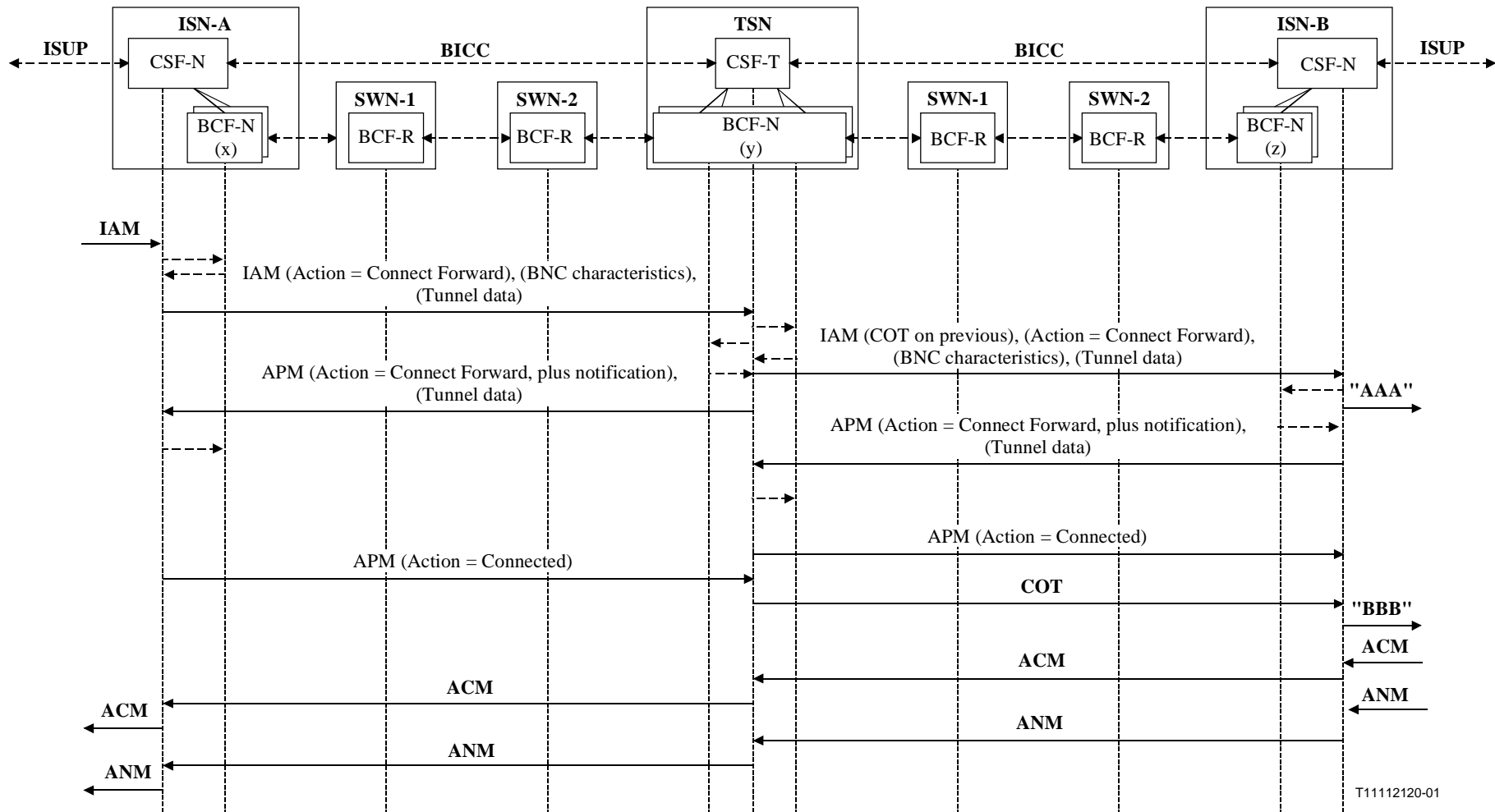
Figure I.4/Q.1902.4 – Per-call bearer set-up using bearer control tunnelling – Fast set-up (forward)
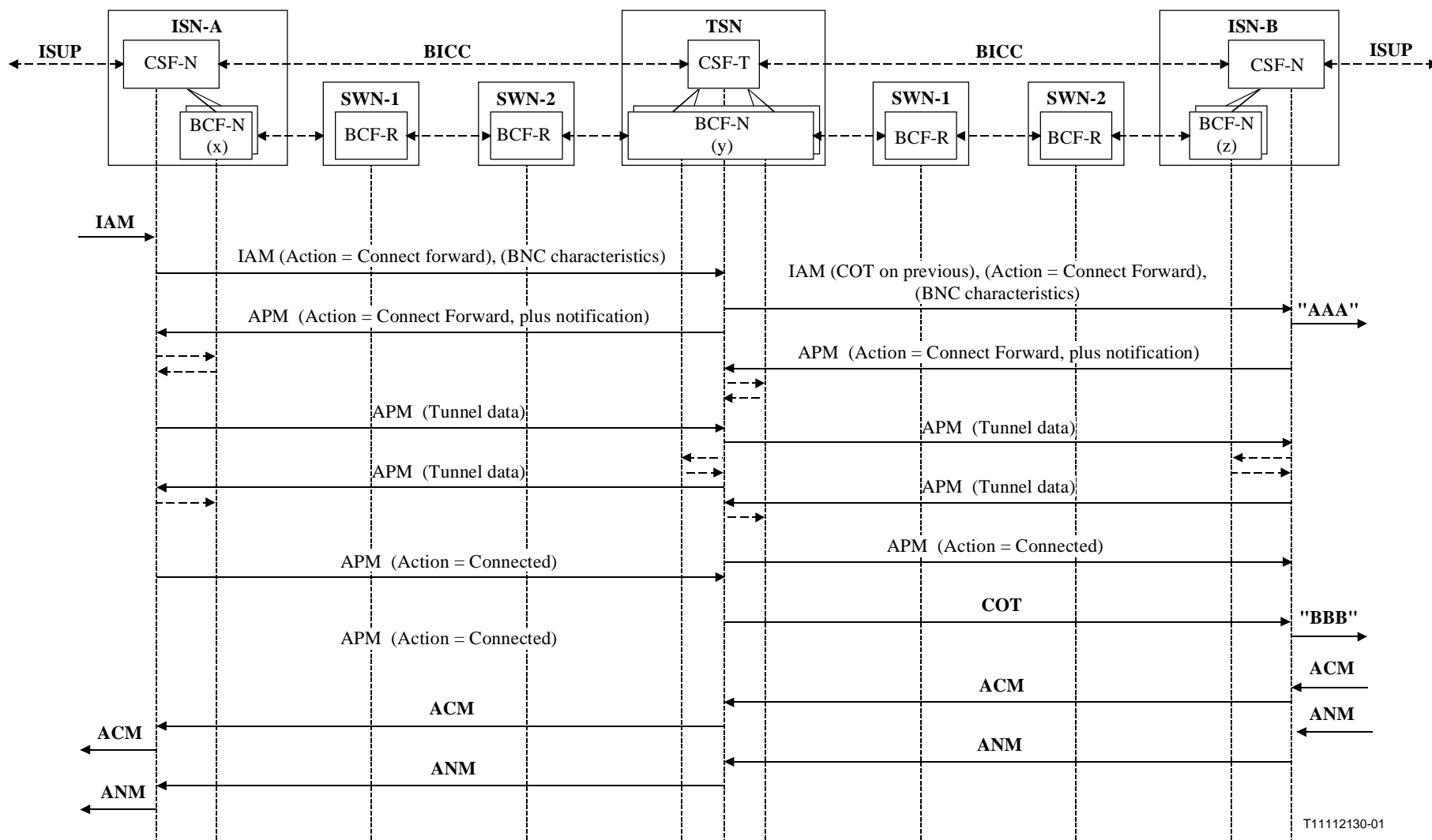
Figure I.5/Q.1902.4 – Per-call bearer set-up using bearer control tunnelling – Delayed forward
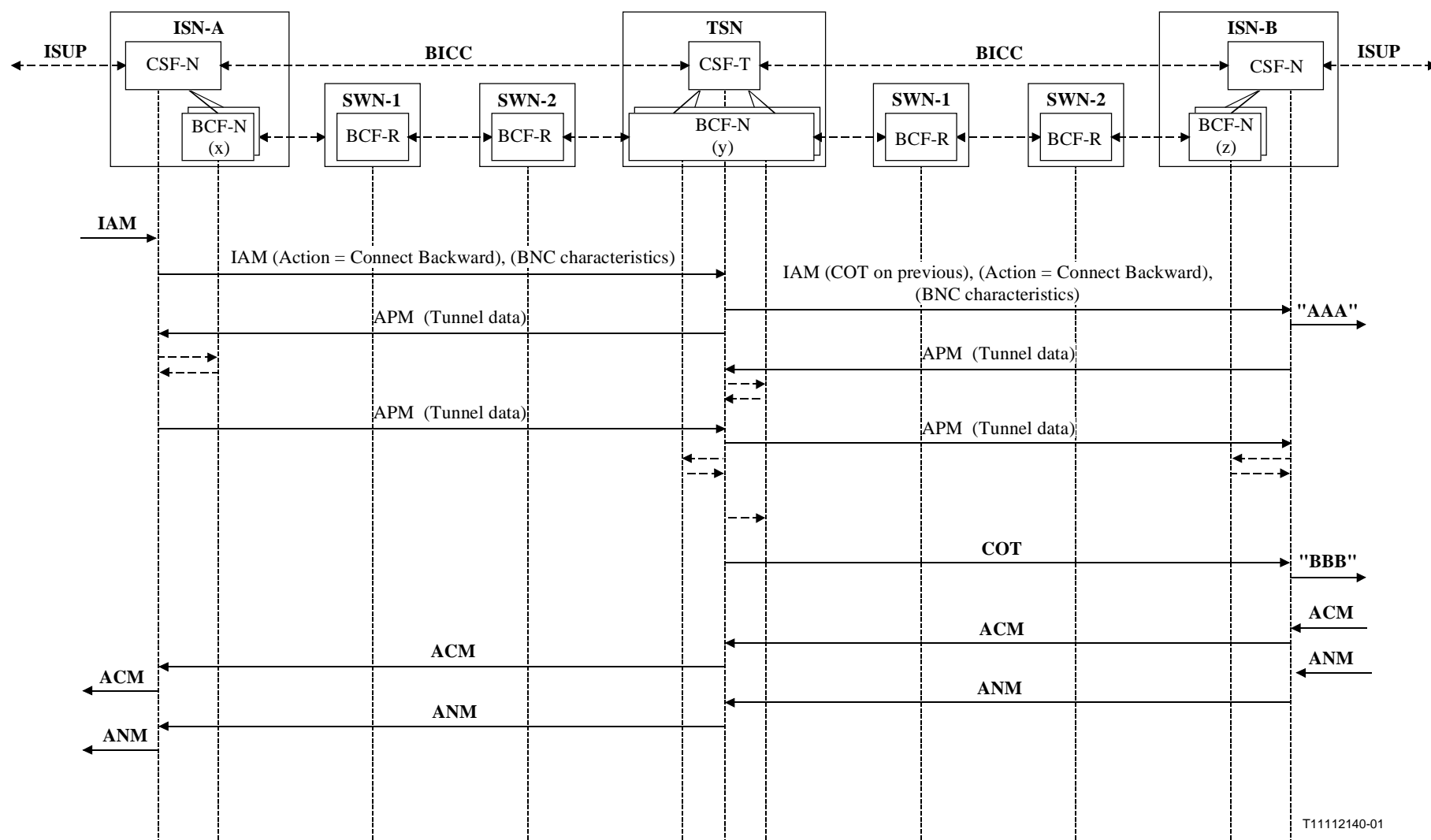
Figure I.6/Q.1902.4 – Per-call bearer set-up using bearer control tunnelling – Delayed backward
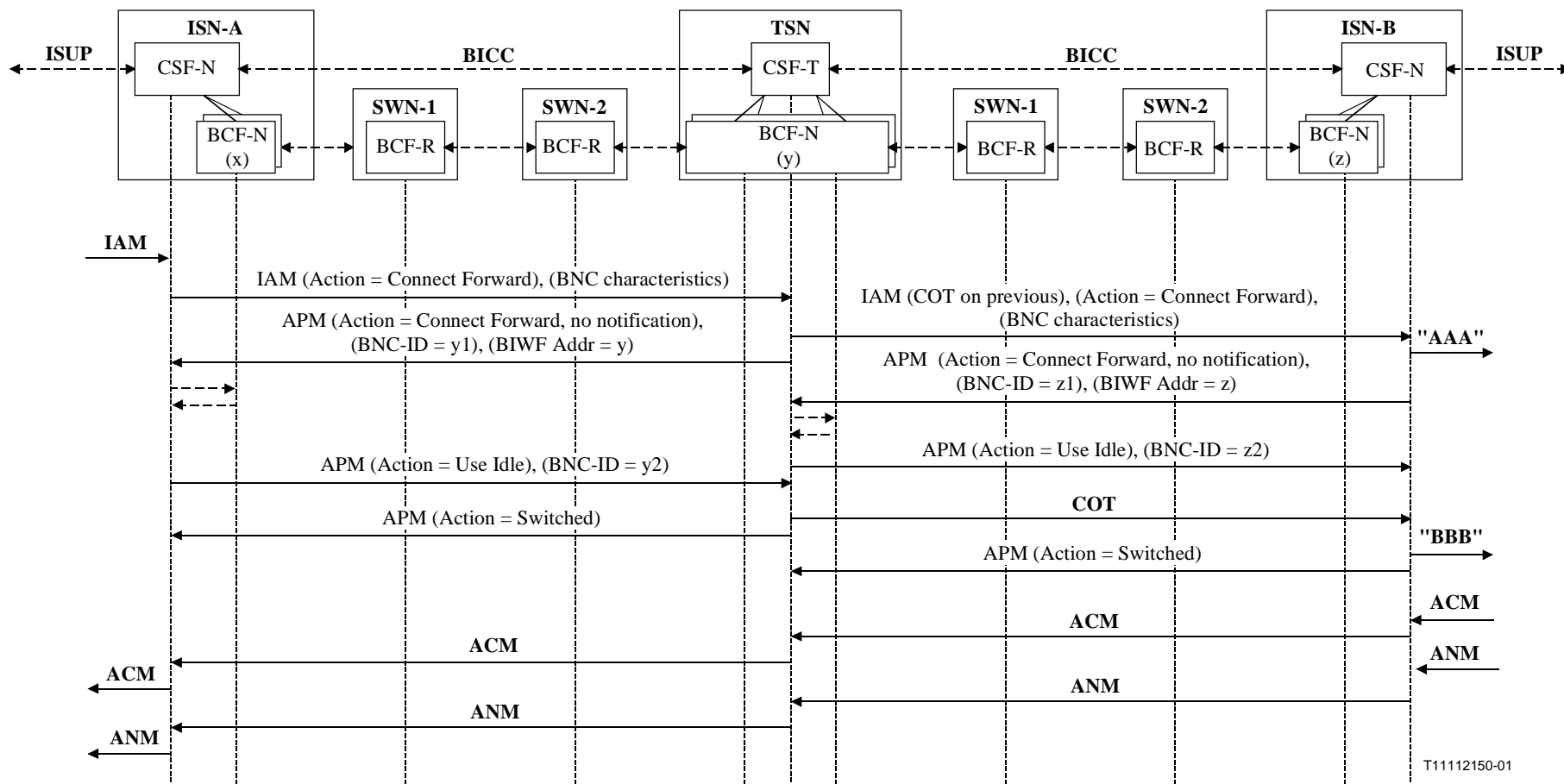
Figure I.7/Q.1902.4 – Use of idle backbone network connection, established in the forward direction
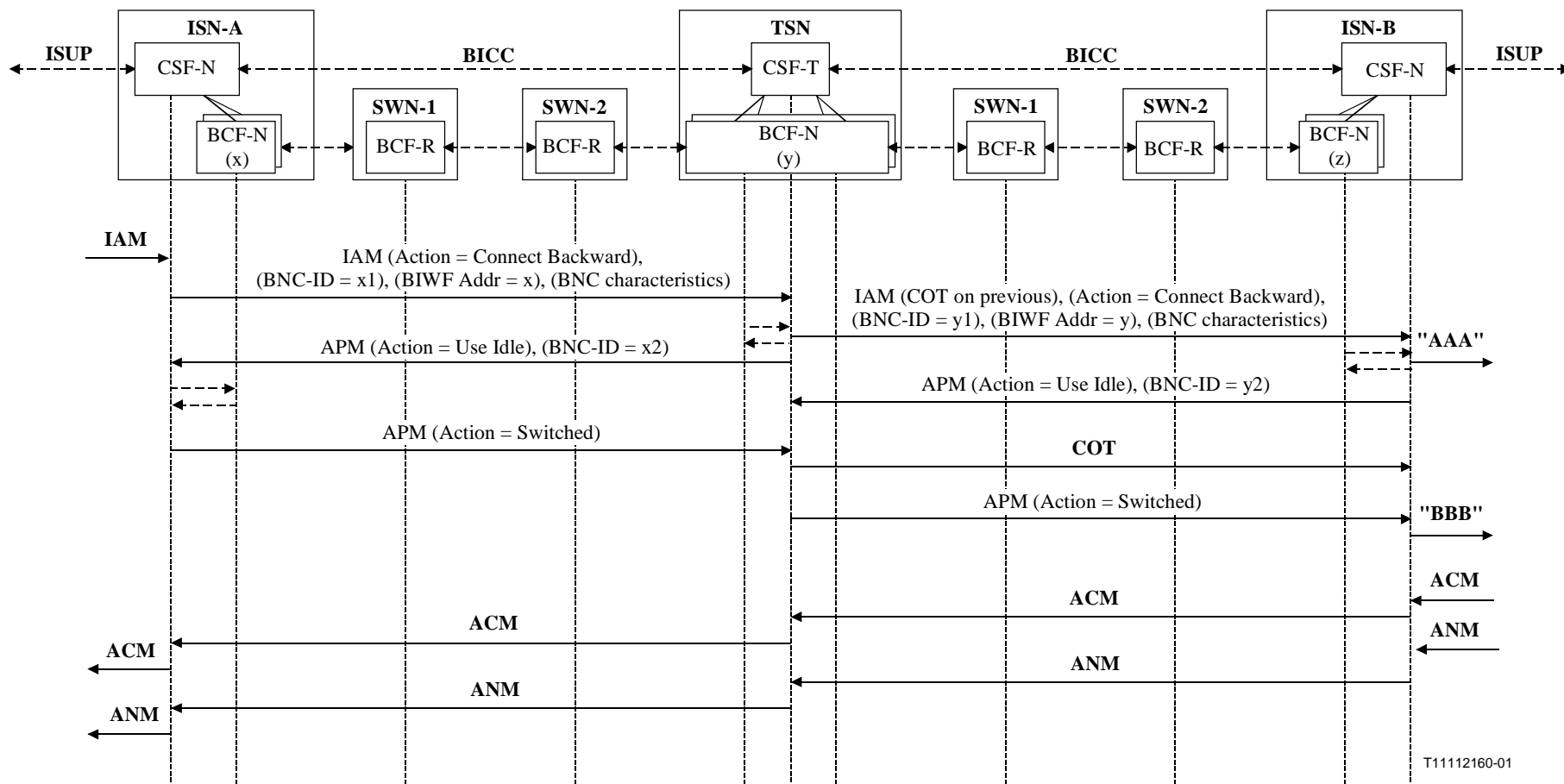
Figure I.8/Q.1902.4 – Use of idle backbone network connection, established in the backward direction

Figure I.9/Q.1902.4 – Multinetwork example: Connect forward, plus notification, followed by connect forward, no notification, followed by connect backward, reuse of idle bearer
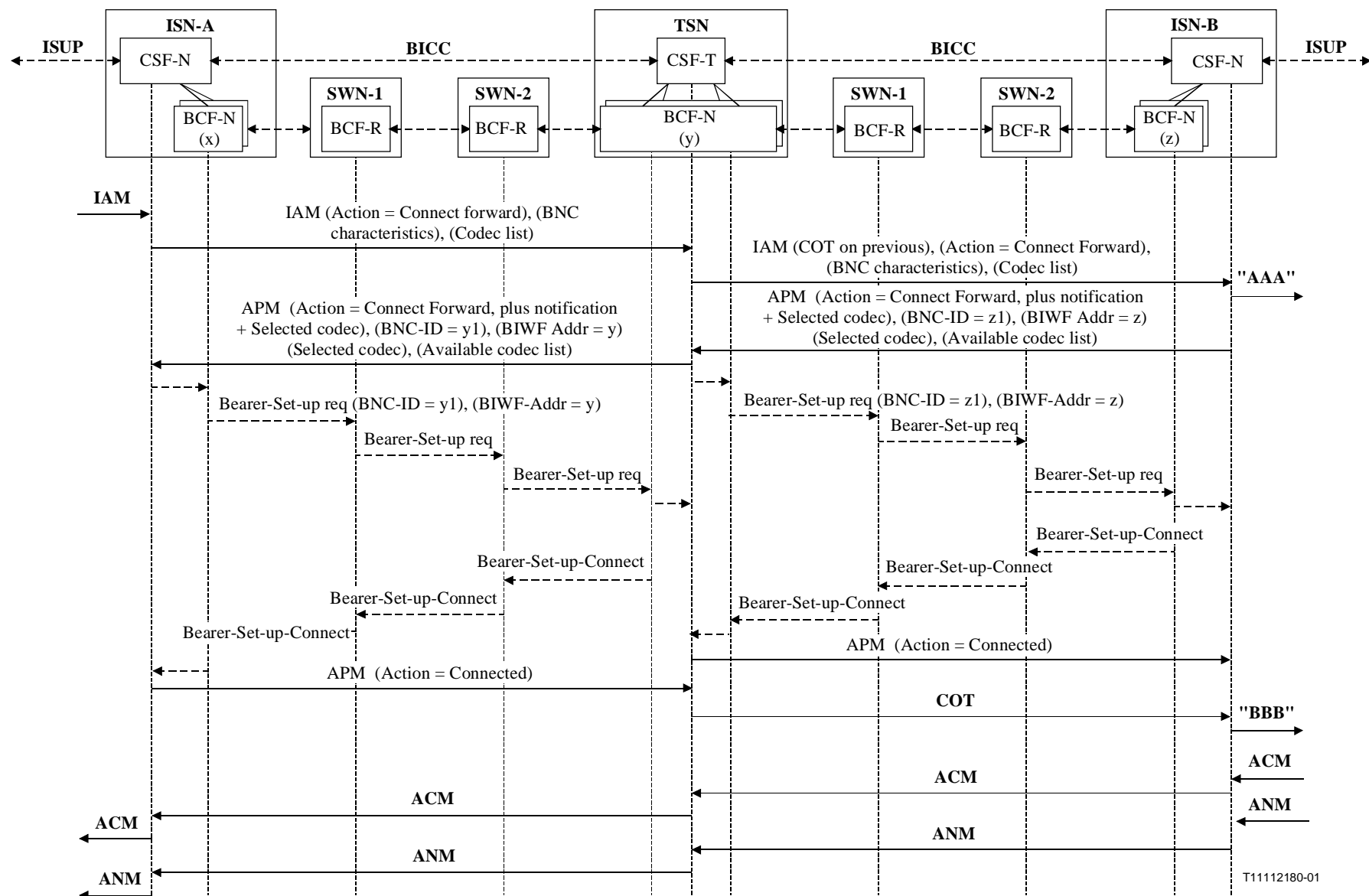
**Figure I.10/Q.1902.4 – Forward establishment of backbone network connection,
(plus notification of bearer connect), with codec negotiation**
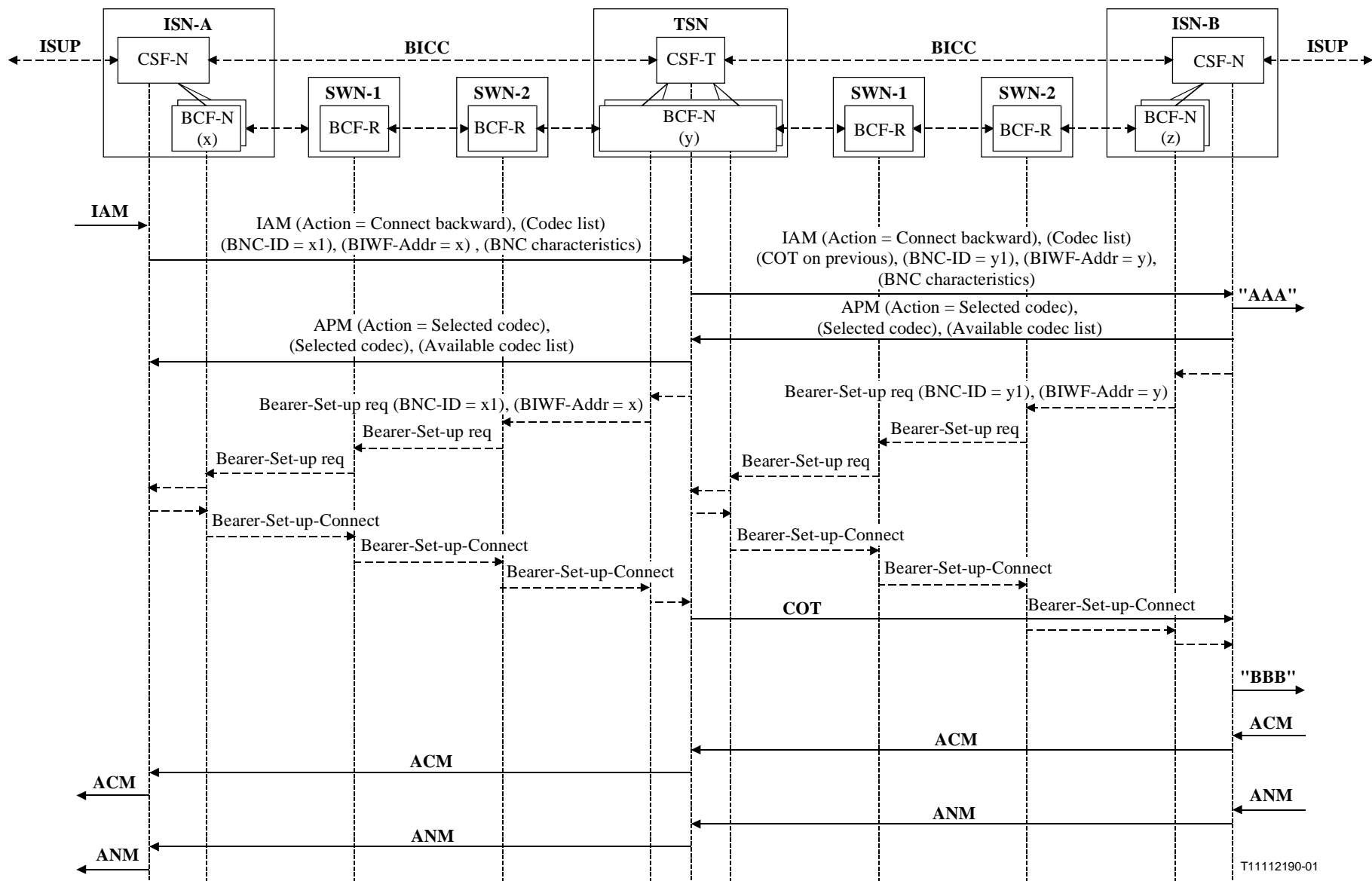
Figure I.11/Q.1902.4 – Backward establishment of backbone network connection, with codec negotiation
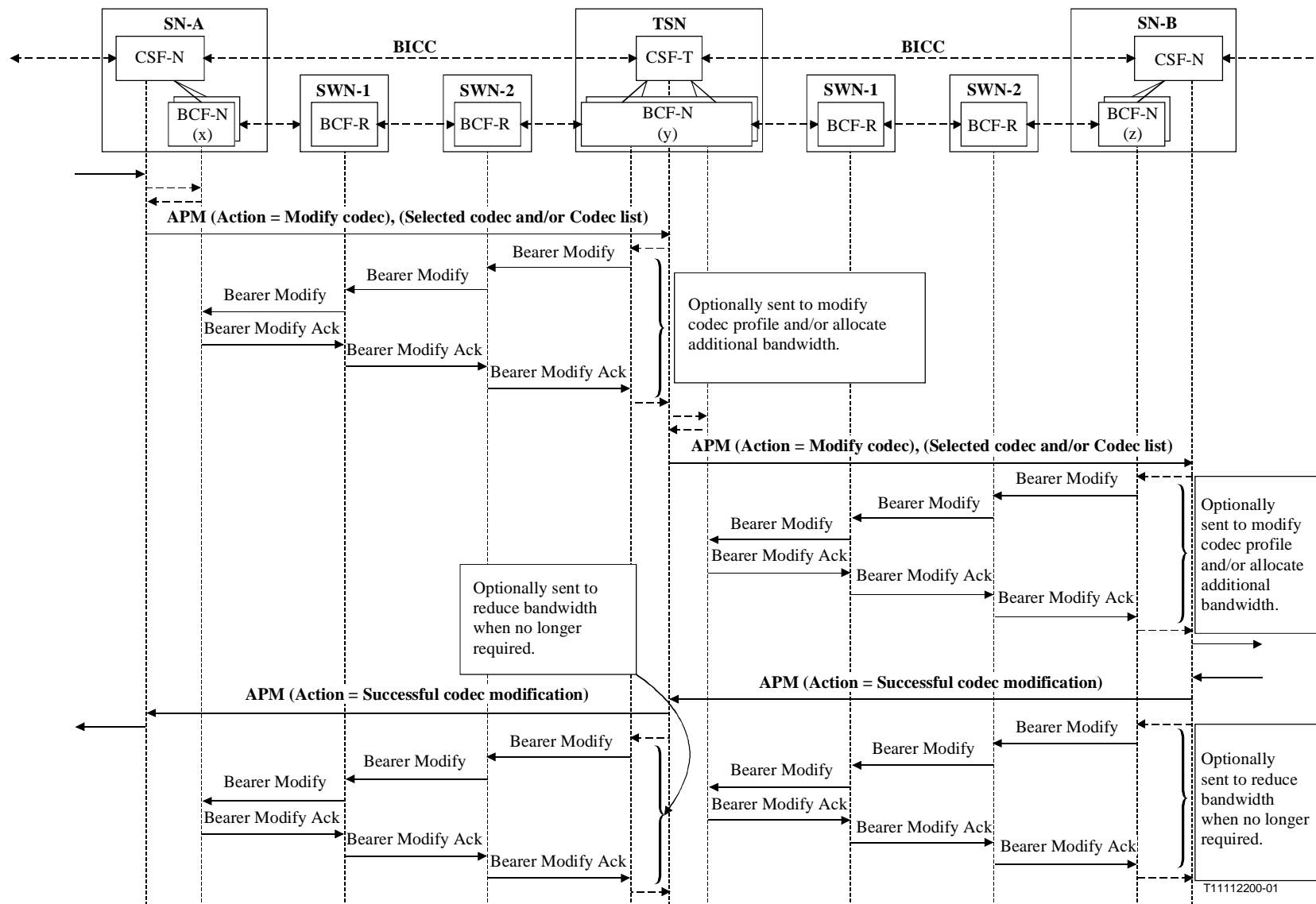
Figure I.12/Q.1902.4 – Codec modification
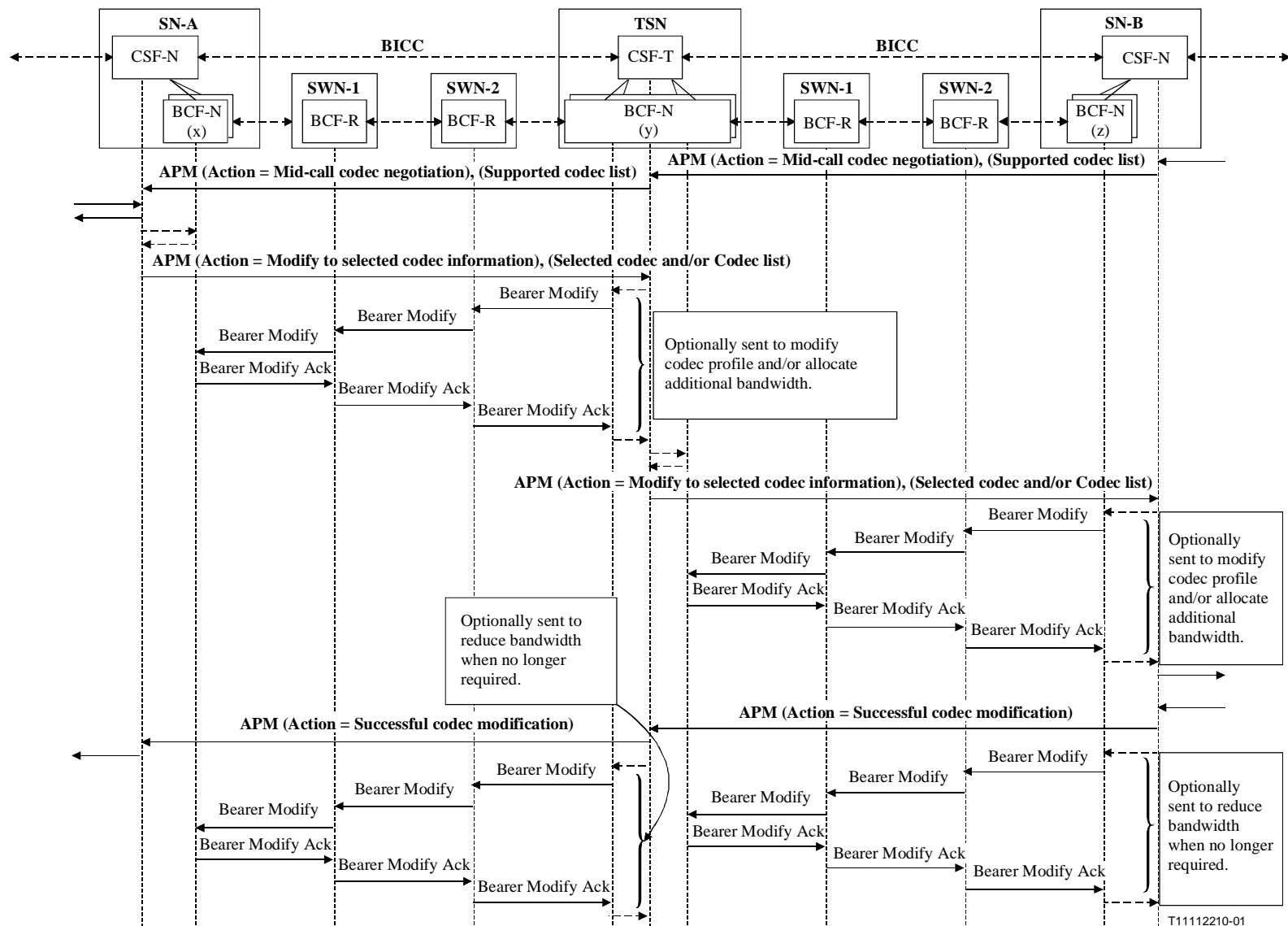
Figure I.13/Q.1902.4 – Mid-call codec negotiation
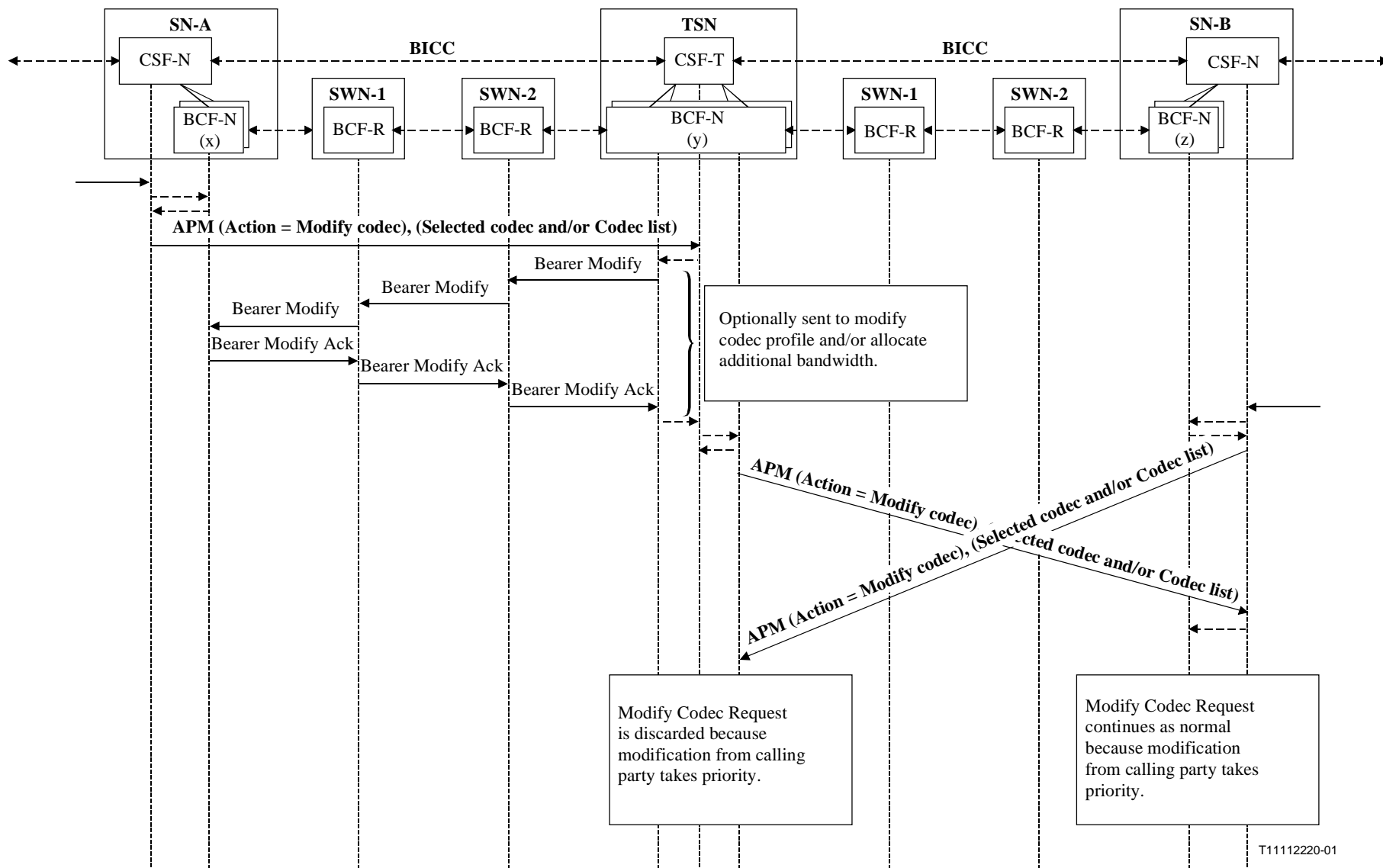
Figure I.14/Q.1902.4 – Codec modification collision
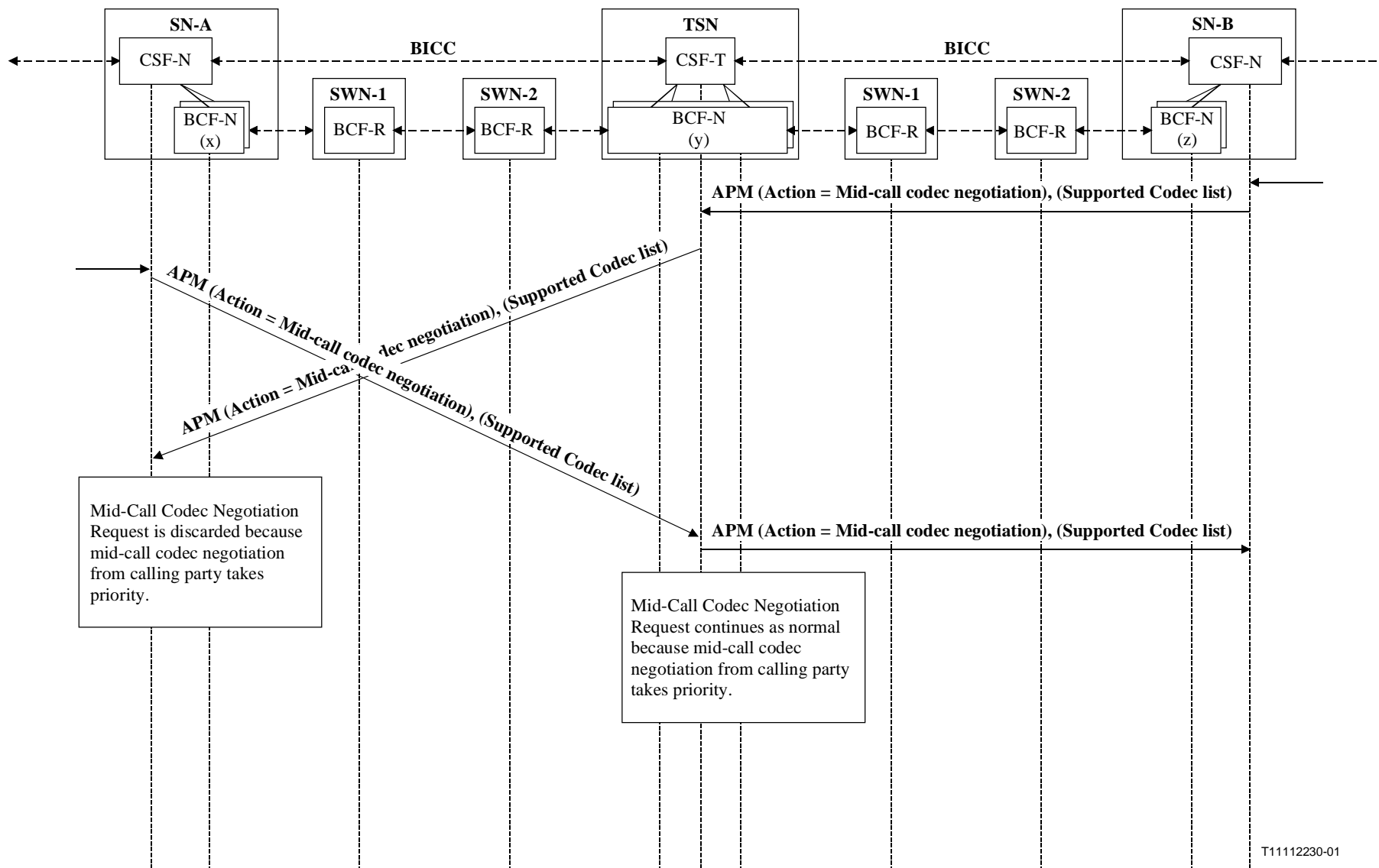
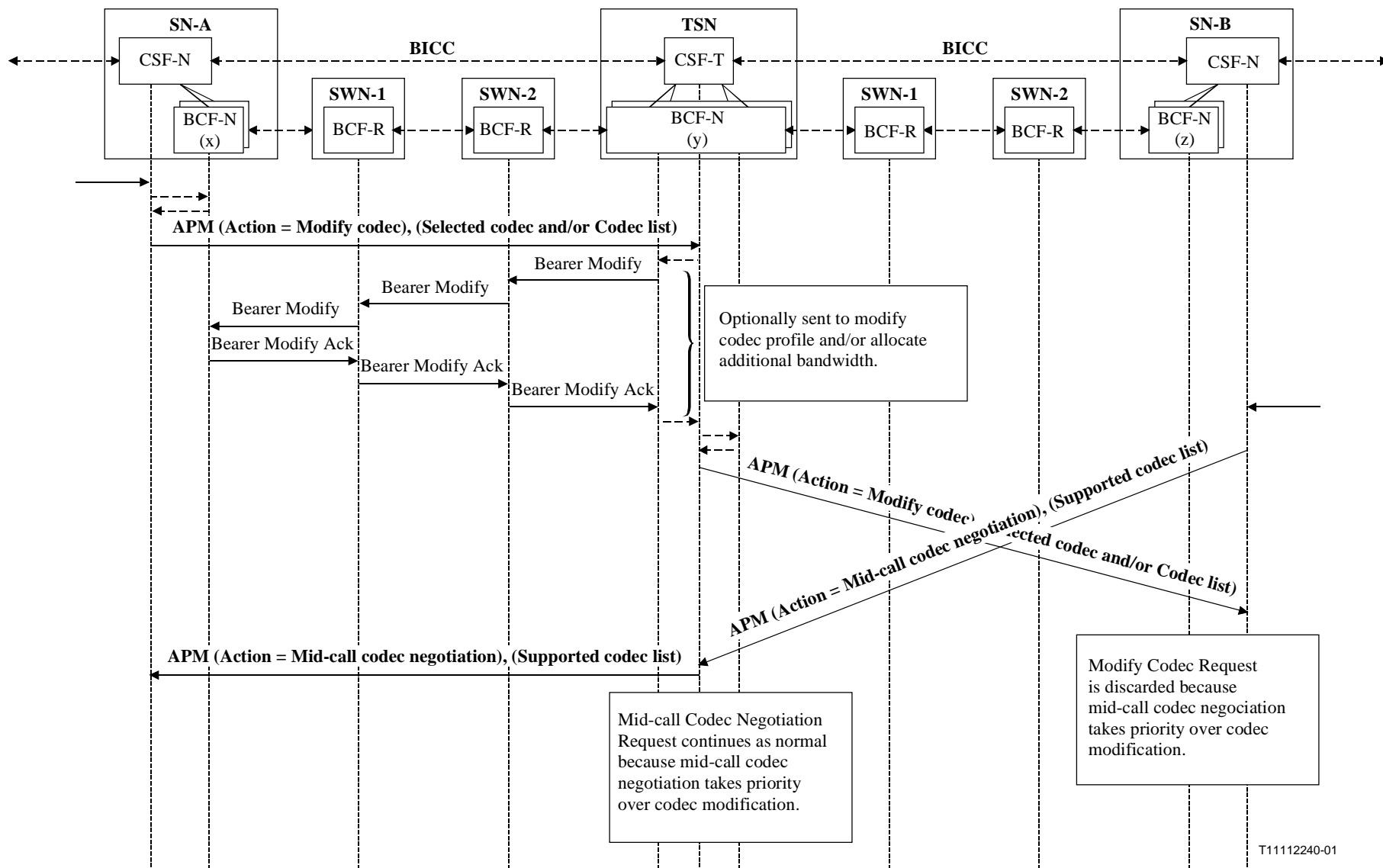**Figure I.15/Q.1902.4 – Mid-call codec negotiation collision**

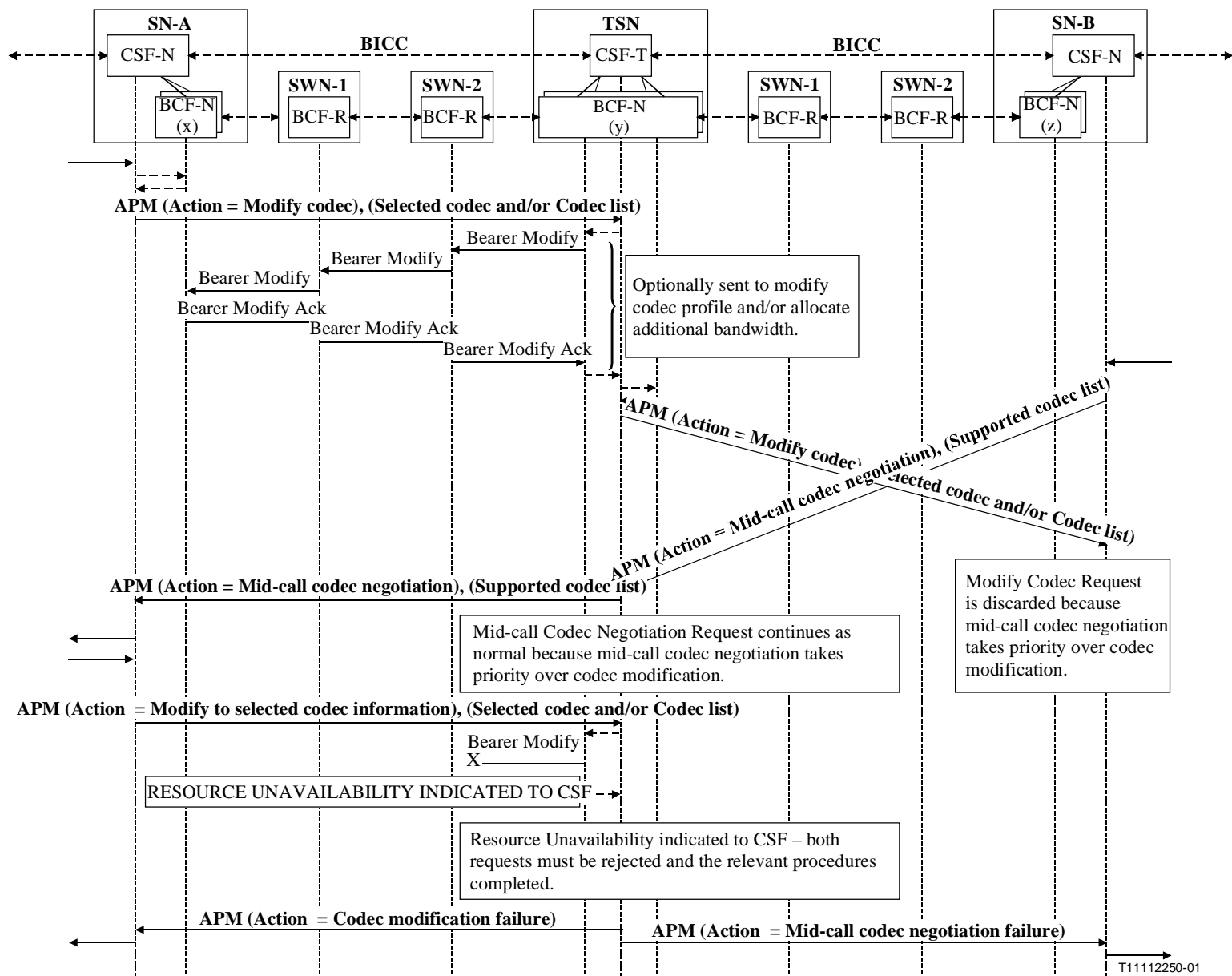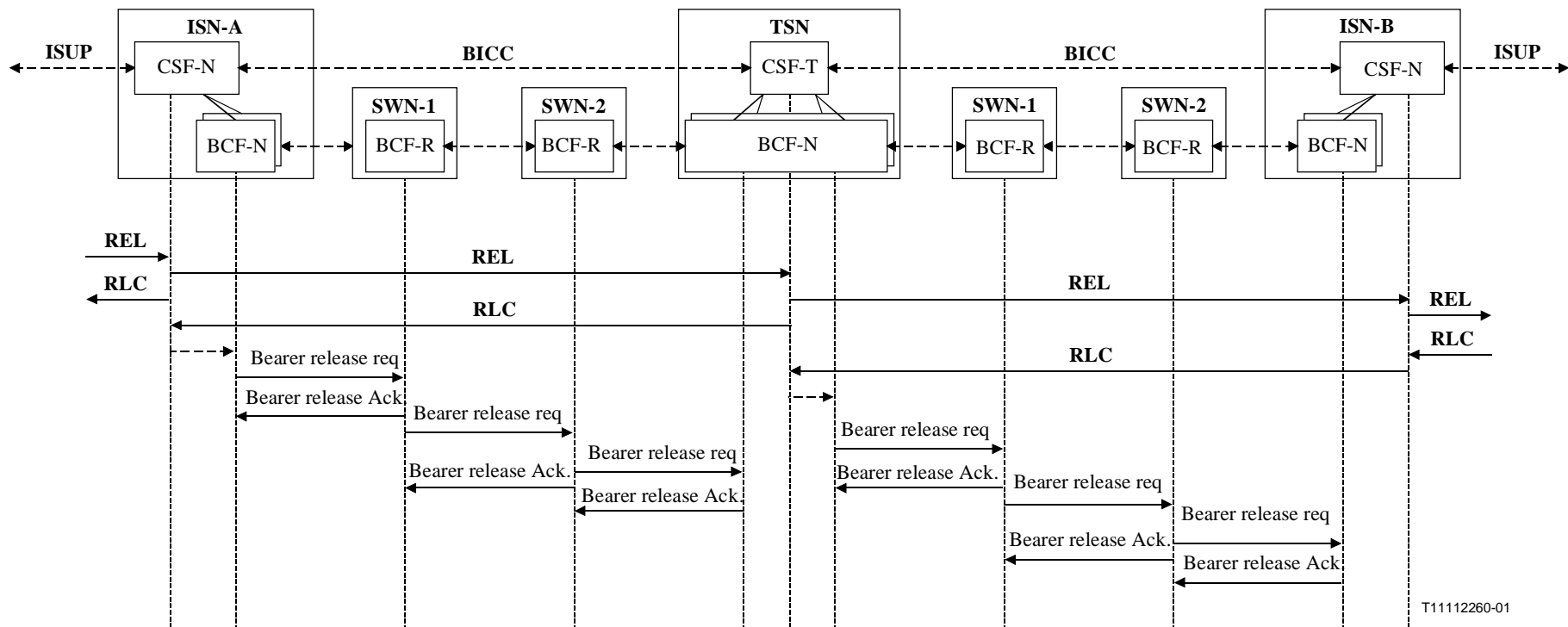**Figure I.16/Q.1902.4 – Collision between mid-call codec negotiation and codec modification**

Figure I.17/Q.1902.4 – Collision between mid-call codec negotiation and codec modification (error following collision resolution)

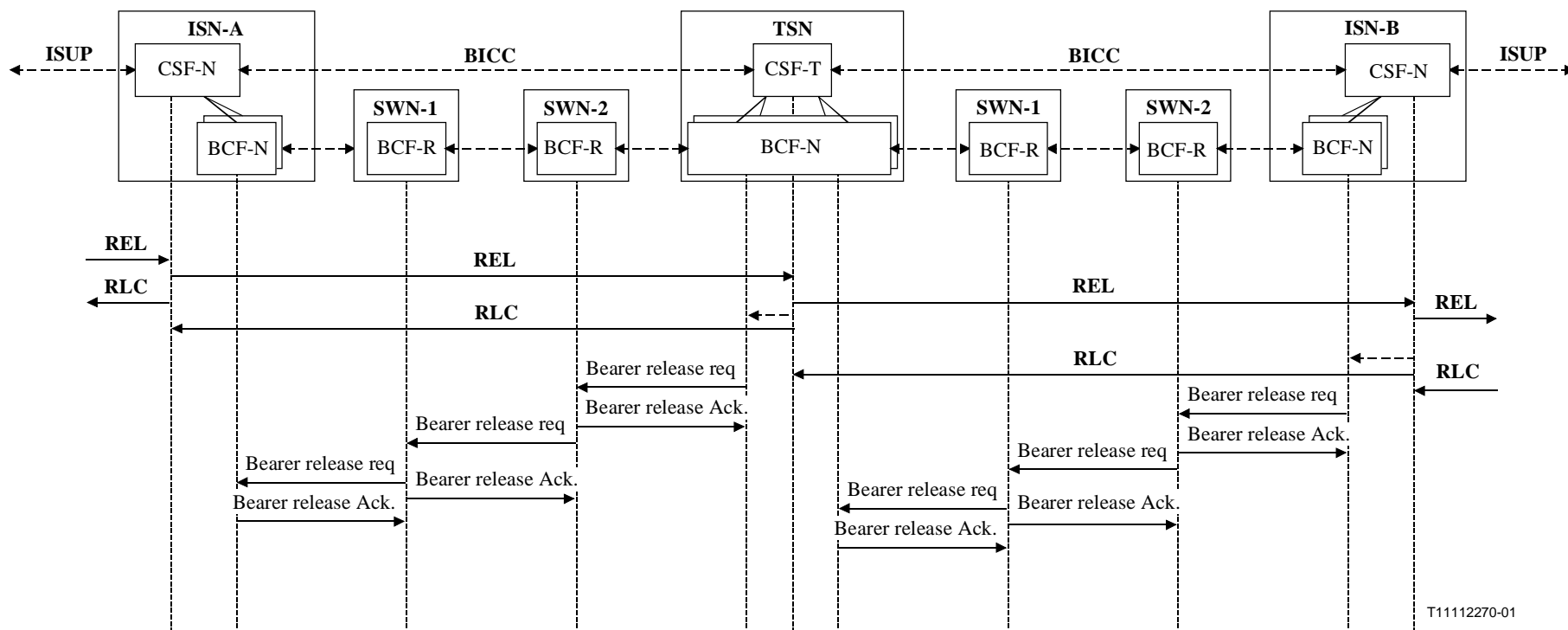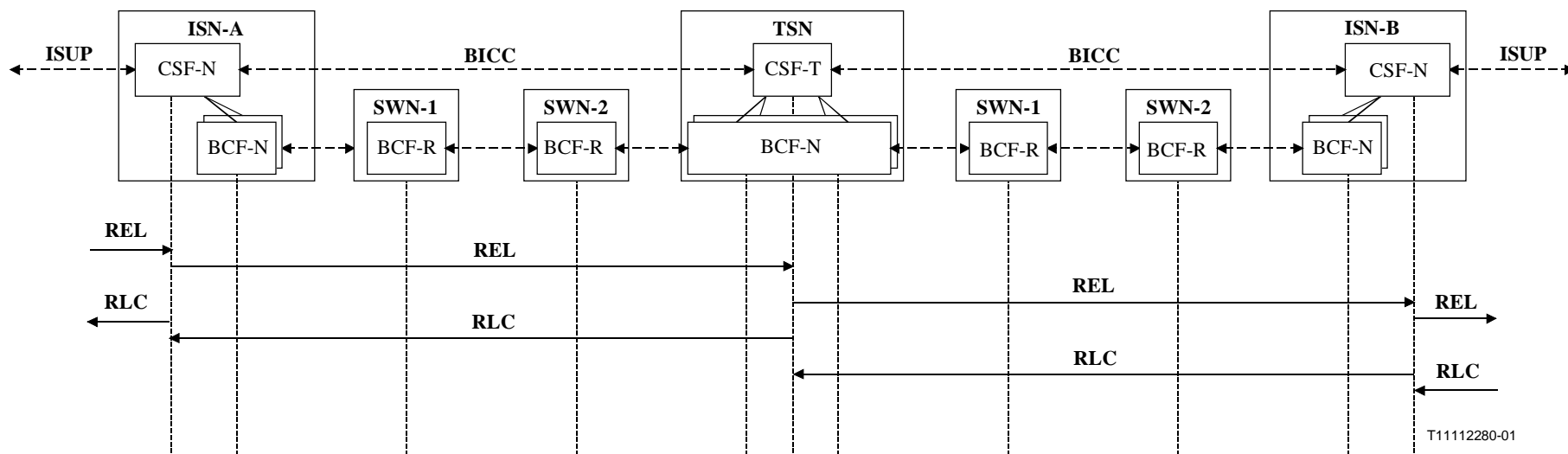**Figure I.18/Q.1902.4 – Forward call and bearer release. Forward bearer set-up**

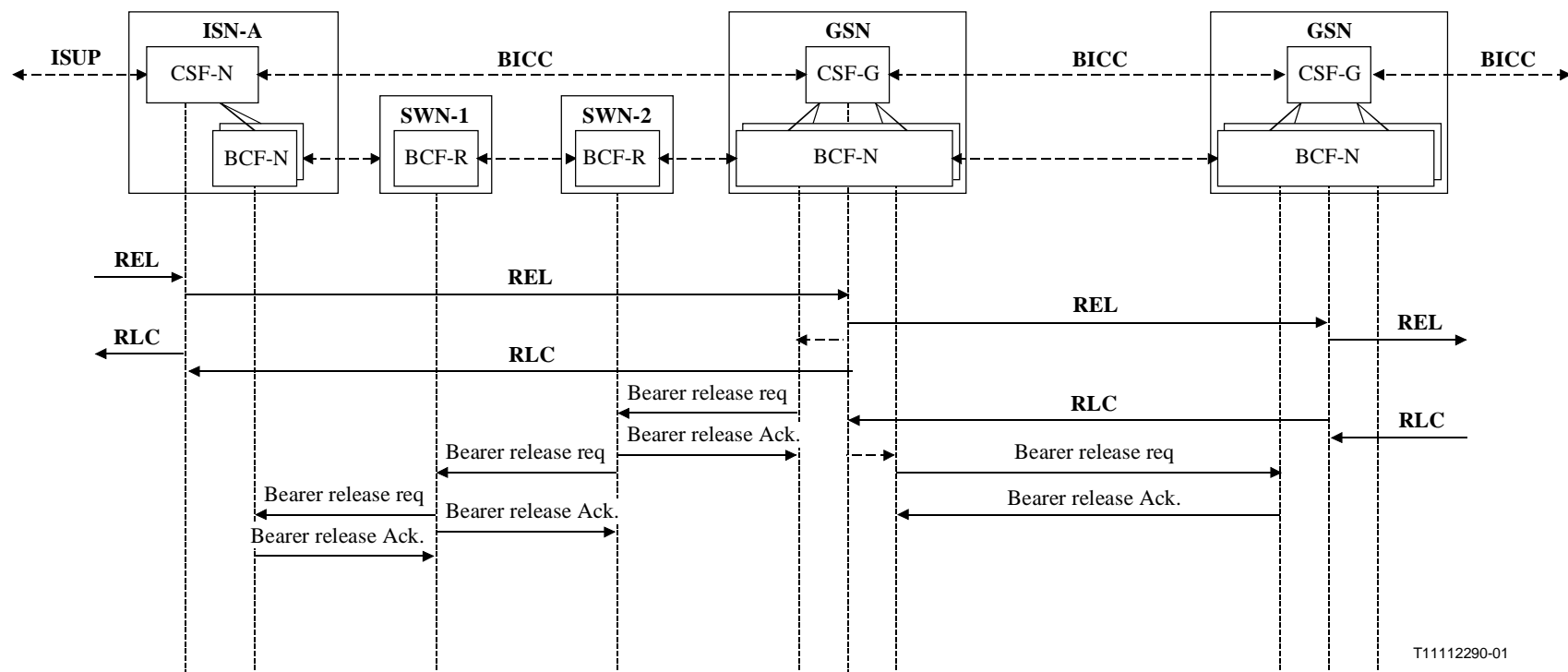**Figure I.19/Q.1902.4 – Forward call and bearer release. Backward bearer set-up**

Figure I.20/Q.1902.4 – Forward call release. Bearers not released

Figure I.21/Q.1902.4 – 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 ITU-T Q.1902.1, 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.

NOTE − This appendix is not applicable when bearer control tunnelling is used.

II.2 BNC-ID

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

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;

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

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.2.3 BNC-ID usage for structured AAL1 bearers

For networks that provide for the use of structured AAL1 bearers, each BCF manages pools of bearer network connections to adjacent SNs. Within each pool there are two sets of bearers: those set-up (and thus "owned") by this BCF, and those set-up by the remote BCF (and thus not "owned" by this BCF). Both sets are further divided into subsets, each subset associated with a structured AAL1 bearer. At any moment in time any of these pools may be non-existent or empty. The management of bearers within the pools, sets and subsets, i.e. what bearers are in which pools, sets and subsets, is 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.

For a bearer network connection associated with a structured AAL1 bearer, the BNC-ID is four octets long and structured as (X, n). The first three octets (X) are used to identify the structured AAL1 connection. The fourth octet (n) is used to identify a particular channel within the structured AAL1 bearer. The fourth octet is interpreted as a binary number indicating the channel within the structured AAL1 bearer. The values of 0000 0000 and 1111 1111 within the fourth octet are reserved and should not be used to indicate channels within a structured AAL1 bearer.

During the call set-up procedure, when a new bearer connection is to be set up, a structured AAL1 bearer consisting of N channels is set up, N being the value coded in the fourth octet of the BNC-ID, (X, N), carried in the BICC protocol. The call is associated with the BNC-ID, (X, N), and the remaining (N-1) BNC-Ids are marked as corresponding to idle bearer network connections associated with the structured AAL1. In other words, the BNC-Ids (X, 1) to (X, N-1) are idle and can be used for new calls.

During the call set-up procedure, when an idle bearer network connection associated with a structured AAL1 bearer is to be reused, the corresponding BNC-ID is transferred by the BICC protocol to indicate to the remote BCF which bearer network connection is to be reused for the call. A BCF can only select a bearer network connection 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.) In the case of structured AAL1 bearer, the BCF shall not release the structured AAL1 bearer until such time as all of the channels associated with the structured AAL1 bearer have become idle.

Under abnormal conditions the BICC CSF procedures can request reset of the bearer connection 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, Structured AAL1, or AAL2.

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